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PILOT TESTING OF NEUTRALIZATION/SUPERCRITICAL WATER OXIDATION OF VX AGENT AT NEWPORT CHEMICAL DEPOT, INDIANA

FINAL
ENVIRONMENTAL IMPACT STATEMENT

December 1998

PROGRAM MANAGER FOR CHEMICAL DEMILITARIZATION
ABERDEEN PROVING GROUND, MD 21010-5401

ORGANIZATION OF THIS ENVIRONMENTAL IMPACT STATEMENT

This Environmental Impact Statement (EIS) addresses the U.S. Army's proposal to construct and operate a pilot facility to test chemical neutralization and supercritical water oxidation of the warfare agent VX currently stored at the Newport Chemical Depot (NECD) in Indiana. An overview of the structure of this EIS is presented below.

The **SUMMARY** briefly describes the proposed action and its alternative, as well *as* the associated environmental impacts.

SECTION 1, PURPOSE OF AND NEED FOR THE PROPOSED ACTION, summarizes the background of the Army's Alternative Technology Program, and, in particular, the proposed action for NECD. It also describes the environmental impact analysis process and defines the scope of this EIS.

SECTION 2, THE PROPOSED ACTION AND ALTERNATIVES, provides background information about the agent VX stored at NECD; the details of the pilot test activities proposed by the Army; and *a* brief discussion of the alternatives to this proposal. The section concludes with a summary comparing the impacts of the alternatives.

SECTION 3, DESCRIPTION OF THE EXISTING ENVIRONMENT, discusses the current physical, environmental, and socioeconomic conditions on and around NECD. This section provides the resource information upon which the assessment of environmental impacts is based.

SECTION 4, ENVIRONMENTAL IMPACTS, presents the potential environmental impacts and the socioeconomic effects associated with the various alternatives; the unavoidable environmental impacts that will accompany the proposed action; the irreversible and irretrievable commitment of resources that will occur under the proposed action; the manner in which the proposed action will affect the short- and long-term productivity of the environment; and the list of permits, approvals, findings, and consultations that are required prior to the implementation of the proposed action.

The **APPENDICES** provide supporting information and/or detailed analyses, too lengthy to be incorporated directly into the main body of the EIS.

A list of **ABBREVIATIONS AND ACRONYMS** is provided to assist the reader. It can be found immediately following the Table of Contents and the List of Tables.

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COOPERATING AGENCIES: DEPARTMENT OF HEALTH AND HUMAN SERVICES
FEDERAL EMERGENCY MANAGEMENT AGENCY
STATE OF INDIANA

TITLE OF PROPOSED ACTION: PILOT TESTING OF NEUTRALIZATION/SUPERCRITICAL WATER OXIDATION OF VX AGENT AT NEWPORT CHEMICAL DEPOT, INDIANA

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DOCUMENT DESIGNATION: FINAL ENVIRONMENTAL IMPACT STATEMENT

ABSTRACT: In response to Public Law 102-484, the U.S. Army is considering the use of technologies other than incineration to destroy the chemical warfare agent VX currently stored at the Newport Chemical Depot (NECD) in Indiana. A series of studies, initiated by the U.S. Army's Alternative Technologies Program and the Program Manager for Chemical Demilitarization, has recommended the pilot testing of a chemical neutralization (i.e., hydrolysis) process followed by supercritical water oxidation as a possible method of accomplishing the required destruction of agent VX.

This Environmental Impact Statement was prepared to assess the potential environmental impacts of the construction and operation of such a pilot test facility. The preferred location for the proposed facility is adjacent to the existing chemical agent storage warehouse at NECD. The alternative is no action (i.e., continued storage of the stockpile).

The environmental impacts of facility construction would be minimal and would be similar to those from the construction of any medium-sized industrial facility. No adverse human health or environmental impacts are expected to occur during the g-month period of routine pilot testing operations.

Preliminary risk analyses and accident assessments indicate that the proposed pilot test operations could involve accidents, but that such accidents would have less severe consequences than accidents that might occur during continued storage of the VX agent. In the event of a worst case accident, the potential number of off-site fatalities during pilot testing could be 50, compared to 18,500 for continued storage.

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ABBREVIATIONS AND ACRONYMS

amsl	above mean sea level
APG	Aberdeen Proving Ground
ATP	Alternative Technologies Program
CA	Cooperative Agreement
CAA	Clean Air Act
CAC	Citizens Advisory Commission
CAIRA	Chemical Accident and Incident Response and Assistance
CDB	chemical demilitarization building
CDTF	Chemical Demilitarization Training Facility
CEQ	Council on Environmental Quality
CFR	*Code of Federal Regulations*
cfs	cubic feet per second
CHHPM	U.S. Army Center for Health Promotion and Preventive Medicine
CO	carbon monoxide
CPRP	Chemical Personnel Reliability Program
CSDP	Chemical Stockpile Disposal Program
CSEPP	Chemical Stockpile Emergency Preparedness Program
CWA	Clean Water Act
CWC	Chemical Weapons Convention
DA	U.S. Department of the Army
DAAMS	depot area air monitoring system
dB(A)	decibels on an A-weighted scale
DHHS	U.S. Department of Health and Human Services
DPE	demilitarization protective ensemble
EIS	Environmental Impact Statement
EPA	U.S . Environmental Protection Agency
ERDEC	Edgewood Research and Development Engineering Center
FEMA	U.S . Federal Emergency Management Agency
FFB	filter farm building
FPEIS	Final Programmatic Environmental Impact Statement
FOTW	federally owned treatment works
ft	feet
FWS	U.S. Fish and Wildlife Service
gal	gallon
GLD	gross level detector
GPL	general population limit
gpm	gallons per minute
h	hour
ha	hectare
HEPA	high-efficiency particulate air
IDLH	immediately dangerous to life and health

in.	inch(es)
IRP	Installation Restoration Program
ISCST3	Industrial Source Complex Short-Term 3 air dispersion model
JACADS	Johnston Atoll Chemical Agent Disposal System
kg	kilograms
km	kilometer
L	liter
lb	pound
μm	micrometers
μg	micrograms
m	meter
MDL	method detection limit
MINICAMS™	miniature chemical agent monitoring system
mg	milligram
MPL	maximum permissible limit
NAAQS	National Ambient Air Quality Standard
NECD	Newport Chemical Depot
NECDF	Newport Chemical Agent Disposal Facility
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NO_2	nitrogen dioxide
NPDES	National Pollutant Discharge Elimination System
NRC	National Research Council
NOI	Notice of Intent
NO_x	oxides of nitrogen
NPDES	National Pollutant Discharge Elimination System
PEL	permissible exposure limit
PGA	peak ground acceleration
PH	hydrogen-ion concentration
PM-2.5	particulate matter less than 2.5 μm in diameter
PM-10	particulate matter less than 10 μm in diameter
PMCD	U.S. Army's Program Manger for Chemical Demilitarization
ppm	parts per million
PPT	Production Prove-Out Test
PQT	Production Qualification Test
PSD	prevention of significant deterioration
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
s	second
SBCCOM	U.S. Army Soldier and Biological Chemical Command
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
TCC	ton container cleanout
TOC	total organic carbon

TSDF	treatment, storage, or disposal facility
TWA	time weighted average
UBC	Uniform Building Code
UVO	ultraviolet light/hydrogen peroxide oxidation
VOCs	volatile organic compounds
VX	a chemical nerve agent

EXECUTIVE SUMMARY

This Environmental Impact Statement (EIS) assesses the potential environmental impacts of construction and operation of a facility at Newport Chemical Depot (NECD) to pilot test chemical neutralization followed by supercritical water oxidation (SCWO) as a potential disposal technology for the bulk agent VX currently stored at the site. This EIS also assesses the potential impacts of alternatives to the proposed action. NECD is located along the west central side of the state of Indiana and encompasses about 2,860 ha (7,100 acres). It is one of nine Army installations where chemical warfare agents and munitions are stored. The bulk agent VX stored in steel ton containers at NECD represents approximately 4% of the total U.S. stockpile which, as required by U.S. law (Title 14, Part B, Sect. 1412 of Public Law 99-145, as amended in Public Laws 100-456, 102-190, and 102-484), is slated for destruction by April 2007. U.S. law also requires that the Army consider technologies other than high-temperature incineration at certain storage sites, including NECD, for stockpile destruction. The proposed action, construction and pilot testing of the Newport Chemical Agent Disposal Facility (NECDF), which represents one of the alternative technologies being developed by the Army, is specific to the bulk agent VX stored at NECD.

The NECDF would demonstrate the feasibility of using the neutralization/SCWO disposal technology to destroy bulk VX agent. Before neutralization, the agent would be pumped from ton containers into a holding tank. Neutralization of VX would be accomplished by mixing the agent VX with a solution of sodium hydroxide in water near the boiling point. After neutralization is complete, the process effluent (also called hydrolysate) from neutralization would be treated at an on-site SCWO facility. The liquid process effluent would be sent to the existing on-site sewage treatment plant and would be subsequently discharged to the Wabash River through the existing discharge outfall from NECD at permissible levels specified in the National Pollution Discharge Elimination System permit for the facility. The proposed NECDF would meet permitting requirements of the Clean Water Act, Resource Conservation and Recovery Act (RCRA), and the Clean Air Act. RCRA hazardous wastes would be characterized, appropriately packaged, and shipped off-site to a permitted disposal facility. Nonhazardous solid process wastes would be disposed of at a permitted landfill located off-site; and decontaminated process metal (i.e., empty ton containers) would be transported to Rock Island Arsenal in Illinois for smelting for recycling.

The proposed NECDF would include a chemical demilitarization building, which would house the ton container cleanout and neutralization processes, the SCWO area, and associated support facilities needed for operations and maintenance. The proposed site for the NECDF is adjacent to and west of the existing chemical agent storage building (Building 144) where the ton containers are currently stored.

The tentative schedule calls for construction of the proposed facility to begin in December 1999, with preoperational testing (i.e., systemization) to commence in March 2002, and pilot testing with live agent to begin in March 2003. Pilot testing with agent VX feed is expected to take about 9 months and would destroy approximately one-third of the stockpile (i.e., 615 of the 1690 ton containers) to fully test operations and to demonstrate environmental compliance of the neutralization/SCWO process. The construction work is expected to peak at about 400 individuals; the estimated operating work force is not expected to exceed 400 individuals.

The site and environs of NECD would be impacted by construction and pilot testing of the NECDF. Pilot testing would involve the potential risk from low probability accidents (as discussed below under the "Accidents" section) that could release agent VX into the environment. Assessment of the potential impacts of operation of the NECDF to destroy the entire agent VX stockpile at NECD is beyond the scope of this EIS. Additional National Environmental Policy Act documentation would be required to address disposal of the entire NECD inventory of agent VX-filled ton containers. The principal findings of this EIS are listed in the following sections for each area of consideration.

CONSTRUCTION ACTIVITIES

The potential environmental impacts associated with construction activities would be minimal. Construction of the disposal facility is expected to be typical of that of any medium-scale industrial facility. Between 20 and 32 ha (50 and 80 acres) of the NECD installation would be disturbed during construction activities.

Construction activities would result in emissions from construction vehicles and increased levels of airborne dust. The National Ambient Air Quality Standards (NAAQS) for particulate matter addresses particles less than 10 micrometers (μm) (PM-10) and 2.5 μm (PM-2.5) in diameter. The estimated PM-10 and PM-2.5 concentrations from construction, when added to the existing background levels in the area (existing for PM-10 only), would not result in either short-term or long-term exceedances of the NAAQS. Moreover, good engineering practices, including wetting of disturbed surfaces, would be employed during excavation and construction to minimize fugitive dust and erosion. Erosion would be minimized by appropriate site drainage and runoff control.

Emissions from commuter and construction vehicles would contribute relatively minor amounts of criteria pollutants. Construction activities could also result in short-term increases in ambient noise levels near off-site residences, but annual average noise levels should remain well below the 5.5 dB(A) level recommended by the U.S. Environmental Protection Agency (EPA). Disposal of nonhazardous construction wastes at an off-site permitted landfill would not result in significant adverse impacts.

New jobs for construction workers would provide minor benefits to the communities near NECD. It is expected that potential in-migration of construction workers would have only minimal effects on existing support services such as housing, schools, hospitals, and utilities. There is the potential for minor disruptions to vehicular traffic along State Route 63 during shift change and associated commuting.

Water use during construction would result in a small increase in water supplied to the installation. At the proposed site (i.e., adjacent to Building 144), no prime farmland, wetland, or floodplain would be adversely affected by construction. The clearing of approximately 2.7 ha (6.6 acres) of deciduous trees in the headwaters of Little Racoon Creek for a storm water detention basin will result in the loss of some foraging habitat for the Indiana bat (the only federally designated threatened or endangered species known to occur within the confines of the NECD installation), but the effects of that habitat should be minimal.

ROUTINE PILOT TESTING

Appreciable adverse human health and environmental impacts are not expected to occur with routine pilot testing of the NECDF. Routine pilot testing would generate 4.3 m^3 (1,140 gal) per day of filtered liquid process effluent that would be sent to the NECD sewage treatment plant and then discharged to the Wabash River. This discharged effluent is expected to have negligible impacts on water quality and aquatic biota in the Wabash River, and on humans potentially exposed to the effluent through dermal (skin) contact.

Estimates of human chronic exposures (via fish consumption) to organic constituents in the process effluent show that chronic cancer risk is well below 1×10^{-6} (a probability of less than 1 excess lifetime cancer death in a population of 1,000,000 exposed). Although no specific federal standards exist for acceptable lifetime cancer risk from exposure levels associated with a facility permitted under RCRA, guidelines have been established by the EPA for acceptable exposure levels from remediation (i.e., clean-up) actions [such as those complying with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)]. For known or suspected carcinogens, acceptable exposure actions are generally those that would impart an excess upperbound lifetime cancer risk to an individual of between 1×10^{-4} and 1×10^{-6} (a probability of 1 excess lifetime cancer death in a population of 10,000 and 1 ,OOO,OOO exposed respectively) using information on the relationship between dose and response (40 CFR 300.430). The EPA has expressed a preference for clean-ups achieving the more protective end of the risk range (i.e., 1×10^{-6}). The estimated risk associated with the process effluent is below this more protective level and only a low number of people would be potentially exposed during the g-month period of operations. Also, the analysis serves as an initial, reasonably conservative (i.e., does not underestimate) estimate of potential human health risk. The U.S. Army's Center for Health Promotion and Preventive Medicine (USACHPPM) will conduct an Assessment of Health Impact (AHI), based on more detailed design information and more comprehensive experimental measurements than were available for the present analysis. As such, fewer conservative assumptions should be required, thus leading to even lower estimates of risk than the present analysis.

The discharged effluent is unlikely to adversely affect aquatic biota beyond a small mixing zone immediately downstream of the outfall in the Wabash River. No significant effects are expected to terrestrial species, and no adverse impacts to federally listed threatened or endangered species are expected.

Routine pilot testing would include atmospheric emissions of criteria pollutants and toxic air pollutants below permitted levels. Using atmospheric dispersion modeling for expected emissions, it was concluded that estimated ambient air concentrations would be well below standards and limits designed to protect human health. Noise levels at the nearest residence would be well below the 55 dB(A) level recommended by EPA. Impacts to land and water use and socioeconomic resources are also expected to be minor.

Solid and sludge wastes from the neutralization and SCWO processes would contain non-agent hazardous constituents (e.g., heavy metals). These wastes would be analyzed to ensure the absence of agent before being packaged, transported, and disposed of in a permitted waste disposal facility (or facilities) consistent with RCRA regulations.

No impacts to on-site historic properties are expected. Consultation with the Indiana State Historic Preservation Office, as required under the provisions of the National Historic Preservation Act, will be initiated by the U.S. Army's Program Manager for Chemical Demilitarization (PMCD) for the proposed action.

ACCIDENTS

For the proposed action a recent risk evaluation has identified a potential aircrash accident with an ensuing fire that would involve two agent VX-filled ton containers. The surviving agent would be lofted by the heat of the fire to become atmospherically dispersed through the breach in the structure created by the aircrash. An evaluation of the accident involving the two ton containers yields a lethal downwind hazard distance of 8.5 km (5.3 miles) under worst-case meteorological conditions.

This accident could have major environmental consequences, including human health effects, destruction of wildlife and wildlife habitat, disruption of economic resources, and contamination of land and water resources. Under the worst-case meteorological conditions such an accident could cause an estimated 50 fatalities among the off-site residential population.

ALTERNATIVES

The alternatives considered in this EIS are no action (i.e., continued storage of agent VX ton containers at NECD) and the proposed action (i.e., constructing and operating the neutralization/SCWO facility at NECD). Although the no-action alternative is not viable under Public Law 99-145, the Department of Defense Authorization Act of 1986, it was analyzed to provide a basis for comparison with the proposed action.

The worst-case accident for the no-action alternative would involve an earthquake or an aircrash, with each of these events having an ensuing fire involving the entire inventory of agent VX stored in Building 144; either of these accidents could have a zone of potential impact extending beyond 100 km (62 miles), with as many as 18,500 fatalities if this accident were to occur during worst-case meteorological conditions, The kinds of impacts associated with accidents for the two alternatives are similar, but the magnitude of those associated with the no-action alternative is potentially much greater than for the proposed action.

1. PURPOSE OF AND NEED FOR THE PROPOSED ACTION

1.1 INTRODUCTION

This Environmental Impact Statement (EIS) has been prepared by the U.S. Army to assess the environmental impacts of constructing and operating a pilot test facility, and of alternatives to this action, at Newport Chemical Depot (NECD) in Indiana as part of a research and development program. The proposed facility would use a chemical neutralization process to destroy the nerve agent VX currently stored at NECD. The agent VX stored at NECD represents approximately 4% of the total U.S. chemical agent stockpile of more than 27,000 metric tons (30,000 tons). To comply with U.S. law, the U.S. stockpile, including the inventory stored at NECD, must be destroyed before April 2007.

As shown in Fig. 1.1, NECD is one of nine Army installations where chemical warfare agents and munitions are stored. The NECD inventory is unique in that it contains only agent VX. The agent VX at NECD is in bulk liquid form contained in 1,690 steel tanks, also known as ton containers. All the VX agent at NECD was manufactured prior to 1968.

To accomplish the stockpile destruction, the Army has established the Chemical Stockpile Disposal Program (CSDP). The mission of the CSDP is to develop methods for safely destroying this chemical warfare material in a manner that protects human health and the environment. Although the focus of the CSDP has been on the use of high-temperature incineration to achieve complete agent destruction since publication of a Final Programmatic EIS (FPEIS) in 1988 (U.S. Army 1988), recent studies (see Appendices A and C) have identified a chemical neutralization process as a potentially viable option for the NECD inventory of chemical agent.

The proposed action addressed in this EIS is to construct and operate a facility at NECD to pilot test chemical neutralization followed by the supercritical water oxidation (SCWO) of the neutralization reactor effluent (also called hydrolysate) as a potential disposal technology for the bulk agent VX currently stored at NECD. This EIS assesses the potential environmental effects of the proposed action and alternatives to the proposed action.

1.2 PURPOSE AND NEED

In response to a congressional mandate to destroy the nation's stockpile of chemical warfare agents and munitions (Title 14, Part B, Sect. 1412 of Public Law 99-145, as amended in Public Laws 100-456, 102-190, and 102-484), the U.S. Department of the Army has proposed the construction and operation of the Newport Chemical Agent Disposal Facility (NECDF). The NECDF would be used to demonstrate the feasibility of using the neutralization/SCWO disposal technology to destroy agent VX stored at NECD. The purpose of the proposed action is to perform full-scale pilot testing of the neutralization/SCWO process with the following goals:

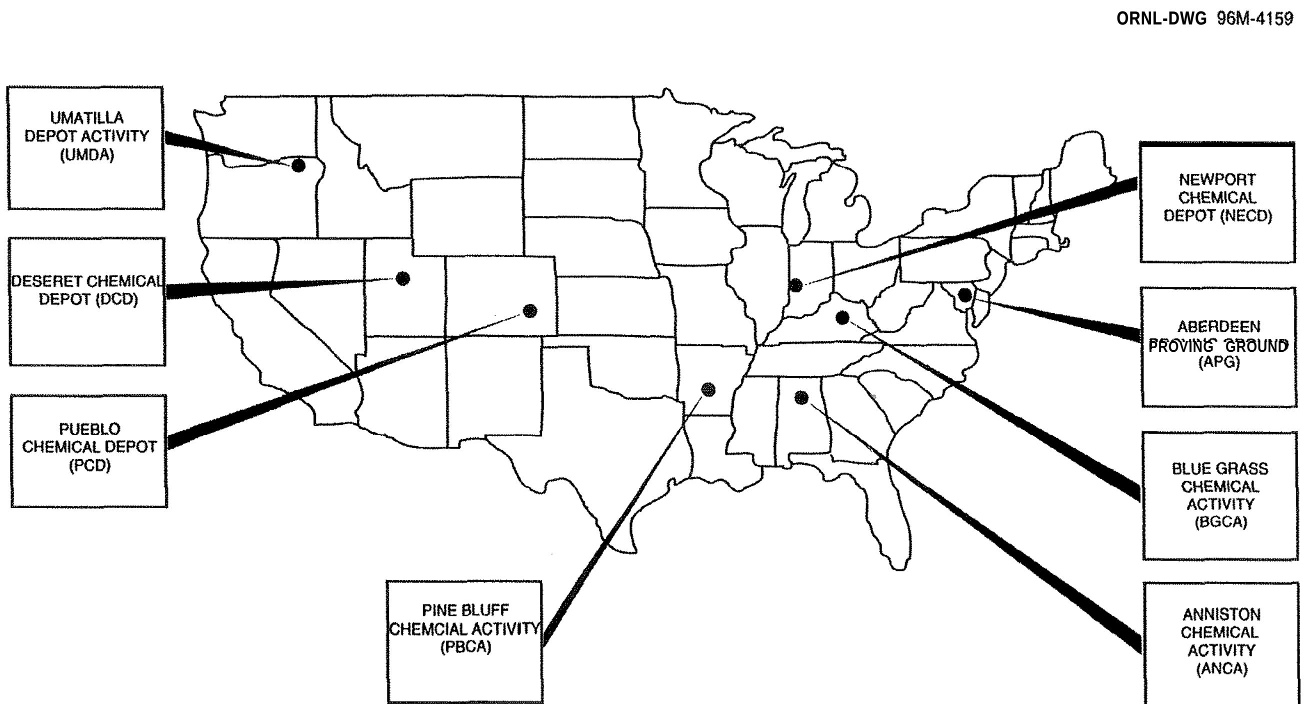

Fig. 1.1. Storage locations of the U.S. stockpile of chemical agents and munitions. An additional inventory is also stored on Johnston Atoll in the Pacific Ocean about 1300 km (800 miles) southwest of Hawaii.

- prove the technical viability and reliability of the proposed disposal technology;
- demonstrate the environmental acceptability of the technology, including the ability to meet environmental regulations;
- demonstrate process safety under representative operating conditions;
- demonstrate equipment and operational procedures; and
- develop data for process equipment performance and processing/throughput rates.

The need for the proposed action arises from strong public interest in pursuing technological alternatives to incineration. In response to this public concern, Congress passed Public Law 102-484 requiring the Army to consider using a technology other than incineration at CSDP sites storing only bulk agent, including NECD. The Army subsequently undertook a major research, development and engineering effort called the Alternative Technologies Program (ATP) to further investigate the feasibility of alternative technologies. Additional details regarding the ATP can be found in Appendix A.

A series of studies and recommendations (see Appendices A and C) initiated by the ATP and the U.S. Army's Program Manager for Chemical Demilitarization (PMCD) supported moving toward pilot demonstration and further evaluation of the proposed neutralization/SCWO process as a potential disposal technology for chemical warfare agent stockpile sites with bulk storage containers only (including the VX stored at NECD). Based on these studies, the Defense Department Acquisition Executive (Kaminski 1997; see Exhibit A. 1 in Appendix A) and the Assistant Secretary of the Army for Research, Development and Acquisition (Decker 1997; see Exhibit A.2 in Appendix A) authorized the PMCD to prepare an environmental impact analysis, in accordance with the National Environmental Policy Act (NEPA) and Army Regulation 200-2, to evaluate the proposal to construct a pilot plant to demonstrate the neutralization process alternative technology at NECD with either on- or off-site post-treatment of the neutralization hydrolysate.

The proposed action in this EIS is an important step in developing the data and information necessary to evaluate the applicability of the alternative technology for destroying the entire NECD stockpile.

1.3 DESCRIPTION OF THE NEPA PROCESS AND THE ARMY DECISION PROCESS

1.3.1 Description of the NEPA Process

A federal undertaking such as the Army's ATP must comply with the provisions of NEPA (Public Law 91-190, as amended by Public Laws 94-52 and 94-83). The procedural provisions of NEPA are implemented by regulations (40 CFR 1500-1508) developed by the President's Council on Environmental Quality (CEQ). As detailed in those regulations, a NEPA review is conducted to ensure that environmental factors are given adequate consideration early in the decision-making process. The NEPA process provides federal agencies with the information needed for weighing the significance of the environmental impacts of a proposed action against those of alternatives prior to a decision on implementing any action. This EIS has been prepared in compliance with the CEQ regulations and Army Regulation 200-2, which contains policy and procedures for implementing both NEPA and CEQ regulations by the Army.

The first step in the preparation of an EIS is the publication in the *Federal Register* of a Notice of Intent (NOI) to prepare the EIS. The NOI describes the proposed action, invites the public to participate in the scoping process for the EIS, and lists the name and address of the person to be contacted for further information. Subsequently, public meetings may be held in those communities potentially impacted by the proposed action. These meetings are intended to inform the public about the proposed action and to solicit public input concerning the issues to be addressed in the EIS. The public scoping process assists the EIS preparers in focusing on those significant environmental issues deserving of detailed study or analysis. For this EIS, the scoping process began with the publication of the NOI on June 3, 1997 (62 *Federal Register* 30315). A public scoping meeting was held in Clinton, Indiana (Vermillion County) on June 30. Details regarding scoping can be found in Appendix B.

Following the scoping process, a Draft EIS is prepared. Upon completion of the Draft EIS, copies are circulated to other government agencies and to interested members of the public, and a notice of availability for the EIS is published in the *Federal Register*. A minimum of 45 days must be allowed for the public to comment on the Draft EIS. All comments received on the Draft EIS must be considered and addressed in the Final EIS.

The draft version of this EIS was issued on June 12, 1998 (63 *Federal Register* 32207) at which time a 45-day review period began. The review comments were due by July 27, 1998, and all received comments are on display in Appendix H in this final version of the EIS. In addition, a public meeting was held in Newport, Ind., on July 7, 1998, to allow individuals to offer comments on the Draft EIS. The comments received at that meeting are also on display in Appendix H .

The concluding step in the NEPA process is the preparation and publication of a Record of Decision (ROD) for the proposed action. The ROD identifies the alternatives considered, states the decision that was made regarding these alternatives, discusses significant factors included in reaching the decision, and describes how those factors affected the final decision.

1.3.2 Army Decision Process

The Army's decision process for alternate technologies involves three distinct phases, each of which includes the compilation of studies and experimental evidence to support a specific decision (or "milestone"). These "milestones" are formalized within the Army system by the issuance of letters from the appropriate level of command to the executing officer. For the Alternative Technologies and Approaches Program, the first "milestone" occurred with the Congressional directive in Public Law 102-484 to study and evaluate technological alternatives to incineration for bulk sites only. In January 1995, the Army initiated Technical Feasibility Testing (TFT), which is synonymous with laboratory and bench-scale testing, for the VX neutralization technology. Based on the results of the laboratory and bench-scale tests, a Milestone I/II decision was reached in January 1997 to pursue pilot testing of the neutralization technology. The two letters on display in Appendix A of the EIS represent the Milestone I/II decision.

During the next phase of decision making, Production Prove-out Testing (PPT), which is synonymous with pilot-plant shakedown testing, and Production Qualification Testing (PQT), which is synonymous with pilot-plant demonstration testing, will be conducted. Based on the results of the proposed pilot testing, the Army anticipates that a Milestone III decision can be reached by April 2004, at which time the Newport neutralization facility will either be or not be selected for use in destroying the entire inventory of agent VX currently stored at NECD.

Accompanying any Milestone III decision to use neutralization in place of incineration will be a response to the language in Public Law 102-484 that requires the Secretary of the Army to issue a determination that (1) the alternative technology is capable of completing all necessary destruction and demilitarization operations by the 2007 deadline and (2) significantly safer and equally or more cost-effective than the incineration process. Prior to implementing a Milestone III decision, the Army would prepare additional NEPA documentation that addressed the destruction of the entire NECD inventory of agent VX (i.e., this additional NEPA documentation would address activities beyond the pilot testing of the facility). Further details about the Army's NEPA review are contained in Sect. 1.5, below.

1.4 THE RELATIONSHIP OF THIS DOCUMENT AND EMERGENCY PREPAREDNESS PROGRAMS

The current storage and maintenance activities at NECD necessitate emergency response planning. Previous studies, including the FPEIS, have identified the need for improved emergency preparedness as a direct consequence of the chemical agents currently in storage; thus, this is not a new need resulting from the proposal to construct and operate a neutralization facility.

A separate program, the Chemical Stockpile Emergency Preparedness Program (CSEPP), has been established by the Army. The purpose of CSEPP is to protect the health and safety of the public by enhancing the emergency preparedness of the installation and its surrounding communities. By Public Law 99-145, the Army is accountable for the execution of the CSEPP. Although the sole source of funding is a Department of Defense (DOD) appropriation, the execution of the CSEPP is accomplished through the cooperation of federal, state, and local governments. As such, there are specific roles that have been assigned to each of the participants for this cooperative execution.

The Project Manager (PM) CSEPP, an element under the direct supervision of the Army's PMCD, is responsible for overall project direction, policy, and technical expertise in chemical agents. Overall funding, schedule, performance, and integration responsibility resides with the PM CSEPP. Emergency preparedness activities within the borders of the eight stockpile sites (including NECD) are the joint responsibility of the Army Chemical Activity Commander (CAC) and PM CSEPP.

The Army has partnered with the Federal Emergency Management Agency (FEMA) which provides emergency preparedness expertise and serves as a conduit for DOD funds to the involved state and local governments through the Cooperative Agreement (CA) process. The CSEPP program enhances state and local emergency preparedness by focusing on the chemical agent unique aspects which, when meshed into existing infrastructure, processes, and capabilities, enables timely response and increased public safety in the unlikely event of a stockpile accident. The two operational elements of FEMA in the project, the headquarters and the regional staffs, provide the liaison and the coordination between the Army and states during program execution.

Within each state, the governor is charged with the responsibility for public safety. The state Offices of Emergency Management (OEMs) are delegated the daily responsibility for the program execution and as such, are the focus of the intrastate coordination among counties. The CA is signed between the FEMA region and the state as grantee. Proper and timely execution of the CA within the state and counties lies with the state OEM. The designated CSEPP counties integrate chemical stockpile specific needs into existing emergency response plans, operations, training, and public information programs. The county personnel closely coordinate with the Army stockpile site personnel.

The Army depot personnel are responsible for the maintenance, safety, and surety of the stockpile. This is also the repository for the cadre of personnel trained and experienced in agent handling procedures. These personnel are responsible for mitigation and cleanup of agent material in the unlikely event of a stockpile accident. The depot staff develop mitigative procedures to reduce public risk posed by the stockpile, as well as response plans which are coordinated and integrated with county/state plans. The depot CSEPP personnel have established effective working relationships with state and local personnel to ensure a seamless response which is refined annually during the joint exercise. Plans for these cooperative relationships will endure through the destruction of the last container of chemical material.

It is important to note the differences between the basis for defining "study zones" or "zones of potential impact" as used in this EIS and that for defining "emergency planning zones" under CSEPP. The basis for both was taken from the probabilistic risk assessment conducted for the FPEIS (see Sect. E.3.1 in Appendix E of this EIS). That risk assessment produced a list of hypothetical accidents and their probabilities of occurrence for the continued storage of the inventories at each depot. The same set of hypothetical storage accidents is used in this EIS as for CSEPP; however, the needs and objectives of the two are different, as discussed below.

This EIS uses the complete list of credible site-specific hypothetical accidents in order to bound the magnitude and extent of potential environmental impact. The focus is on the maximum downwind hazard distance (expressed as a ""no-deaths" or "0% lethality" distance) associated with the most severe accident. In general, the credible hypothetical accident releasing the largest quantity of chemical agent under the most unfavorable meteorological conditions is used in this EIS to define a circular study area. The spatial extent of this study area is expressed as a downwind hazard distance [e.g., 100 km (62 miles)] associated with the radius of the circular area.

The boundaries of emergency planning zones under CSEPP are based on credible non-externally initiated hypothetical accidents, their plume arrival times, the distribution of people and resources, and other geopolitical factors. The planning zone boundaries are generally not circular but form irregular polygons around the depot. The determination of these zones is ultimately made by local and state authorities. Although the Army does not encourage state and local planners to ignore worst-case accidents (i.e., those resulting from catastrophic external events such as earthquakes, airplane crashes, and meteorite strikes), the Army, FEMA, and other CSEPP participants use credible non-external events for their emergency planning basis. Hence, there may be differences between the accidents used as a basis for CSEPP planning and those used to bound environmental impacts in this EIS.

The current storage and maintenance activities at NECD involve emergency response planning, such as the Chemical Accident and Incident Response and Assistance (CAIRA) plans currently in place at NECD. Emergency response teams have been trained to implement these plans. These plans would also apply to any potential accidental release of agent VX from the proposed neutralization facility. These existing emergency response plans are not examined further in this EIS.

1.5 SCOPE OF THIS ENVIRONMENTAL IMPACT STATEMENT

This section summarizes the issues identified and considered during the preparation of this EIS. Because many citizens are in favor of the proposed project being considered as an alternative to incineration, the prevalent theme expressed by the public during the scoping process has been for the Army to accelerate the EIS schedule so that construction and full-scale pilot testing of the proposed project can begin sooner than planned. The Army plans to complete the NEPA process expeditiously and will make a decision regarding the proposed action upon completion of the NFPA process.

Regarding technical issues, some public concern has been expressed regarding public and worker health and safety, future use of the NECD, air quality, water pollution and use, accident risk to humans and natural resources, cancer risks from neutralization, hydrolysate and SCWO salts storage, hydrolysate transportation, emergency response, environmental monitoring, the neutralization process, post-operation cleanup, VX destruction verification, and permitting. All these issues are addressed in this EIS.

It is premature to assume that the proposed NECDF will successfully demonstrate the neutralization/SCWO technology or to assume that the technology can be used to destroy the entire NECD inventory instead of the incineration technology selected for implementation in the ROD for the CSDP FPEIS (U.S. Army 1988). Any use of the proposed NECDF beyond pilot testing is beyond the scope of this EIS and would be addressed in future NEPA review and documentation. This EIS addresses only the construction and operation of a facility to pilot test, as part of the ATP research and development program, the neutralization/SCWO process as a potential disposal technology for the agent VX currently stored in ton containers at NECD. The relative merits of the neutralization/SCWO process and the CSDP incineration process are not compared in this EIS. Any decision regarding the use of a technology other than incineration for the destruction of the NECD stockpile must await the demonstration of the viability of the neutralization/SCWO process.

Although they often include discussions of technology-related and regulatory issues, NEPA documents are required to be prepared early in the planning process and, therefore, rarely contain design information sufficiently detailed for supporting the various permit applications required by other statutes. Regulatory compliance for the proposed NECDF will require the Army to include a comprehensive, detailed description of the disposal technology and proposed pollution control measures in the applications for permits to be issued pursuant to the Resource Conservation and Recovery Act (RCRA), Clean Air Act (CAA), Clean Water Act (CWA), and other applicable laws, regulations and executive orders, including requirements related to emergency planning and preparedness. The various permits are discussed in detail in Sect. 4.9. For example, the RCRA permit application will cover all aspects of the operation, maintenance, and closure of the proposed facility (i.e., will cover activities beyond the pilot testing addressed in this EIS). Thus, separate regulatory documentation beyond the scope of this EIS will be prepared as necessary independent of the NEPA review process for the NECDF. The permitting process may also include public meetings to discuss pertinent environmental issues. In particular, the permitting process for RCRA may raise issues that are related to the proposed disposal technology; it will also provide an additional forum for public comment. As discussed in Appendix B, some of these issues are relevant to the scope of this EIS.

1.6 ALTERNATIVES

This section discusses alternatives addressed in this EIS and alternatives eliminated from further consideration.

1.6.1 Alternatives Addressed in this EIS

Alternatives addressed in this EIS are (1) the proposed action of constructing and operating an on-site facility to pilot test the neutralization/SCWO processes as a potential disposal technology for the destruction of the NECD stockpile and (2) no action (i.e., continued storage of VX ton containers at NECD). The proposed action, construction and full-scale pilot testing of the NECDF, would evaluate the destruction of agent VX by means of a process involving neutralization/SCWO. Before neutralization, the agent would be pumped from the ton containers into a holding tank. Neutralization of VX would be accomplished by vigorously mixing the agent with a hot [90°C (194°F)] aqueous sodium hydroxide solution. After neutralization is complete, the neutralization hydrolysate would be processed at a SCWO facility located on-site. The no-action alternative is addressed as required by CEQ regulations, even though its implementation is precluded by Public Law 99- 145.

1.6.2 Alternatives Eliminated from Further Consideration

CEQ regulations (40 CFR 1502.14) require that an EIS include a discussion of the reasonable alternatives to the proposed action. "Reasonable" must be defined within the context of the proposed action. The goals of the federal action, for instance, often establish the limits of its reasonable alternatives. For this proposed action, Sect. 173 of Public Law 102-484 establishes the very specific goal of instructing the Army to re-examine alternative technologies to the use of the incineration process for disposal of chemical agents stored in bulk (ton containers). As such, the purpose of the proposed action is to bring forward a feasible technological alternative to the incineration process for bulk agent VX by research and development of that process. If the proposed technology alternative is demonstrated successfully during pilot testing, the decision will be made to use the full-scale pilot plant to destroy the remaining bulk agent VX at NECD. If the pilot testing is unsuccessful, the Army will be required to use some other technology to dispose of the remaining bulk agent VX inventory, which will restart the NEPA process. Because the proposed action itself can be regarded as an alternative (i.e., to the baseline incineration technology), the range of alternatives to this proposed action that are reasonable to consider is narrowed considerably for this EIS. Moreover, as summarized below and described in detail in Appendix A, the ATP has implemented a systematic R&D program to identify multiple technological alternatives to dispose of bulk agent VX and has selected neutralizations/SCWO as the most promising of those alternatives.

Section 173 of Public Law 102-484 requires the Secretary of the Army to submit a report to Congress on the potential alternatives to the use of the incineration process for disposal of bulk chemical agents. Two reports by the National Research Council (NRC) (NRC 1993, 1994) formed the basis for the Army's report to Congress (U.S. Army 1994).

The NRC identified several technologies as alternatives to the incineration technology and made recommendations to the Army for further evaluation (NRC 1994). In deriving its recommendations, the NRC was concerned primarily with the technical aspects of safe disposal operations; however, the committee also recognized that other issues could influence the selection of disposal technologies, not the least of which are the concerns of citizens who might be affected by these operations. Among the NRC's findings was the recommendation for further study of four alternative technology combinations for agent destruction, all based upon neutralization (chemical hydrolysis) of the agent as a first step. The four alternatives were (a) neutralization, followed by incineration of the hydrolysis products, either on-site or transported off-site to another liquid-incinerator-equipped location; (b) neutralization, followed by wet air oxidation, followed by biological oxidation; (c) neutralization, followed by supercritical water oxidation; and (d) neutralization followed by biological treatment.

For the alternative technologies applicable to the stockpile of agent VX at NECD, the Army has concluded that there is no advantage to the neutralization/incineration combination as recommended by the NRC [see item (a) in the preceding paragraph] and inserted neutralization followed by solidification/stabilization into the research and development program instead. Testing determined that 40-50% of the stabilized material leached from the matrix, resulting in cancellation of the neutralization followed by solidification/stabilization alternative.

The ATP also conducted and/or funded several laboratory- and bench-scale tests examining various disposal technologies, including neutralization and three technologies offered by commercial vendors (electrochemical oxidation, high temperature gas phase reduction and molten metal). Using data from these tests and information from the vendors, the NRC re-examined these alternative disposal technologies (NRC 1996) and concluded that, for the agent VX stockpile at NECD, neutralization has a number of advantages over other alternative disposal technologies:

- Neutralization of chemical agent VX with sodium hydroxide solution destroys agent effectively and substantially lowers toxicity of the process stream.
- The equipment required for neutralization has been used extensively in industry for processes similar to those planned for agent destruction.
- Because neutralization is performed at low temperature and near-atmospheric pressure, the potential process hazard (e.g., from explosions or fires) is relatively low.
- No combustion products are emitted because no combustion is involved.

The NRC committee did note some uncertainty regarding the appropriate disposal method for the VX hydrolysate due to its potential toxicity. The NRC committee further recommended pilot-scale testing of VX neutralization and additional investigation into the appropriate treatment and disposal of VX hydrolysate from chemical neutralization.

The technologies selected for additional treatability (i.e., post-treatment) testing after the NRC's 1996 study included the catalytic extraction process, gas-phase hydrogen reduction, electrochemical oxidation, and SCWO. The conclusions from the evaluation of these treatability studies were that each technology demonstrated reduction of thiols and organic compounds containing the carbon phosphorus bond in the hydrolysate by at least 99% and that SCWO appeared to be the most suitable and effective of the technologies for destroying hydrolysate. Other factors leading to the selection of SCWO for further testing included the existence of multiple potential SCWO vendors, the research base at national laboratories and academic institutions, the completeness of the destruction, and the suitability of the process to the aqueous stream.

Based on the aforementioned reviews and evaluations of alternative technologies, the Under Secretary of Defense (Kaminski 1997) and the Assistant Secretary of the Army (Research, Development and Acquisitions) (Decker 1997) authorized the Army to proceed with efforts to demonstrate the neutralization (hydrolysis) process alternative technology followed by either on-site or off-site post-treatment for nerve agent VX at Newport. This authorization was also consistent with information obtained through interactions between PMCD and members of the Citizens Advisory Commission for NECD.

Under the proposed action, the treatment of the hydrolysate from the neutralization reactors would occur on-site at NECD. At one time, off-site disposal options were under consideration by the Army, and endorsed in the NRC (1996) report. The four primary off-site treatment and disposal options considered were neutralization/stabilization/solidification, biodegradation, deep-well injection, and incineration. Only a single SCWO unit is currently in operation in the United States, and that facility does not have the proper environmental permits to process VX hydrolysate. The other off-site treatment options were also dismissed from detailed consideration in this EIS for the reasons given below.

Testing of the stabilization/solidification samples has shown that a significant percentage of the organophosphorus products of VX hydrolysis leaches out of the solidified matrix. Laboratory biodegradation studies and testing at a leading biotreatment facility have also had limited success. Among the principal characteristics that must be overcome are the relative toxicity of the hydrolysate, its flammability, and a high total organic carbon content. The remaining two options-deep-well injection and incineration-are inherently counter to the objectives of the ATP.

As discussed below, compounding factors led the Army to seek maintaining its own control over the hydrolysate and to conduct all operations (including post-treatment) on-site. In its attempt to seek off-site post-treatment of the hydrolysate, the Army learned that almost all viable and capable vendors for *off-site* treatment planned to use incineration processes. Because the use of incineration runs contrary to the charter of the Alternative Technologies Program, the Army decided to abandon its search for off-site post-treatment vendors. Furthermore, because of potential Chemical Weapons Convention (CWC) treaty-compliance problems that might result from the inability of any vendor to complete all tasks expeditiously (e.g., securing environmental permits) the Army decided to pursue development of its own post treatment technology. As discussed in Appendix A, however, numerous vendors have participated in the Army's development of alternative technologies that led to the Army's proposed action to pilot test neutralization and supercritical water oxidation of VX agent at NECD. The other off-site treatment options were also dismissed from detailed consideration in this EIS for the reasons given below.

In view of the uncertainties associated with the available off-site treatment technologies and the absence of other viable options, the technical risks of identifying and implementing such off-site treatment options are considered by the Army to be too high. Furthermore, the public input that has been received to date indicates that a significant percentage of the residents within the Newport community are uncomfortable with the concept of shipping partially treated wastes from a chemical warfare destruction facility to other sites.

For the above reasons, off-site treatment of the hydrolysate from the neutralization process is not further addressed in this EIS; and treatment of the hydrolysate in an on-site SCWO unit *is* a part of the proposed action.

Because of the NRC studies, Army agency reviews, public input, and the rationale for on-site versus off-site post-treatment indicated above, the PMCD has recommended neutralizations/SCWO for full-scale pilot testing at NECD. Other alternative disposal technologies and off-site options are not addressed further in this EIS. Moreover, since the proposed action itself is a research and development activity to test and evaluate a tecl-mological alternative, a detailed evaluation of the potential environmental impacts from additional alternative disposal technologies is beyond the scope of this EIS.

1.7 AGENCY INTERACTIONS AND SUPPORTING STUDIES

The information and analyses in this document are based on site visits made by the EIS authors to NECD and its environs; meetings with citizens; consultations with local, state, and federal agencies and officials; and literature searches. Support studies are incorporated by reference into this EIS and are summarized in Appendix C.

Cooperating agencies providing information for and reviews of this EIS are the U.S. Department of Health and Human Services (DHHS), the U.S. Environmental Protection Agency (EPA), FEMA, and the state of Indiana. Comments were solicited from these agencies and were considered in this EIS.

In addition to the cooperating agencies, the following agencies and organizations were consulted:

Edgar County Emergency Services and Disaster Agency, Paris Illinois

Edgar County Sheriff's Department, Paris, Illinois

Fountain County Emergency Management Department, Covington, Indiana

Illinois Department of Natural Resources, Springfield, Illinois

Illinois Department of Revenue, Springfield, Illinois

Illinois Department of Transportation, Springfield, Illinois

Indiana Department of Education, Indianapolis , Indiana

Indiana Department of Environmental Management, Indianapolis, Indiana

Indiana Department of Labor Market Information, Indianapolis, Indiana

Indiana Department of Natural Resources, Indianapolis, Indiana

Indiana Department of Revenue, Indianapolis, Indiana

Indiana Department of Transportation, Indianapolis, Indiana

Newport Town Clerk, Newport, Indiana

Parke County Economic Development Council, Rockville, Indiana

Parke County Health Department, Rockville, Indiana

Parke County Planning and Zoning Department, Rockville, Indiana

Rockville Town Board, Rockville, Indiana

U.S. Fish and Wildlife Service, Bloomington, Indiana

U.S. Fish and Wildlife Service, Rock Island, Illinois

U.S. Geological Survey, Books and Open-File Reports, Denver, Colorado

Vermilion County Health Department, Danville, Illinois

Vermillion County Economic Development Council, Newport, Indiana

Vermillion County Sheriff

1.8 REFERENCES

Decker, G. F. 1997. "Authorization for Further Planning Steps for the Proposed Implementation of an Alternative Technology Pilot Plant at Newport, Indiana," Assistant Secretary of the Army for Research, Development and Acquisition memorandum to the Program Manager for Chemical Demilitarization, Jan. 29.

Kaminski, P. G. 1997. "'Authorization for Further Planning Steps for the Proposed Implementation of Alternative Technology Pilot Plants at Newport, Indiana, and at Aberdeen Proving Ground, Maryland," Defense Department Acquisition Executive memorandum to the Secretary of the Army, Jan. 17.

NRC (National Research Council) 1993. *Alternative Technologies for the Destruction of Chemical Agents and Munitions*, National Academy Press, Washington, D.C.

NRC (National Research Council) 1994. *Recommendations for Disposal of Chemical Agents and Munitions*, National Academy Press, Washington, D.C.

NRC (National Research Council) 1996. *Review and Evaluation of Alternative Chemical Disposal Technologies*, National Academy Press, Washington, D.C.

U.S. Army 1988. *Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement*, Vols. 1-3, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md.

U.S . Army 1994. *U. S. Army's Alternative Demilitarization Technology Report for Congress*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md.

2. THE PROPOSED ACTION AND ALTERNATIVES

This EIS examines two alternatives in detail, no action and the proposed action. To provide a basis for the discussion of alternative actions, Sect. 2.1 presents background material on the type of chemical agent stored at NECD and on the current storage configurations and maintenance activities. Section 2.2 describes the proposed action-construction and operation of a facility to pilot test the neutralization process followed by SCWO as a potential disposal technology for the VX currently stored in ton containers at NECD. The no-action alternative of continued storage of the NECD stockpile is described in Sect. 2.3. Section 2.4 compares the impacts of the no-action alternative and the proposed action.

2.1 BACKGROUND

2.1.1 Agent VX Characteristics

Agent VX, the only chemical agent stored at NECD, is a nerve agent that is highly toxic in both liquid and vapor forms. Agent VX is persistent but not particularly volatile. Table 2.1 summarizes the physical and chemical characteristics of agent VX.

Table 2.1. Physical and chemical characteristics of agent VX

Common name	Agent VX
Chemical Abstract Service (CAS) number.	50782-69-g
Chemical name	O-ethyl S-(2-diisopropylaminoethyl) methyl phosphonothiolate
chemical formula	$C_{11}H_{26}NO_2PS$
Vapor pressure (at 20°C)	0.0007 mm Hg
Liquid density {at 4°C)	1.006 g/cm^3
Melting point	below -51°C
Color	clear to straw
Mode of action	nervous system poison

The hazards to humans and animals from exposure to agent VX depend on the physical and toxicological characteristics of the agent and the extent, route, and duration of exposure. Exposure to high doses can result in convulsions and death because of paralysis of the respiratory system. Death from agent VX can occur quickly, often within 10 min of absorption of a lethal dose. Sublethal effects of acute exposures include effects on the skeletal muscles (uncoordinated motions followed by paralysis), effects on nervous system control of smooth muscles and glandular secretions (pinpoint pupils, copious nasal and respiratory secretion, bronchoconstriction, vomiting, and diarrhea), and effects on the central nervous system (though disturbances and convulsions).

2.1.2 Storage Configuration

At NECD, bulk agent VX is stored in thick-walled cylindrical tanks (also called ton containers) within a heavy corrugated sheet-metal warehouse (known as Building 144; see Fig. 2.1). No chemical munitions (e.g., rockets, mines, projectiles, mortars, and bombs) and/or chemical agents other than VX are stored at NECD. Originally, ton containers were developed and used during World War I for the transport and storage of chlorine, another chemical warfare agent. Although all the ton containers in the NECD stockpile were manufactured in the 1940s, these ton containers were reconditioned in the 1970s by grinding the outside of the container to bare metal, adding primer paint to the ground surface, and applying a heat-reflective silver coating. During the reconditioning process, the containers were thoroughly inspected and no defects were noted. After this reconditioning process, each ton container was weighed to determine a baseline amount of agent VX in each container. Eleven hundred and fifty metric tonnes (1,265 tons) are stored at NECD in 1,690 ton containers. The characteristics of the ton containers stored at NECD are listed in Table 2.2.

In the current configuration within Building 144, VX is stored in carbon steel ton containers stacked three high and clamped together on top of wooden platforms. The containers are clamped together to prevent their becoming airborne in the event of a tornado. The platforms rest on a sealed concrete floor with floor drains connected to a central sump. This system is designed to enable containment and decontamination of chemicals in the unlikely event of a leak from the ton containers.

2.1.3 Surveillance and Inspection

Building 144, is a controlled-access area patrolled by security forces 24 h/day. Chemical agent storage requires periodic surveillance and inventorying of ton containers. Surveillance includes air monitoring for the presence of agent VX and visual inspection of ton containers. Six automatic continuous air monitoring systems (ACAMS) operate at NECD, with two ACAMS in a mobile laboratory and two each on the east central side and southwest comer of Building 144; these units detect any possible elevated levels of chemical agent. Maintenance activities associated with storage have historically been related to rusting and include repainting of ton containers and replacement of plugs or valves on an as-needed basis.

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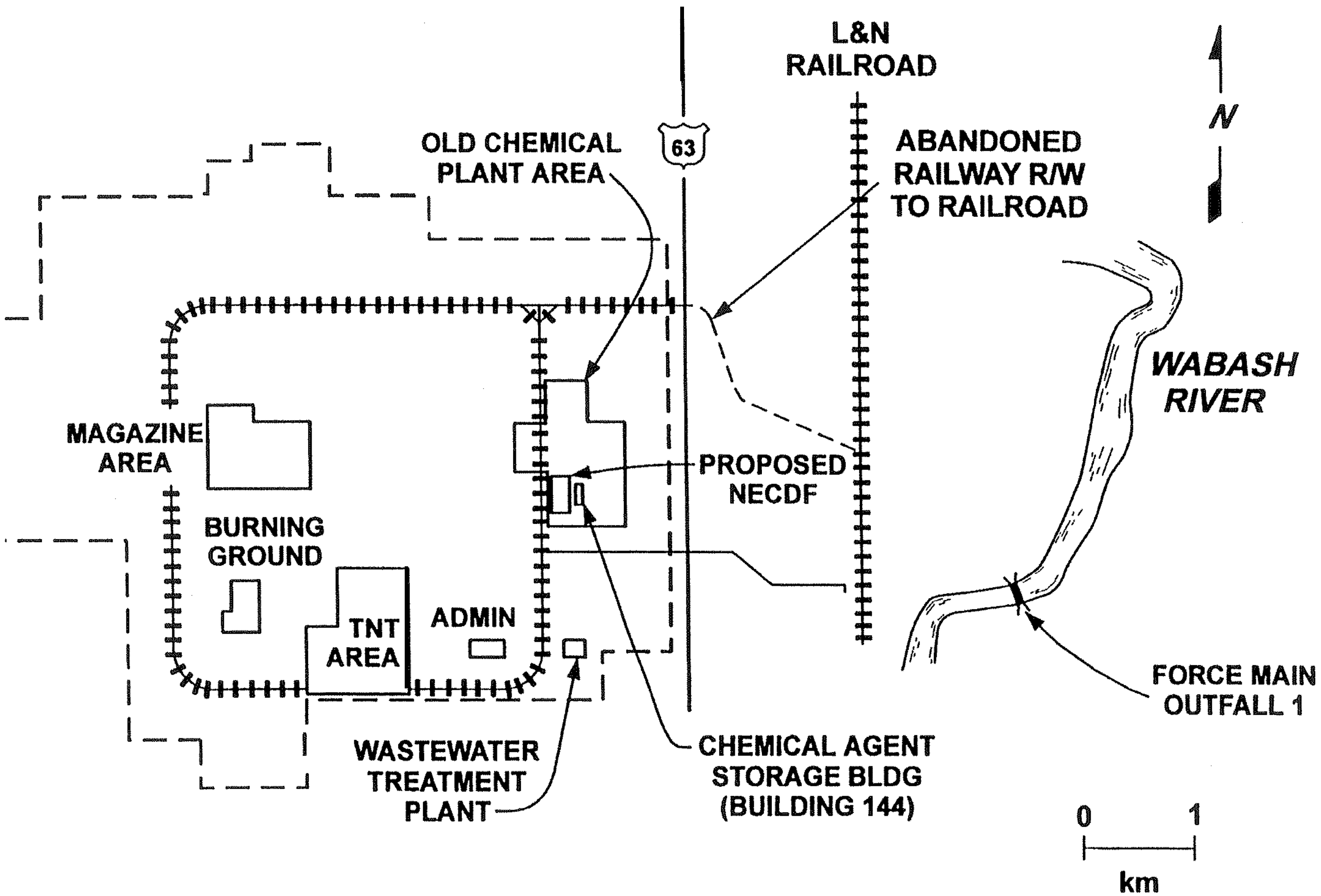

Fig. 2.1. General layout of relevant facilities at proposed NECDF.

Table 2.2. Storage characteristics of agent VX at the NECD

Number of containers in Building 144	1,690
Total agent stored in Building 144	1,150 metric tonnes (1,265 tons)
Ton container length	207 cm (81.5 in.)
Ton container diameter	75 cm (30.1 in.)
Weight per ton container	1,360 kg (3,000 lb)
VX nominal fill weight per ton container	682 kg (1,500 lb)

2.1.4 Treatment of Leaking Containers and Emergency Response

To date, no confirmed leaks have been detected in the ton containers stored at NECD. An anomaly involving a suspected pinpoint leaker was mitigated by overpacking the ton container. Work crews, using a chemical agent detection kit, sampled the area and found no evidence of a leak or other contamination.

Should a leak in a ton container be detected, tightening a plug or valve would be the first step in stopping the leak. If that action did not stop the leak, the container would be placed in a specially designed piece of equipment, where the valve or plug would be replaced while the container remained full of agent. Personnel performing such operations would wear protective clothing, and the exterior of the ton container would be decontaminated after the valve or plug replacement. If replacing the valve and plug did not stop the leak, the contents of the ton container would be transferred into a new container.

The Army currently has CAIRA plans in place at NECD to guide emergency response in the unlikely event of a release of chemical agent during storage. Emergency response teams have been trained to implement these plans. These plans would also cover any potential accidental release associated with the proposed action and alternatives.

2.2 THE PROPOSED ACTION

This section describes the proposed action, including the disposal technology, the proposed facility, the proposed operations, and the anticipated schedule and labor requirements.

2.2.1 Overview of the Disposal Technology

The NECDF would be used to demonstrate the feasibility of using the neutralization/ SCWO disposal technology to destroy agent VX at NECD. Figure 2.2 shows a schematic overview of the proposed disposal process. The proposed pilot-test operations are anticipated to occur over a 9-month period and are expected to consume the contents of approximately 615 ton containers, as discussed below. The 615 ton containers represent an upper bound on the quantity of agent VX that will be destroyed during the pilot testing.

Individual VX containers would be moved from the existing storage warehouse to the proposed facility for processing. Before neutralization, holes would be mechanically punched in the containers allowing the drained agent VX to be pumped into a holding tank. The punching operation would be done by remote control. After VX is pumped from a ton container, the empty container would be cut into halves, flushed with hot water, then cleaned with high-pressure water and steam and dried. After cleaning, the container would be sampled to ensure adequate levels of surface decontamination and then sent to Rock Island Arsenal, Illinois, to be smelted for reuse.

Neutralization of drained agent VX would be accomplished in a reactor vessel/tank by mixing the agent with a solution of sodium hydroxide in water at 90°C (194°F). In the ensuing hydrolysis reaction, VX would be destroyed, producing a liquid effluent (also called hydrolysate) that consists primarily of the sodium salt of ethyl methyl-phosphonic acid (EMPA) and the sodium salt of an amino thiol compound. The wash water used to decontaminate the empty containers would be processed in a second neutralization reactor, which also receives the hydrolysate from the drained agent reactor. There is little solid residue from this particular process. After neutralization is complete, the hydrolysate from the second reactor would be treated at an on-site SCWO facility. Two independent SCWO units would be operated side by side to ensure redundancy so that in the event of maintenance of one, the second would be operable.

The purpose of the SCWO is to convert organic compounds to carbon dioxide, water, and inorganic salts. The hydrolysate produced during the neutralization step becomes the feed to the SCWO process. The feed liquid is pumped to high pressure, about 21 MPa (about 3,500 psi), and heated to an operating temperature of about 650°C (1,200°F). The hydrolysate is then fed to the SCWO unit where it is mixed with oxygen and water. The resulting supercritical fluid is a very dense gas phase in which the salts produced during the oxidation of the hydrolysate are insoluble while the organic components are soluble.

After the SCWO process is complete, the solids, liquids, and gases are cooled and separated following pressure reduction. The liquid phase is sent to an evaporator/crystallizer. Part of the evaporator overhead stream (approximately 5%) would be condensed and sent to the existing on-site Federally Owned Treatment Works (FOTW) at NECD, and part (approximately 95 %) would be recycled as process water to the neutralization reactors. The solids from the filter press would be shipped off-site to a treatment, storage, and disposal facility (TSDF). The salts generated consist primarily of sodium sulfate and sodium phosphate. The gases from the SCWO unit would be discharged to a cascade filtration system and then to the atmosphere.

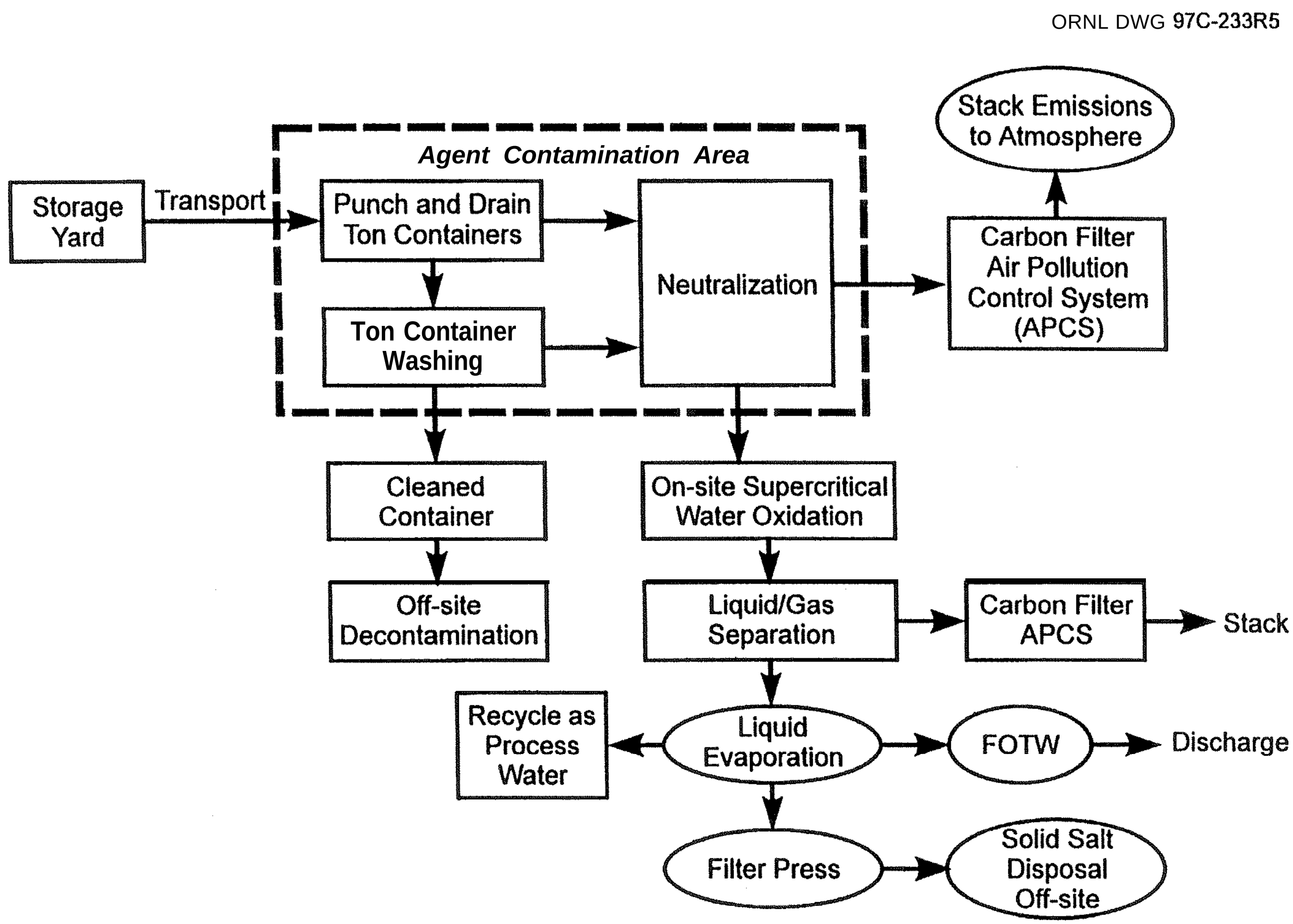

Fig. 2.2. Overview of proposed neutralization/SCWO process. (Note: FOTW is the existing Federally-Owned Treatment Works at NECD used for wastewater treatment.

The Test and Evaluation Master Plan (TEMP) is the management document specifying the requirements of the test program that must be satisfied during pilot testing proposed at NECD (PMATA 1998). The total test program consists of a number of phases including: (1) technical feasibility testing (TFT), (2) systemization, (3) production prove-out testing (PPT), and (4) production qualification testing (PQT). The TFT phase of the VX neutralization/SCWO technology began in 1995 and is scheduled to be completed in September 2002. Systemization of the proposed NECDF is scheduled to occur between August 2002 and August 2003. The PPT is scheduled to be conducted from September 2003 through January 2004, with PQT to immediately follow and continue through May 2004.

Technical Feasibility Testing. Phase 1 of the TFT program consisted of small-scale (up to 5 liters) laboratory experiments and bench-scale (2 to 115-liter reactor) experiments, performed at the Edgewood Research, Development, and Engineering Center (ERDEC) at Aberdeen Proving Ground, Maryland, and contractor facilities capable of working with neat agent. The bench-scale testing results were critical to determining the alternative technology selected for pilot testing (at the Milestone I/II decision, as described in Sect. 1.3.2). The testing determined or confirmed reaction times, pressure, temperature, viscosity, heats of reaction, effects of impurities, process variability, reactor configuration, mass transport, mixing efficiency, destruction efficiency, process monitoring procedures, materials of construction, and confirmation of pilot plant design. Phase 2 of the TFT, scheduled to occur from January 1997 (after the Milestone I/II decision) to September 2002, has or will collect, compile, and evaluate all available data and work related to this area, identify data gaps, perform testing, and produce VX hydrolysate for materials of construction testing and SCWO toxicity testing. Work completed under TFT Phase 2 is scheduled to be performed at ERDEC and at the Chemical Agent Munitions Disposal System (CAMDS) in Utah.

Systemization. The systemization phase refers to the period between construction completion, including equipment installation/precommissioning, and the commencement of toxic operations. The intent of systemization is to ensure that chemical demilitarization plant equipment and personnel are prepared to dispose of chemical agent in a manner consistent with the program's operational philosophy, which is to maximize the number of items processed within a fixed operational window in a safe and environmentally sound manner. During systemization, entire systems are tested individually with non-agent fluids to verify functionality and conformance with operational requirements. Also, during this period, the workforce is hired and trained, the laboratory is certified, operations and readiness inspections are conducted, and support services are concurrently integrated with the plant processing equipment operation. The final stage of systemization is the pre-operational survey to verify readiness to proceed to agent shakedown operations (the PPT) and to provide independent validation of the process. Systemization testing would occur at NECD.

Production Prove-Out Testing. The PPT phase would establish baseline operating parameters with agent for individual process lines and the integration of the multiple lines. The PPT will consist of pilot testing of a full-scale system with a reactor volume of 1,000 gallons for the VX process. Results of the PPT would be used to establish destruction rates, verify automation of ton container cleanout process, determine equipment availability, evaluate the throughput of the full-scale system, and determine the ability to dispose of the hydrolysate in accordance with all applicable environmental regulations. The PPT will be used to provide data on the attainability of the critical performance characteristics prior to Milestone III (see

Sect. 1.3.2). Following completion of the pre-operational survey, PPT will commence with agent shakedown testing and will address and characterize reactor configuration, mass transport, destruction efficiency, reaction times, pressure, temperature, viscosity, heats of reaction, effects of impurities, and choice of reagents. Generated waste will be characterized to ensure that it can be packaged and shipped to permitted waste management facilities for treatment or disposal. Process monitoring and materials of construction will be tested and evaluated. Prior to the start of chemical agent trials, the prototype reactor will be tested and evaluated to confirm proper control and operation of all mechanical and electrical parts and instrumentation and ensure that the reactor and process are safe to operate and test. Each parallel process line will be tested at a low rate that is increased to a maximum rate. This process will continue until all processing lines are tested at maximum rates at the same time. Operational data will be gathered to evaluate the prototype reactor and reactions for ease of operation, compatibility with full chemical protective clothing, maintainability, safety, human factors and engineering, and overall design efficiency. The PPT will also test and evaluate chemical agent-specific biomass reaction parameters of the chemical neutralization followed by the SCWO process.

Production Qualification Testing. The PQT will consist of demonstration/post-demonstration testing of a full-scale system and will follow successful systemization and PPT of the facility. This test is designed to show that the facility will operate at the design operating conditions and will meet environmental and regulatory requirements, as well as Army and CWC treaty requirements concerning feasibility, safety, monitoring, and schedule. The objective of PQT is to verify the capability of the selected technology and hardware configuration to successfully and safely perform chemical agent detoxification operations as a fully integrated system in compliance with all environmental regulations. PQT will demonstrate that the full-scale facility will operate at the designed operating conditions while processing agent. Upon completion of the demonstration test, the Army will continue with PQT. During this time, data will be obtained to evaluate the treatment operations, equipment performance, schedule, and the overall feasibility of the process technology to support a Milestone III decision. As discussed in Sect. 1.3.2, the Milestone III decision will be a decision to either continue with long-term operations or proceed with another technology.

Upon successful completion of the demonstration tests, the NECDF will continue to operate both reactors at the demonstration test conditions until approval of the demonstration test report by the regulators and subsequent issuance of a final operating permit. During this post-demonstration phase of PQT, the NECDF will conduct reliability, availability, and maintainability analysis, shift data monitoring, and will continue process testing.

Quantities of Agent Destroyed. The amounts of agent VX to be destroyed during PPT and PQT can be approximated as follows. At the start of toxic operations (i.e., in September 2003), the NECDF would operate only a single processing line and would process about 8 ton containers during the month. During the second month, two processing lines would be operated with a combined throughput of about 37 ton containers for the month. The processing throughput would increase in the third month, with each of the two lines processing up to 45 ton containers per month. Pilot testing in subsequent months would involve both processing lines, with each line operating at about 48 ton containers per month. This level of throughput would continue through the eighth month of testing, which would also be the completion of PQT. The maximum number of ton containers consumed during pilot testing would therefore be 615 (i.e., 8 containers for the first month, 37 for the second month, 90 for the third month, and 96 per month for the final five months).

Table 2.3 provides information regarding the technical parameters and objectives for the proposed pilot-testing of NECDF. Additional details regarding testing to be conducted during the proposed action can be found in the TEMP (PMATA 1998).

2.2.2 Facility Description

2.2.2.1 Proposed site

The NECD installation formerly manufactured munitions, chemical weapons, and heavy water. Its current mission is stockpile surveillance. The preferred site for the proposed NECDF would be just west of the existing storage building (Building 144). This location is near the former VX synthesis plant, about 1.0 km (0.6 mile) from the nearest site boundary.

Other sites on the installation were assessed but deemed inferior to the proposed site for a number of reasons: the proposed site is closer to the stored stockpile, reducing on-site stockpile transportation costs and risks; the proposed site is already cleared, thereby requiring little or no habitat destruction; alternate sites on the installation are close to the habitat of protected species (including Henslow's sparrow, Indiana bat, ginseng, and goldenseal); and alternate sites would require the development of more infrastructure (e.g., utilities and roads) than the proposed site.

2.2.2.2 Primary process and process support buildings

Figure 2.3 shows the layout of the facilities at the proposed NECDF. The heart of the disposal plant would be the chemical demilitarization building (CDB). The CDB would be a two-story building with high bays that would house the toxic cubicle, where the drained agent would be stored. The actual draining, cutting in half, and cleaning of the ton containers would be undertaken in the Ton Container Cleanout (TCC) facility. Other facilities in the CDB would include the control room, the demilitarization protective ensemble (DPE) service area, a toxic maintenance area for servicing contaminated equipment, a viewing **gallery,** a laboratory, and storage areas.

The CDB would be supported by a process auxiliary building that would house chemical mixing equipment, heat exchangers, utilities, chemical storage, and wastewater tanks; a filter farm building (FFB) housing carbon filter banks, high-efficiency particulate air (HEPA) filters, and air monitors; a utility building containing the plant air compressor, steam boilers, and boiler water treatment equipment; a laboratory building for analysis of process solids and liquids; a repair shop for the monitors that would detect the presence of airborne agent; and a personnel and maintenance building housing a medical facility, offices, change rooms, a lunchroom, a maintenance area, and communication facilities.

Table 2.3. Critical technical parameters and performance objectives during pilot testing of the Newport Chemical Agent Disposal Facility

Critical technical parameter/ performance objective	Test phase'	Technical objective or threshold/indicator
Agent exposure		
General population limit [72-hr time weighted average (TWA)]	PPT	≤0.000003 mg/m^3
	PQT	≤0.000003 mg/m^3
Maximum agent concentration in areas with unprotected workers	PPT	≤0.00001 mg/m^3
	PQT	≤0.00001 mg/m^3
Maximum agent concentration in hydrolysate	PPT	≤20μg/l
	PQT	≤20μg/l
Stack emissions agent (8-hr TWA)	PPT	VX ~0.00001 mg/m^3
	PQT	VX ~0.00001 mg/m^3
Agent destruction efficiency	PPT	99.9999 %
	PQT	99.9999%
Mechanical performance		
Plant availability[b]	PPT	50%/30%
	PQT	70%/50%
Agent processing rate (lbs/day)	PPT	4,500/2,700
	PQT	6,300/4,500
Total agent disposal (lbs)	PPT	*346,500*
	PQT	*576,000*

[a]PPT = production prove-out testing, which is scheduled to occur from September 2003 to January 2004; PQT = production qualification testing, which is scheduled to occur from January 2004 to May 2004.

[b]Since multiple combinations of plant availability and peak rate can result in an identical number of operating days, plant availability and peak rates are not listed as critical technical parameters. It should be noted that the evaluation of these parameters is necessary and will be conducted during both PPT and PQT to reduce the risk of not meeting the required completion date of the program. Sufficient data will be collected and scored on equipment failures and downtime such that estimate of availability and throughput rates can be evaluated.

Source: derived from PMATA (1998).

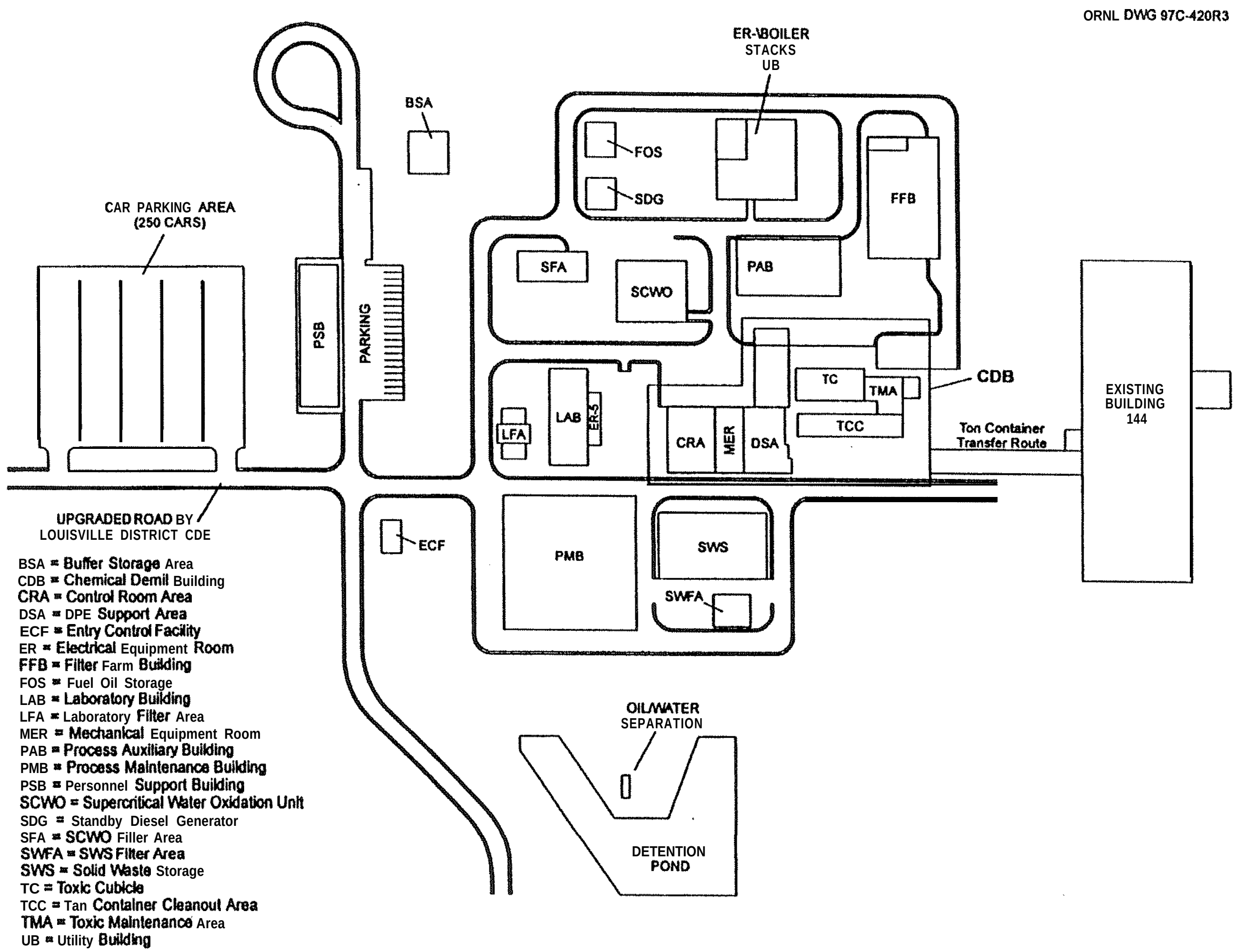

Fig. 2.3. Proposed schematic layout for the NECDF.

The CDB structure and ventilation are being designed to control hazardous materials and vapors within the building (SWEC 1997). The process area in the building would have a negative pressure with respect to the outside environment to prevent the escape of vapors from the building. Different air-ventilation zones in the CDB would be established according to the anticipated degree of agent contamination, and the zones would be separated by physical barriers for agent confinement. Pressure differentials between zones would direct airflow from zones of lower potential for agent contamination to zones of higher potential (i.e., a cascading ventilation system). Building ventilation exhaust would be filtered in the FFB before being discharged to the atmosphere.

The ventilation exhaust from all buildings would flow to the FFB, which would house a pre-filter, two HEPA filters, and six carbon filters in series. Another two carbon filters would be kept as spares. The HEPA filters would operate in series, and the first bank would be adequate to remove 99.9999% of any possible incoming agent. After passing through the filter train, the gas would be exhausted to a 30.5 m (100 ft) high, 2 m (6 ft) diameter stack to the southwest of the building. Agent air monitors would be located after the first, second, and fourth carbon filters. Two different types of agent monitoring systems, a MINICAMS™ and a depot area air monitoring system (DAAMS), would be employed at various places to detect any chemical agent that might escape into the air in and around the proposed facility. The MINICAMS™ would be located in the exhaust stack from the FFB, in the FFB filter banks, and in most rooms of the CDB. A DAAMS would be located outside the FFB and outside the laboratory building, among other sites. Also, the ACAMS currently surrounding the storage building would remain. These systems are described in more detail in Sect. 4.8 on monitoring.

A solid waste storage area with a shed roof and metal siding would be constructed to contain over one thousand 55-gal drums of solid wastes such as 3X decontaminated[1] DPE suits and spent carbon filter beds.

The medical facility, located in the personnel and maintenance building (PMB), would provide support in the event of an accident that could occur during handling, storage, maintenance, surveillance, or demilitarization operations. Qualified medical personnel would remain on-site for each operating shift and would be able to treat victims of an industrial or chemical agent accident. A decontamination area would be located in the medical facility. An ambulance dock would be available.

Bulk chemicals such as sodium hydroxide would be stored and handled inside the process auxiliary building in bermed areas. Sodium hydroxide would be stored as 50% (by wt.) solution in one 48.1-m^3 (12,690-gal) tank for use in the chemical neutralization process, in a 31.1 m^3 (8,200 gal) tank as an 18-wt. % solution for use with the SCWO, and as a dilute 1% (by wt.) solution in 41.7-m^3 (11,000-gal) tanks for decontamination purposes. A 53.9-m^3 (14,200-gal) tank would hold heated water. A small tank would contain ethylene glycol for the secondary cooling system.

[1]"3X" is an Army specification for decontaminated items that must remain under the control of the U.S. government. Technically, the air above the 3X decontaminated surface must contain less than 0.00001 mg/m^3 of VX. This is considered adequate decontamination to allow Army personnel to operate in the area without wearing chemical agent protective garments.

A separate SCWO building would be constructed to house the process equipment. It would contain the SCWO reactor, high-pressure pumps, heat exchangers, separatory equipment, and off-gas pollution control devices. An evaporator/crystallizer for concentration of liquid wastes would be located outside the SCWO building. Following the evaporator would be a filter press which would dewater the solids in the evaporator bottoms (concentrate) in preparation for shipment to an off-site TSDF. The evaporator overhead stream would be condensed, and about 95% of the volume [76.5 L/min (20.2 gpm)] would be recycled as process water with the remainder [3 L/min. (0.8 gpm)][sent to the FOTW.

2.2.2.3 Roads

Approximately 5 km (3 miles) of roadway will be upgraded or constructed to provide access to and emergency evacuation from the proposed facility. Existing roads would be used for transporting construction equipment from the installation boundary to the site of the proposed facility. These same roads would be used for removal of solid waste (hazardous and nonhazardous) from the facility.

Ton container transport would be accomplished using forklifts. With the preferred location, all transport of agent would occur within the high-security area. The transport distance for any individual ton container would be less than 250 ft. A short, new forklift route would connect the storage warehouse with the NECDF site; this concrete road would be designed to withstand the weight of the ton container-laden vehicles.

Projected traffic densities resulting from operation of the proposed disposal facility are given in Table 2.4. A parking lot would be constructed adjacent to the proposed Process Support Building and Entry Control Facility on the west side of the site. The projected capacity of the lot is approximately 250 vehicles.

Table 2.4. Projected on-site traffic densities (in number of round trips/day) associated with the proposed Newport Chemical Agent Disposal Facility

Type”	Site access road[b,c]	Plant roads’ [c]	Plant roads[b,c]	NECDF parking[b,c]
Type of pavement	Asphalt	Asphalt	Concrete	Asphalt
Vehicle				
Group 1	700	150	150	80
Group 2	30	40	40	10
Group 3	10	20	20	50

‘Group l-passenger cars, panel trucks, pickup trucks; Group 2-two-axle trucks, forklifts under 6000 Ib.; Group 3—three-, four-, five-axle trucks: forklifts 6000 to 10,000 lb.
[b]Maximum single-axle load is 18,000 lb; maximum tandem-axle load is 32,000 lb.
‘Round trips per day.

2.2.2.4 Utilities and support facilities

This section outlines the utilities and support facilities that would be required by the proposed facility. Table 2.5 presents a summary of the estimated utility requirements.

Water. Water is required to support the disposal process, fire, and personnel needs. NECD currently obtains its water from Ranney wells along the Wabash River. These wells provide sufficient capacity to support the proposed disposal facilities.

Natural gas and diesel **fuel.** Natural gas would be the primary fuel of the hot water boilers for process steam and building heat. It would be supplied to the facility by an existing pipeline. The specific route that the extension would take has not yet been determined. A natural gas metering and regulating station would also be required.

Table 2.5. Approximate utility demands for the proposed Newport Chemical Agent Disposal Facility and support facilities

Utility	Usage
Process water	
Average	223 m^3/day (59,040 gal/day)
Peak	6.4 m^3/min (1,681 gpm)
Potable water	
Average	42 m^3/day (11,185 gal/day)
Peak	2.0 m^3/min (523 gpm)
Fire water	
Peak	4.4 m^3/min (1,160 gpm)
Sanitary sewer	
Average	46 m^3/day (12,510 gal/day)
Peak	2.8 m^3/min (740 gpm)
Natural gas	
Average	14,190 m^3/day (501,100 scfd)
Peak	1124 m^3/h (39,700 scfh)
Fuel oil[a]	
Average	3.6 m^3/day (962 gal/day)
Peak	1.5 m^3/h (406 gal/h)
Electricity	
Average	10.0 mVA
Peak	13.3 mVA

[a]Fuel oil is required for the emergency generators.

Diesel No. 2 would fuel the emergency power generators that would serve as a backup for process steam, building heat, and for SCWO start-up. Diesel fuel would be delivered to the facility by tank truck and piped to the on-site storage tank. The diesel fuel tanks would be located in the fuel storage area outside the utility building (see Fig. 2.3) and would have a protective roof and containment dikes sized to contain more than the contents of the largest tanks.

Electric power. The existing electrical distribution system for NECD has sufficient capacity to support the proposed disposal facility. An existing 69-kV line would be extended to power a new 69-kV to 4.16-kV substation. The new site normal load is estimated at 10-MVA normal load. A 15-MVA line would be required.

Wastewater treatment. The existing NECD wastewater treatment plant is considered to be adequate to support the proposed disposal facility (see Sect. 2.2.3.4). This wastewater treatment plant is permitted under the National Pollutant Discharge Elimination System (NPDES), and is designated an FOTW. The plant can treat a maximum of 49,000 gal/d (185 m^3/d) and discharges to a 3-km (2-mile) long, 0.3-m (13-in.) diameter force main which empties to the Wabash River as shown in Fig. 2.1. Effluent from the SCWO evaporator would be fed to this treatment facility.

Storm water drainage. A site storm water drainage system is being designed to dram to a common point outside the fence around the disposal facility. Approximately 2.7 ha (6.6 acres) on the southern portion of the proposed site would be cleared of deciduous trees for the construction of the detention basin. The stormwater detention basin would have a surface area of approximately 0.4 ha (1 .O acre) and would be up to 4.6 m (15 ft) deep, with a minimum capacity of 4 acre feet.

Support facilities. No existing buildings would be converted to warehouses for the facility. The fire service and potable water storage systems and pumps housed in the existing water reservoir building would be used.

2.2.3 Detailed Process Description

The disposal process (Fig. 2.2) to be pilot tested at full scale involves four main steps: (1) punching, draining, and washing of the ton containers; (2) chemical neutralization of the VX agent; (3) on-site SCWO; and (4) management of waste materials that would remain after processing. These four steps are briefly described below. Table 2.6 provides a general summary of resource requirements for the neutralization/SCWO processes. A more detailed description of the process is provided in SWEC (1997).

2.2.3.1 Punching, draining, and washing

In the TCC area, the ton containers would be punched and drained in a manner consistent with Army experience at the Johnston Atoll Chemical Agent Disposal System (JACADS) (MITRE 1989). After punching and draining, the containers would be cut into two pieces around the circumference using a technique to avoid the production of excess metal

Table 2.6. Summary of unit operations and material inputs required for each process configuration

Unit oneration	Material inputs
Ton container drain and cleanout	ton containers, agent, water, steam, air
Neutralization reaction	agent, water, sodium hydroxide
Supercritical water oxidation	neutralization reactor hydrolysate, utilities, and pure oxygen

shavings. The sections would be washed and rinsed with hot water and then steam and air dried to decontaminate them to a 3X level. The washing operation would generate an agent-contaminated off-gas that would be condensed, scrubbed with caustic, carbon filtered, sent to a plenum chamber, and finally vented to the CDB exhaust. The off-gas condensate would be recycled to the washing operation. After drying, the containers would be packed in bags and shipped to Rock Island Arsenal in Illinois for smelting.

All of the wash water would be recycled except for a side stream which would be sent to a TCC effluent tank to await pumping to a neutralization module. One 2,500-L (660-gal) holding tank and one 5,375-L (1,420-gal) surge tank would store drained agent from the ton containers until the agent would be transferred to the neutralization reactor. The surge tank (normally empty) would be located adjacent to the agent holding tank to serve as an emergency backup in the event of failure or overflow of the holding tank. The two tanks would be provided with secondary containment in the event of a leak, that is a bermed area would exist that could contain the entire contents of the tanks.

2.2.3.2 Chemical neutralization

The chemical neutralization process would use two process lines, each with two neutralization reactors operating in series, and related equipment such as pumps, sampling apparatus, and heat transfer equipment. The general arrangement and flow of material are shown in Fig. 2.4. The pure liquid agent from the punch and drain operation and the wash solution from the ton container washing and steam drying operation (called TCC effluent) would be treated as follows. A portion of TCC wash solution containing small amounts of agent would be mixed with 50% sodium hydroxide solution until a concentration of 20.4 % sodium hydroxide is achieved. This 20.4% sodium hydroxide solution would be added to the first neutralization reactor and then pure liquid agent would be added. The contents of this reactor would be heated, mixed, and recirculated for PO min at 90°C (194°F) under an atmosphere of nitrogen gas at 0.04 mPa (6 psig) above atmospheric pressure to prevent any air in-leakage. The agent would be converted to relatively non-toxic organophosphorous compounds.

4

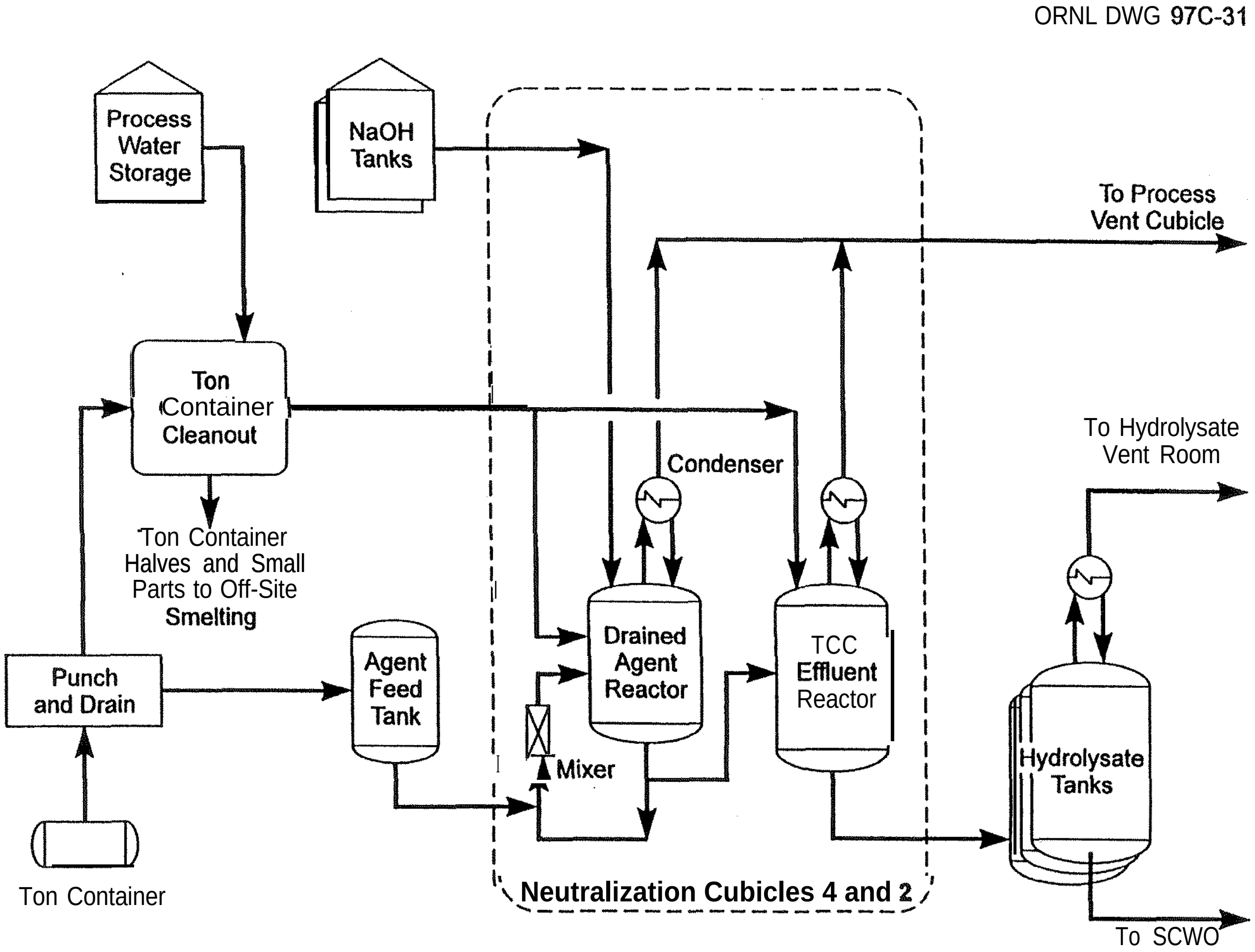

Fig. 2.4. **VX neutralization process.**

The neutralized agent solution from the first reactor would then be pumped to a second reactor and mixed with an approximately equal portion of TCC wash solution (the portion of TCC wash solution not used above to mix with the 50% sodium hydroxide solution). No additional sodium hydroxide would be used in the reaction, but otherwise the process would be conducted in the same way as in the first reactor.

A heat transfer system would be maintained to provide heating to the process reactors and to maintain a barrier between the reactors and the process water system. If a leak occurred in the heat transfer system, the heat transfer fluid (water) would be designed to leak into the process reactors because of the higher pressure [2.13 MPa (310 psig)] in the heat transfer system. Any possible leakage of agent to the heat transfer system would be further contained in the toxic control area because there would be no connection between the system and the process water system.

After the neutralization treatment in the second reactor, the product solution (hydrolysate) would be sampled to determine the degree of agent destruction. If the agent VX concentration is less than 20 parts per billion (ppb), the hydrolysate would be sent to the next treatment step. If the agent VX concentration is greater than or equal to 20 ppb, the hydrolysate would be kept in the neutralization reactor for further processing. The 20-ppb concentration value represents the agent VX method detection limit (MDL). The MDL, as specified in Appendix C of 40 CFR 425, is defined as the minimum concentration of a substance that can be identified, measured and reported with 99% confidence that the concentration is greater than zero. For the purpose of classifying the process effluent as non-hazardous under RCRA, concentrations below 20 ppb are considered to represent the absence of agent VX.

2.2.3.3 Supercritical water oxidation

A SCWO facility would process the neutralization hydrolysate. The combined hydrolysate liquids produced from the treatment of agent VX and TCC would be processed together in the SCWO.

The SCWO treatment would occur in a single flow-through supercritical water reactor as depicted in Fig. 2.5. The hydrolysate feed would be piped from the hydrolysate holding tank to the SCWO building where it would be mixed with a small amount of deionized water and recycle water from the evaporator condensate, pumped to high pressure, heated, and simultaneously mixed with gaseous oxygen and fed to the SCWO reactor. The reactor would operate at approximately 650°C (1,200°F) and 24.1 MPa (3,500 psi) pressure, at which point the total organic carbon content of the hydrolysate would be destroyed with greater than 99% efficiency in less than 1 min. (SWEC 1997). After the feed material has reacted, it would be quenched with cool water, further cooled in a heat exchanger, and reduced in pressure. Separations of liquids and gases would then be performed. The gas would be collected in a tank, analyzed, and recycled to the reactor if it is found to be above a certain specified concentration of contaminants. If not, the gas would be mixed with SCWO building ventilation air in a plenum chamber and exhausted through a cascading carbon filter system prior to discharge to the atmosphere. The liquid waste would be concentrated by evaporation and the concentrate sent to the NECD on-site sewage treatment plant. The solids from the SCWO operation and the water treatment plant sludge would be sent off-site to a permitted TSDF for permanent disposition.

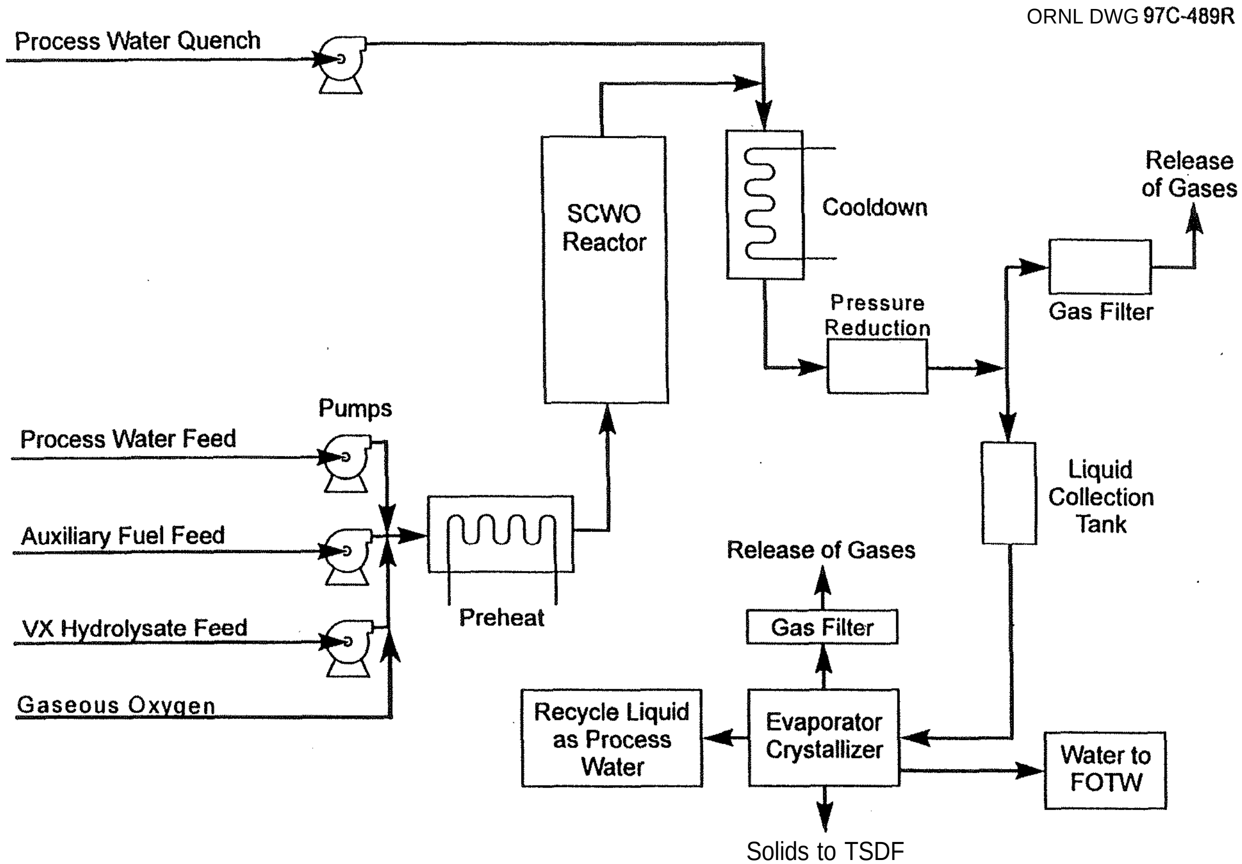

Fig. 2.5. Detailed description of supercritical water oxidation process. *Source:* SWEC 1997.

2.2.3.4 Waste management

Wastes from the proposed facilities would include gaseous emissions, solid wastes, sludge wastes, salt wastes, and liquid wastes. The approach taken by the Army to calculate the volumes and concentrations of gaseous emissions, solid wastes, and process liquid effluents follows the philosophy suggested by US EPA guidance on the characterization of atmospheric emissions-if the facility has not been built, if similar facilities have not been built, if no similar facility exists, and if no appropriate emission factors exist, use an engineering evaluation of the facility. Thus, the concentrations and volumes were derived from the following: mass/material balance, energy balance, design information, applicable method detection limits (MDLs), theoretical chemistry, process calculations, and design requirements/specifications. The specific values were obtained from the RCRA Part B permit application (NECD 1998) and the NPDES permit application (CHPPM 1998). Table 2.7 summarizes the waste streams for each process configuration. Additional details are provided in the discussion below.

Gaseous **emissions.** The types and quantities of emissions to the atmosphere are discussed in detail and analyzed in Sect. 4. Emissions would originate from the TCC

Table 2.7. Summary of waste streams and quantities of each process component of the proposed action"

Waste stream	Disposal method	Waste quantity (kg/1000 kg agent destroyed)
Gaseous emissions		
Ton container clean-out and neutralization	filter through carbon before atmospheric discharge	1,736
SCWO	filter through carbon before atmospheric discharge	660
Liquid wastes		
SCWO aqueous effluent	to NECD Wastewater Treatment Plant	1,340
Solid wastes		
Ton containers, valves, plugs, and metal cuttings	to Rock Island Arsenal for smelting	935
Activated carbon	to TSDF[a] (landfill)	2.0
Evaporator/crystallizer brine	to TSDF[a] (landfill)	1,510

‘TSDF = treatment, storage, and disposal facility permitted under the Resource Conservation and Recovery Act.

operations, the hydrolysis reaction, filtered ventilation from process areas, and the SCWO. The NECDF would not constitute a major source of hazardous air pollutants according to the Clean Air Act Amendments of 1990 because it would emit less than 10 tons per year of any one hazardous air pollutant and less than 25 tons per year of total hazardous air pollutants.

Gases from the neutralization and the hydrolysate tank room each would go to a separate plenum and then to the CDB ventilation exhaust system. The CDB ventilation exhaust would be sent to the FFB, with an additional bank of 6 carbon bed filters, and finally to the atmosphere via a 1.9 m (6 ft) diameter stack outside the FFB at an elevation of 30.5 m (100 ft). The exhaust from the SCWO air would also be carbon filtered by two carbon beds in series but exhausted through a separate stack [a 0.5 m (1.5 ft) diameter stack at an elevation of 24 m (80 ft)] and would not flow through the FFB. The two carbon beds in series are each designed to remove total organics with 95 % efficiency in normal operations.

Activated carbon filtration is an accepted method of removing hydrocarbon and similar organic chemicals from air and gas streams. It is commonly used in petrochemical industries, and it is the preferred method for treatment of ventilation airflows in chemical weapons facilities. Fixed-bed activated carbon filters have been used effectively in this capacity by the CSDP for several years. Because complete agent destruction would occur during the neutralization and scrubbing processes, these activated carbon filter units would be incorporated as an additional safety feature to further preclude the potential for a chemical agent release. If breakthrough of a hazardous air pollutant is detected in the first of a series of charcoal beds, vent gas would be redirected to one of two backup beds, and the spent bed replaced.

The filtered exhaust gases would be monitored continuously for agent. Carbon filter replacement would be rigorously controlled to protect the workers and to prevent release of agent. Table 2.8 is a list of predicted (calculated) chemical constituents of the gaseous stream to be discharged to the atmosphere. These data apply to emissions from the filter farm which services the toxic areas, the SCWO filter which services the SCWO, and the boiler which provide utilities to the pilot plant.

Solid wastes. Large amounts of solid wastes would be generated from the ton container cleaning operations (e.g., the ton containers, valves and plugs, and metal shavings from the cutting operations). Up to 615 ton containers (about 36% of the total NECD inventory) may be processed during the pilot testing. Assuming the weight of an empty ton container is 636 kg (1,400 lb), approximately 390,000 kg (860,000 lb) of total metal wastes would be generated and sent to Rock Island Arsenal for smelting and recycling. Another source of solid waste would be DPE suits, which would first be decontaminated, then packed in 55-gal drums for off-site disposal at a RCRA-permitted TSDF. Spent carbon filters from the gaseous vent system would also be a source of solid waste. It is possible that carbon filters may be reactivated.

Empty decontaminated ton containers would be transported off-site by truck and/or rail. A new storage building would be designed to hold a 90-day volume of waste DPEs and spent carbon filters. If solid wastes were transported by truck, up to six trips would be required each day depending on the inventory of wastes. Table 2.9 is a list of predicted (calculated) chemical constituents of the process solids that would be disposed at an off-site RCRA-permitted TSDF. The process solid waste stream is primarily evaporator/crystallizer brine that would total approximately 634,000 kg (1,400,000 lb) during pilot testing.

Table 2.8. Calculated gaseous emissions from the proposed facility

Emission	Quantity (lb/day)
Filter Farm Discharge	
Water (R.H. 60% at 85°F, 0.0156 lb/lb dry air)	153,120
Air (96,000 acfm @ 0.071 lb dry air)	9,815,040
Total organic compounds	<0.18
Total	9,968,160
SCWO Gaseous Effluent Filter Discharge	
Water (R.H. 60% at 85°F, 0.0156 lb/lb dry air)	9,144
Excess oxygen	10,487
Carbon dioxide	16,231
Nitrous oxide	739
Air (6,000 cfm @ 0.071 lb/ft^3 (dry air)	586,080
Total organic compounds (TOC)'	< 0.0031
Boiler Flue Gas Effluents	
Flue gas cornposition for natural gas	Peak firing rate = 1,378 lb/h
Carbon dioxide (CO,)	85,656
Water (H_2O)	75,404
Sulfur dioxide (SO_2)	6.6
Nitrogen (NJ	437,873
Oxygen (O_2)	12,670
Total	611,610
Flue gas composition for No.* 2 *diesel fuel	Peak firing rate = 1,490 lb/h
Carbon dioxide (CO,)	116,568
Water (H_2O)	48,624
Sulfur dioxide (SO_2)	48
Nitrogen (N_2)	433,416
Oxygen (O_2)	12,024
Total	610,680

"Laboratory analyses were conducted for approximately 50 different volatile organic compounds (VOCs). Of these VOCS, only 5 were detected and at very low concentrations. Acetonitrile, 2-butanone, carbon disulfide, and vinyl acetate were detected at concentrations ranging from 9 to 41 parts per billion (ppb). The most prominent VOC was acetone which was present at 41 ppb.

Table 2.9. Calculated process solid wastes from the proposed facility

Constituents	Concentration' (mg/kg except as noted)	Daily rate[b] (lb/day)
H_2O	37.13%	5116
TOC[c]	39	0.538
Chlorine	1570	21.66
Nitrite-N[d]	1147 [349]	15.82
Nitrate-N[d]	1475 [333]	20.35
Bromide	58.3	0.804
Phosphate-P[d]	258,380 [84,300]	3565
Sulfate	182,000	2511
Ag	ND (0.25)	—
Al	9.14	0.126
As	ND (0.25)	—
B	44.7	0.617
Ba	1.35	0.0186
Be	ND (0.25)	—
Bi	ND (0.25)	—
Ca	6.50	0.090
Cd	ND (0.25)	—
Co	ND (025)	
Cr	2.8	0.039
Cu	0.486	0.0067
Fe	ND (1)	
Hg	0.011	0.002
K	160	2.207
La	ND (0.25)	—
Li	3.24	0.0447
Mg	ND (0.25)	—
Mn	ND (0.25)	—
Mo	0.605	0.0083
Na	18,800	259
Ni	ND (0.25)	—

Table 2.9 (continued)

Constituents	Concentration[a] (mg/kg except noted)	Daily rate[b] (lb/day)
P	91,400	1261
Pb	ND (0.25)	
Pd	ND (0.5)	
S	72,300	997.5
Sb	ND (0.25)	
Se	ND (1)	
Si	565	77.95
Sn	ND (0.25)	
Sr	ND (0.25)	
Th	ND (0.5)	
Ti	1.36	0.0188
Tl	ND (1.25)	
U	ND (10)	—
V	ND (0.25)	—
W	ND (1)	
Y	ND (0.25)	—
Zn	ND (2)	—
Zr	ND (0.25)	—

[a]"ND" denotes that this constituent was not detected to the limit of the analytical method used. The methods detection limit appears in parentheses.

[b]Daily rate based on 6 ton containers per day effluent flow of 13,789 lb/day.

‘Preliminary testing of the process solid effluent indicates that ethyl methyl phosponic acid (EMPA), methyl phosphonic acid (MPA), and VX-thiols could be present and would contribute to the total organic carbon (TOC) content.

‘These constituents are reported exclusive of oxygen. Nitrite amount = N x 3.286. Nitrate amount = N x 4.429. Phosphate amount = P x 3.065. The “as reported” values for N and P alone appear in brackets.

Sludge wastes. Sludge wastes would be generated during the waste water treatment in the NECD FOTW. This waste would be handled in a manner consistent with current NECD FOTW practices.

Liquid wastes. Liquid wastes generated from the NECDF would include process water and nonprocess water. The former would consist of the liquids generated from the neutralization of agent. The latter would consist of sanitary sewage, used boiler water, and other waters that had not been in contact with any contaminated areas.

The total liquid generated from on-site SCWO and evaporation would be approximately 115,000 kg/day (250,000 lb/day); of this amount, approximately 95 % would be recycled and used in the process and 5 % would be sent to the existing NECD FOTW. Here it would be treated and discharged to the Wabash River. Table 2.10 is a list of predicted (calculated) chemical constituents of the liquid stream discharged to the Wabash River. Sanitary sewage from the disposal facility would also be handled by the existing NECD Treatment Plant.

2.2.4 Maturity of the Disposal Technology

Agent VX has been neutralized by mixing with hot sodium hydroxide solution and prepared for SCWO in 114-L (30-gal) batches containing 25 to 30 kg (55 to 66 lb) of agent per batch at the Edgewood Research and Development Engineering Center (ERDEC) of Aberdeen Proving Ground. In a number of tests, destruction efficiency for VX of greater than 99.9999 % has been achieved within 120 min. In addition, bench-scale operations have been conducted with 1-L (0.26-gal) reactors in which 265 g (0.58 lb) of agent were destroyed in a batch. A total of about 351 kg (773 lb) of VX has been neutralized and 3,178 kg (7,000 lb) of hydrolysate produced which has been shipped off-site to a TSDF. In bench-scale testing, it has been demonstrated that the ton containers can be decontaminated to 3X levels.

The ton container punch and drain station is essentially identical to the JACADS system (MITRE 1989). The decontamination technique (i.e., the cutting and cleanout of ton container valves) used for the punched and drained ton container is new.

GA Technologies of San Diego, California, performed tests of the SCWO process using actual VX hydrolysate generated at ERDEC. Tests were conducted for a maximum duration of 8 h at approximately 600°C (1,112°F) wall temperature. Destruction efficiencies for total organic carbon ranged from a low of 98.4% in one test to 99.9% in 3 of 7 tests. Though salt deposition was a problem, with extended operation the salt mass balance appeared to reach a steady state. The samples of hydrolysate were characterized by the Southwest Research Institute (SwRI) in San Antonio, Texas.

2.2.5 Schedule and Labor Requirements

Construction of the NECDF is scheduled to begin in December 1999 and end in March 2002. The systemization test would last approximately 1 year. The PPT would begin in March 2003 and last 140 days. The PQT would conclude pilot testing and last about 140 days.

During construction, the average construction work force is expected to be about 400. The NECDF would be a government-owned, contractor-operated facility. The estimated work force needs during pilot testing is not expected to exceed 400 total personnel.

Table 2.10. Process liquid effluents from the proposed facility

(a) Compounds detected in evaporator distillate

Constituent	SCWO effluent as received at evaporato (mg/L)	Evaporator distillate as sent to FOTW (mg/L)	Duplicate evaporator distillate as sent to FOTW (mg/L)	Larger value of evaporator distillate as sent to FOTW (mg/L)
O-phosphate	4100	0.31	NA	0.31
nitrite (NO2/N)	21	0.06	NA	0.06
ammonia (N)	<0.1	0.3	NA	0.3
T. phosphorus	4,800	0.03	NA	0.03
TSS	600	2	NA	2
boron	0.0598	0.0187	0.0115	0.0187
calcium	12.2	0.218	0.216	0.218
iron	0.0774	0.0106	0.0193	0.0193
silicon (silica)	3.57	0.061	0.0853	0.0853
sodium	9040	0.139	0.147	0.147
titanium	2.23	0.043 1	<0.0007	0.0431
aluminum	0.0667	0.0251	0.0145	0.0251
antimony	<0.00075	<0.000075	0.000086	0.000086
barium	0.0142	0.00023	0.00043	0.00043
chromium	0.0152	0.00096	0.0012	0.0012
copper	0.144	0.00058	0.001	0.001
lead	0.011	0.0014	0.0019	0.0019
manganese	0.0116	0.0041	0.0056	0.0056
mercury - low level	0.000058	0.0000469	NA	0.0000469
molybdenum	0.0425	0.00022	0.00053	0.00053
nickel	0.0674	0.00029	0.001	0.001
selenium	0.0078	0.00052	0.00041	0.00052
vanadium	0.0024	0.00011	<0.0001	0.00011
zinc	0.261	0.0108	0.0071	0.0108
acetone’	0.019	0.027	0.032	0.032
carbon disulfide	<0.001	0.0016	0.0015	0.0016
bis(2-ethylhexyl)phthalate[a]	0.018	0.21	0.21	0.21

“Likely contaminants from instrumentation.
NA = not available

Table 2.10 (continued)

(b) Compounds screened for but not detected in evaporator distillate

Constituent	Method detection limit for constituent (mg/L)	Constituent	Method detection limit for constituent (mg/L)
chloride	1.0	sulfate (SO,)	1.0
fluoride	0.1	T. cyanide	0.01
nitrate (NO3/N)	0.05	phenols	0.01
bromide	0.05	sulfite (SO,)	1
TOC	1	chloromethane	0.001
T. sulfide (S)	1	cis-1,2-dichloroethene	0.001
magnesium	0.015	cis-1,3-dichloropropene	0.001
potassium	0.019	dibromochloromethane	0.001
tin	0.038	ethylbenzene	0.001
mercury	0.00011	methylene chloride	0.002
arsenic	0.00012	styrene	0.001
beryllium	0.00023	tetrachloroethene	0.001
cadmium	0.00013	toluene	0.001
cobalt	0.000071	trans-1,2-dichloroethene	0.001
silver	0.00009	trans-1,3-dichloropropene	0.001
thallium	0.000068	trichloroethene	0.001
1,1, I-trichloroethane	0.001	vinyl chloride	0.001
1,1,2,2-tetrachloroethane	0.001	T. xylenes	0.001
1,1,2-trichloroethane	0.001	1,2,4,5-tetrachlorobenzene	0.00s
1 , 1-dichloroethane	0.001	1,2,4-trichlorobenzene	0.00s
1, I-dichloroethylene	0.001	1,2-biphenyl htdrazine	0.005
1,2-dibromo-3-chloropropane	0.001	2,2'-oxybis(1-chloropropane)	0.005
1,2-dibromoethane	0.001	2,4,5-trichlorophenol	0.020
1,2-dichlorobenzene	0.001	2,4,6-trichlorophenol	0.005
1,2-dichloroethane	0.001	2,4-dichlorophenol	0.005
1,2-dichloropropane	0.001	2,4-dimethylphenol	0.005
1,3-dichlorobenzene	0.001	2,4-dinitrophenol	0.020
1,4-dichlorobenzene	0.001	2,4-dinitrotoluene	0.005
2-butanone	0.005	2,6-dinitrotoluene	0.005
2-hexanone	0.005	2-chloronaphthalene	0.005
4-methyl-2-pentanone	0.00s	2-chlorophenol	0.00s
acrolein	0.010	2-methlynaphthalene	0.005
acrylonitrile	0.005	2-methyl phenol	0.005
benzene	0.001	2-methyl-4,6-dinitrophenol	0.020

Table 2.10 (continued)

(b) Compounds screened for but not detected in evaporator distillate

Constituent	Method detection limit for constituent (mg/L)	Constituent	Method detection limit for constituent (mg/L)
bromodichloromethane	0.001	2-nitroaniline	0.020
bromoform	0.001	2-nitrophenol	0.005
bromomethane	0.001	3,3'-dichlorobenzidine	0.005
carbon tetrachloride	0.001	3-nitroaniline	0.020
chlorobenzene	0.001	4-bromophenyl phenylether	0.005
chlorobromomethane	0.001	4-chloro-3-methylphenol	0.005
chloroethane	0.001	4-chloroaniline	0.005
chloroform	0.001	4-chlorophenyl phenylether	0.00s
4-methyl phenol	0.00s	phenol	0.005
4-nitroaniline	0.020	pyrene	0.005
4-nitrophenol	0.020	aldrin	0.00001
acenaphthene	0.005	alpha-BHC	0.00001
acenaphthylene	0.005	beta-BHC	0.00001
anthracene	0.005	delta-BHC	0.00001
benzidine	0.020	gamma-BHC(lindane)	0.00001
benzo(a)anthracene	0.005	gamma-chlordane	0.00001
benzo(a)pyrene	0.00s	alpha-chlordane	0.08001
benzo(b)fluoranthene	0.00s	4,4'-DDD	0.00002
benzo(ghi)perylene	0.005	4,4'-DDE	0.00002
benzo(k)fluoranthene	0.005	4,4'-DDT	0.00002
bis(2-chloroethoxy)methane	0.005	dieldrin	0.00002
bis(2-chloroethyl)ether	0.005	endosulfan I	0.00001
butylbenzylphthalate	0.005	endosulfan II	0.00002
carbazole	0.005	endosulfan sulfate	0.00002
chrysene	0.005	endrin	0.00002
di-n-butylphthalate	0.005	endrin ketone	0.00002
di-n-octylphthalate	0.005	endrin aldehyde	0.00002
dibenzo(ah)anthracene	0.005	heptachlor	0.00001
dibenzofuran	0.005	heptachior epoxide	0.00001
diethylphthalate	0.005	methoxychlor	0.0001
dimethylphthalate	0.005	toxaphene	0.001
fluoranthene	0.00s	aroclor-1016	0.8002
fluorene	0.005	aroclor-1221	0.0004
hexachlorobenzene	0.00s	aroclor-1232	0.0002

Table 2.10 (continued)

(b) Compounds screened for but not detected in evaporator distillate

Constituent	Method detection limit for constituent (mg/L)	Constituent	Method detection limit for constituent (mg/L)
hexachlorobutadiene	0.005	aroclor- 1242	0.0002
hexachlorocyclopentadiene	0.005	aroclor- 1248	0.0002
hexachloroethane	0.005	aroclor-1254	0.0002
indeno (1,2,3-cd) pyrene	0.005	aroclor- 1260	0.0002
isophorone	0.005	chloroacetic acid	0.025
n-nitrosodi-n-propylamine	0.005	fluoroacetic acid	0.025
n-nitrosodiphenylamine	0.005	EMPA	0.025
naphthalene	0.005	MPA	0.050
nitrobenzene	0.005	VX	0.010
pentachlorobenzene	0.005	DEMP	0.050
pentachlorophenol	0.020	DIAEM	0.050
phenanthrene	0.005	RSSR	0.050
RSCCSR	0.050	CDI	1
RSCCSH	1	BIS	1
PH	1	EA-2192	1
EMPSH	1	ethanol	1
DIPA	1		

Source: U.S. Army Center for Health Promotion and Preventive Medicine, 1988, Appendix B. Evaporator Distillate Test Data Summary, *DRAFT National Pollutant Discharge Elimination System Permit Application for the Department of the Army Newport Chemical Depot Newport Chemical Demilitarization Facility*, Aberdeen Proving Ground, MD (March 16, 1998).

2.2.6 Future Use, Dismantling, and Closure

The proposed pilot testing of the NECDF would involve the destruction of about 36% (615 ton containers) of the total NECD inventory (1,690 ton containers). The fate of the entire NECD inventory-as related to the national stockpile disposal program-is beyond the scope of this EIS; however, in the event that pilot testing is successful, the use of the NECDF for destruction of the total NECD inventory would be considered. Because such a decision would depend on the results of pilot testing, additional NEPA documentation would be required to address the use of the NECDF for disposal of the entire NECD inventory of VX-filled ton containers.

Public Law 99-145 requires chemical stockpile disposal facilities to be dedicated solely to the disposal of chemical agents and munitions. If the NECDF were eventually used for destruction of the entire NECD inventory, then the facilities would be dismantled and closed at the completion of the destruction campaign. Final closure requirements would result in removal and decontamination of process equipment, structures, soils, or other materials containing or contaminated with hazardous waste or hazardous constituents. Closure requirements will be defined in the RCRA permit issued for the NECDF. The types of wastes generated during closure would be expected to include the same types of wastes generated during plant operations.

If a decision is made to propose using the NECDF to destroy the entire NECD inventory of agent VX-filled ton containers, future NEPA documentation would address potential environmental impacts from dismantling and closure. It is premature to address such impacts in this EIS.

2.3 THE NO-ACTION ALTERNATIVE

The no-action alternative for this EIS is not to build the proposed facility to pilot test the neutralization/SCWO process, and therefore, to continue to store the agent VX stockpile at NECD. Under the no-action alternative, research and development of the neutralization followed by SCWO process would not be pursued further.

The no-action alternative is addressed as required by CEQ regulations, even though its implementation is precluded by Public Law 99-145. It should be noted that for the purpose of the analyses presented in this EIS the no-action alternative is limited to activities related solely to the continued storage of the agent VX inventory at NECD. As such, the no-action alternative is open ended in that the eventual fate of the NECD inventory is not included in this definition of no action. The analyses of continued storage do not include the continued aging of the ton containers, nor do the analyses include the risks or potential impacts of whatever disposal process(es) may eventually be implemented to dispose of the NECD inventory.

It is assumed, for the purpose of comparing the impacts of this alternative with those of the proposed action, that existing Army storage procedures would be followed during the period of continued storage, including surveillance and inspection activities as described in Sect. 2.1.3.

The stockpile is currently stored in compliance with Army regulations (i.e., agent VX must be stored in a manner that protects human health and the environment). These requirements would continue to be met under the no-action alternative. The principal hazards of continued storage involve possible accidental releases of agent that could result from (1) activities associated with ton container surveillance and inspection {Sect. 2.1.3) and with the treatment of leaking ton containers (Sect. 2.1.4) and (2) external events (e.g., natural hazards, such as earthquakes, tornadoes, meteorite strikes, and airplane crashes) that could affect the ton containers in storage.

Under the no-action alternative, monitoring for the presence of chemical agent vapor in the Building 144 would continue. Monitoring capabilities and practices could be enhanced as a result of improvements in instrumentation and safety standards derived through ongoing studies supporting the CSDP.

2.4 SUMMARY COMPARISON OF POTENTIAL IMPACTS AMONG ALTERNATIVES

This section provides a comparative summary of impacts of alternatives, which are addressed in greater detail in Sect. 4. Two alternatives are examined in this section: the proposed action (i.e., full-scale pilot testing of the NECDF, as described in Sect. 2.2) and the no-action alternative (i.e., continued storage and maintenance of agent VX at NECD, as described in Sect. 2.3).

Impacts of construction, routine operations, and accidental releases of agent VX are summarized for both alternatives in Table 2.11. This EIS considers impacts to human health, socioeconomic resources, air quality, land and water resources, ecological resources, and cultural resources. Accidental releases of agent VX during pilot testing of the NECDF or continued storage of the stockpile would be unlikely, but could result in appreciable adverse impacts. The worst-case accident for the proposed action would be an aircrash involving two ton containers of agent VX awaiting processing, resulting in a fire, with a zone of potential impact (lethal hazard distance) extending to 8.5 km (5.3 miles). The worst-case accident for the no-action, continued storage alternative, on the other hand, would involve an earthquake or an aircrash, with each of these events having an ensuing fire involving the entire inventory of agent VX stored in Building 144; either of these accidents could have a zone of potential impact extending beyond 100 km (62 miles). For the proposed action, there could be as many as 50 off-post fatalities under worst-case meteorological conditions, whereas there could be as many as 18,500 off-post fatalities resulting from the worst-case accident for the continued storage alternative. Other, less catastrophic accidents are also possible for both the proposed action and continued storage alternatives. For the proposed action, spills of hydrolysate onto land surfaces are expected to result in only minor impacts assuming proper and prompt decontamination procedures; for the continued storage alternative, minor accidents should likewise result in minor impacts assuming proper and prompt decontamination procedures.

With the exception of an accident, continued maintenance and storage of the agent VX stockpile would have only minor environmental impacts.

Construction of the NECDF is expected to have only temporary and minor impacts to land and water resources, air quality, ecology, and socioeconomic resources. There will be a small to moderate impact to the local transportation network (i.e., the intersection of the NECD gate and State Road 63) as workers commute to and from the proposed facility.

Routine pilot testing of the NECDF would generate filtered process effluent. Estimated concentrations of process effluent discharged to the Wabash River are not expected to adversely affect water quality, aquatic biota or humans exposed to the effluent through dermal (skin) contact. Significant adverse human health impacts are not expected. Impacts to threatened and endangered species, including various freshwater mussels, the Indiana bat, and the American bald eagle, from exposure to the process effluent are unlikely. Impacts to land, air quality, and socioeconomic resources are expected to be minor from routine pilot testing of the NECDF. As during the construction period, there will be a small to moderate impact to the local transportation network (i.e., the intersection of the NECD gate and State Road 63) as workers commute to and from the proposed facility during its operating period.

Table 2.11. Comparison of environmental impacts among alternatives

Potentially affected resource	Proposed action (i.e., neutralization followed by on-site supercritical water oxidation)	No action (i.e., continued storage)
	Impacts from construction	
Land and water	From 20-32 ha (50-80 acres) of land inside NECD would be disturbed for construction of the proposed neutralization and supercritical water oxidation facilities, support facilities, and utilities. Adverse impacts to land and water resources are not expected to result from construction of the NECDF.	No construction activities or impacts would occur.
Air quality	Impacts to ambient air quality from construction activities are expected to be minor. Ambient air concentrations of particulate matter resulting from fugitive dust emissions would not exceed National Ambient Air Quality Standards.	No construction activities or impacts would occur,
Noise	Noise levels at the nearest residence would be well below levels recommended by the U.S . Environmental Protection Agency.	No construction activities or impacts would occur.
Human health	No deleterious effects to the health of workers are expected from construction, Off-site impacts to human health are not expected.	No construction activities or impacts would occur.
Ecology	No significant impacts on terrestrial or aquatic ecology are expected from construction activities. No rare or unique plant or animal species, habitat, or natural communities are known to exist within the proposed facility areas, although an Indiana bat was sighted (June 1998) approximately 0.5 km (0.3 mile) south of the proposed site. The loss of foraging habitat for the Indiana bat (due to tree clearing for the proposed detention pond) is not expected to be significant. No wetlands are present in the project and support facility areas, although wetlands and surface waters close to the construction site may be adversely but temporarily affected by sedimentation or spills related to construction activities.	No construction activities or impacts would occur.

Table 2.11 (continued)

Potentially affected resource	Proposed action (i.e., neutralization followed by on-site supercritical water oxidation)	No action (i.e., continued storage)
Socioeconomics	New jobs for construction workers would provide slight benefits to the communities near NECD. Potential worker in-migration would have minimal effects on educational and other services. There will be a small to moderate impact to the local transportation network (i.e., the intersection of the NECD gate and State Road 63) as workers commute to and from the proposed facility.	No construction activities or impacts would occur.
Cultural, archaeological, and historical	No impacts are expected to off-site cultural, archaeological, or historical resources. The Army will consult with the Indiana State Historic Preservation Officer in compliance with Section 106 of the National Historic Preservation Act of 1966.	No construction activities or impacts would occur.
Cumulative	The impacts to land and water use, air quality, and regional employment would not appreciably or adversely add to existing or foreseeable impacts from activities unrelated to the proposed action.	No construction activities or impacts would occur.
	Impacts from routine operations	
Land and water	Land and water use impacts would be minimal. Pilot testing of the proposed NECDF would generate filtered process effluent at an average daily rate of approximately 4.3 m^3 (1,140 gal). Estimated concentrations of process effluent constituents are not expected to adversely affect water quality.	Land use and water use would not change, and impacts would remain minor.
Air quality	Emissions of criteria and toxic air pollutants from pilot testing of the proposed NECDF would be relatively small and would produce maximum ambient air concentrations that are well below regulatory standards and permitted limits.	Emissions from vehicle activity (fuel combustion products and fugitive dust) would not adversely affect air quality.
Noise	Noise levels at the nearest residence would be at or below levels recommended by the U.S. Environmental Protection Agency.	Noise levels would be less than the proposed action.

Table 2.11 (continued)

Potentially affected resource	Proposed action (i.e., neutralization followed by on-site supercritical water oxidation)	No action (i.e., continued storage)
Human health	No adverse human health impacts are expected from exposure to atmospheric emissions from pilot testing of the proposed NECDF. Acute exposures, such as skin contact, to the liquid process effluent discharged from the NECDF would result in minimal effects. Chronic exposure principally through fish consumption, to the liquid process effluent as discharged into and mixed with the Wabash River is expected to result in insignificant health risk.	Risks to human health are small.
Ecology	The final effluent from the proposed NECDF, as discharged from the force main outfall into the Wabash River, is unlikely to adversely affect aquatic biota beyond a small mixing zone immediately downstream of the outfall. No significant effects are expected to terrestrial resources. There are no federally listed threatened or endangered aquatic species in on-site streams or the Wabash River within 20 km of the outfall of the FOTW, and the only terrestrial species with federal protected status that may occur along the reach of the Wabash River which is to receive effluent from the pilot test plant are the threatened bald eagle and the endangered Indiana bat; no adverse impacts to federally listed threatened or endangered species are expected.	No appreciable impacts would occur.
Socioeconomics	New jobs for plant workers would be somewhat beneficial to communities near NECD. Other than the potential for slight traffic disruption at shift changes, no adverse impacts to community infrastructure and resources are anticipated.	Economic benefits from jobs related to stockpile maintenance would continue but would be minimal.

Table 2.11 (continued)

Potentially affected resource	Proposed action (i.e., neutralization followed by on-site supercritical water oxidation)	No action (i.e., continued storage)
Cultural, archaeological, and historical	No impacts are expected to off-site cultural, archaeological, or historical resources. The Army will consult with the Indiana State Historic Preservation Officer in compliance with Section 106 of the National Historic Preservation Act of 1966.	No significant impacts would occur.
Cumulative	The impacts of atmospheric emissions, land and water use, and disposal of solid wastes would not appreciably increase the existing or foreseeable impacts from activities unrelated to the proposed action. The Installation Restoration Program and the demolition of nonstockpile facilities on NECD are scheduled to continue throughout the period that the pilot plant would operate, employing the same number of workers as during the construction period. Currently, no new off-site industrial additions or expansions are planned for the operations period, but new commercial and industrial enterprises could be developed in the future.	The level of impact would be less than that of the proposed action; however, continued deterioration of the stockpile would continue until such time as it is eventually destroyed. The requirements for increased maintenance and/or surveillance during long-term storage periods were not quantified.
	Impacts from accidents releasing agent VX	
Human health	The worst-case accident associated with pilot testing of the proposed NECDF would be an aircrash accident involving the agent VX contents of two ton containers with an ensuing fire. The lethal downwind hazard distance of this accident is 8.5 km (5.3 miles) and could cause an estimated 50 fatalities among the off-site residential population under worst-case meteorological conditions.	The possibility of accidents would continue for as long as agent VX is stored at NECD. The worst-case accident associated with continued storage would be an earthquake or an aircrash, with each of these events having an ensuing fire. The entire inventory of the storage warehouse could be involved in such an accident. The lethal downwind hazard distance associated with such an accident under worst-case meteorological conditions could be greater than 100 km (62 miles) and could cause an estimated 18,500 off-site fatalities.

Table 2.11 (continued)

Potentially affected resource	Proposed action (i.e., neutralization followed by on-site supercritical water oxidation)	No action (i.e., continued storage)
Land and water	An accidental release of agent VX into the atmosphere could potentially affect land and water bodies downwind from the site of the release [to a no-effects distance of approximately 60 km (37 miles)]. Certain land use (e.g., agriculture) could be temporarily precluded in contaminated areas. The impacts of a lesser, spill-type accident would be expected to be minor with rapid response and decontamination at the spill site in accordance with the NECD spill prevention, control, and countermeasures plan.	The types of impacts are the same as for the proposed action, but the zone of potential impact for the worst-case accident during continued storage would be much larger [greater than 100 km (62 miles), in contrast with 60 km (37 miles)].
Air quality	No long-term impacts would occur.	No long-term impacts would occur.
Ecology	Populations of some wildlife species could be temporarily reduced, including terrestrial species, birds, insects, and aquatic populations of lentic surface waters (e.g., ponds and lakes) as far away as 60 km (37 miles). Serious impacts to aquatic populations in flowing waters (creeks and rivers) would probably be limited to the small creeks such as Little Raccoon Creek within 2 to 3 km (I .2 to 1.8 miles) of the release because the time of exposure would be relatively short. Endangered species of freshwater mussels, the Indiana bat, and the bald eagle may be adversely affected by an accidental release of agent VX.	The types of impacts are the same as for the proposed action, but the zone of potential impact for the worst-case accident during continued storage would be much larger [greater than 100 km (62 miles), in contrast with 60 km (37 miles)].

Table 2.11 (continued)

Potentially affected resource	Proposed action (i.e., neutralization followed by on-site supercritical water oxidation)	No action (i.e., continued storage)
Socioeconomics	Social disruption might occur in affected communities because of temporary evacuation or relocation of residences and businesses.	The types of impacts are the same as for the proposed action, but the zone of potential impact for the worst-case accident during continued storage would be much larger [greater than 100 km (62 miles), in contrast with 60 km (37 miles)].
Cultural, archaeological, and historical	A number of sites that are listed in the National Register of Historic Places, including several covered bridges, are located within the 10-km (6-mile) area, and more than 50 historic and archaeological sites are within the 60-km (27-mile) zone. Access to affected sites would be restricted until they could be decontaminated.	The types of impacts are the same as for the proposed action, but the zone of potential impact for the worst-case accident during continued storage would be much larger [greater than 100 km (62 miles), in contrast with 60 km (37 miles)].
Cumulative	A possible accident could have major cumulative impacts on human health, land and water use, ecology, and socioeconomics within 60-km (37-miles) of the proposed site.	The types of impacts are the same as for the proposed action, but the zone of potential impact for the worst-case accident during continued storage would be much larger [greater than 100 km (62 miles), in contrast with 60 km (37 miles)].

2.5 ARMY'S PREFERRED ALTERNATIVE

Part 1502.14(e) of the regulations (40 CFR 1500 to 1508) implementing NEPA (see Sect. 1.3.1) requires an EIS to "identify the agency's preferred alternative if one or more exists, in the draft statement, and identify such alternative in the final statement.. . . " This section contains such an identification and description of the Army's preferred alternative.

This EIS addresses the potential impacts from the Army's proposed action to construct and operate a chemical neutralization facility for the destruction of agent VX, with supercritical water oxidation of the process effluent. To compare the impacts of the Army's proposal, a no-action alternative (i.e., continuing to store the agent VX at NECD) was also evaluated in this EIS.

Impacts from construction and operation of the proposed facility are summarized in Sect. 2.4 and are compared to the impacts of the no-action alternative. For the reasons given in the above section, the Army believes that the proposed action (i.e., construction and pilot-test operation of the NECDF) would best accomplish its statutory mission and responsibilities, giving consideration to economic, environmental, technical and other factors. The construction and operation of the proposed NECDF at a location adjacent to the existing chemical storage building at NECD is thus explicitly identified as the Army's preferred alternative.

2.6 REFERENCES

MITRE 1989. *Operational Verification Test and Evaluation Master Plan for the Johnston Atoll Chemical Agent Disposal System (JACADS),* MTR-88W250, prepared for the U.S. Army Office of the Program Manager for Chemical Demilitarization, prepared by the MITRE Corporation, McLean, Va.

NECD (Newport Chemical Depot) 1998. *Resource Conservation and Recovery Act Hazardous Waste Permit Renewal Application for Storage in Containers at Building 729A and Addition of Newport Chemical Agent Disposal Facility Container Storage, Storage/Treatment in Tanks, and Treatment in Miscellaneous Units at Newport Chemical Depot,* submitted to The Indiana Department of Environmental Management, Indianapolis, Indiana, March 1998.

PMATA (Product Manager Alternative Technologies and Approaches) 1998. *Test and Evaluation Master Plan for NECDF Chemical Neutralization Followed by Supercritical Water Oxidation* (SCWO) DRAFT (June 10, 1998), Aberdeen Proving Ground, MD .

SWEC 1997. *Evaluation of Confirmatory Testing of Supercritical Water Oxidation for Treating VX/NaOH Hydrolysate,* May 3, 1997.

USACHPPM (U.S. Army Center for Health Promotion and Preventive Medicine) 1998. *National Pollutant Discharge Elimination System Permit Application for The Department of the Army Newport Chemical Depot Newport Chemical Demilitarization Facility*, submitted by Newport Chemical Depot to The Indiana Department of Environmental Management, Indianapolis, Indiana, May 1998.

3. DESCRIPTION OF THE EXISTING ENVIRONMENT

This section describes the NECD installation and the existing environment that could be impacted by the proposed action and the no-action alternative considered in this EIS, If a severe accident involving agent VX occurred during certain meteorological conditions, existing environments several miles from NECD could be affected. The primary region of concern, defined as the zone of potential impact, is the area within 100 km (62 miles) of the chemical storage area (Fig. 3. 1), because the "worst case" accident associated with the continued storage alternative could cause significant human health effects and environmental impacts in this area (as discussed in the FPEIS-U.S. Army 1988). In contrast, possible accidents associated with the proposed action would involve less chemical agent and would be a concern primarily within 10 km (6.2 miles) of the proposed pilot plant. In accordance with CEQ regulations, this EIS analyzes the no action alternative (i.e., continued storage), as well as the proposed action, as explained in Sect. 1.5.

The description of various human and environmental features provided in this section focus on the geographical regions of primary concern. Topics include meteorology, air quality, noise, land and water resources and use, ecological resources, and human or community resources. These descriptions provide a basis for the assessment of the impacts of the proposed action and the no-action alternative in Sect. 4.

3.1 NECD OPERATIONS

NECD is located near the Illinois border in Vermillion County in west central Indiana. Terre Haute lies about 40 km (24 miles) to the south of NECD, and Danville, Illinois, lies about 30 km (18 miles) to the north-northwest (see Fig. 3.1). The small towns of Newport, to the northeast of the installation, and Dana, to the southwest of the installation, are located within 5 km (3 miles) of the installation. Other nearby towns in the predominantly rural area are Clinton, Cayuga, and Rockville. NECD occupies approximately 2,860 ha (7,100 acres) immediately to the west of State Route 63.

3.1.1 History and Mission

The Army developed the Wabash River Ordnance Works in 1941 on property that was primarily residential and agricultural. Because of the war in Europe, the Army purchased the properties and developed plans for a munitions factory. After Pearl Harbor, development proceeded quickly and an explosives plant was constructed and brought into operation in 1942. A heavy-water pilot plant was constructed in support of the Manhattan Project and placed into production during World War II, with as many as 10,000 workers involved in construction and 2,000 workers employed in production. The factories wound down and fell into disrepair following World War II but, with the war in Korea, the explosives plant was reactivated and a

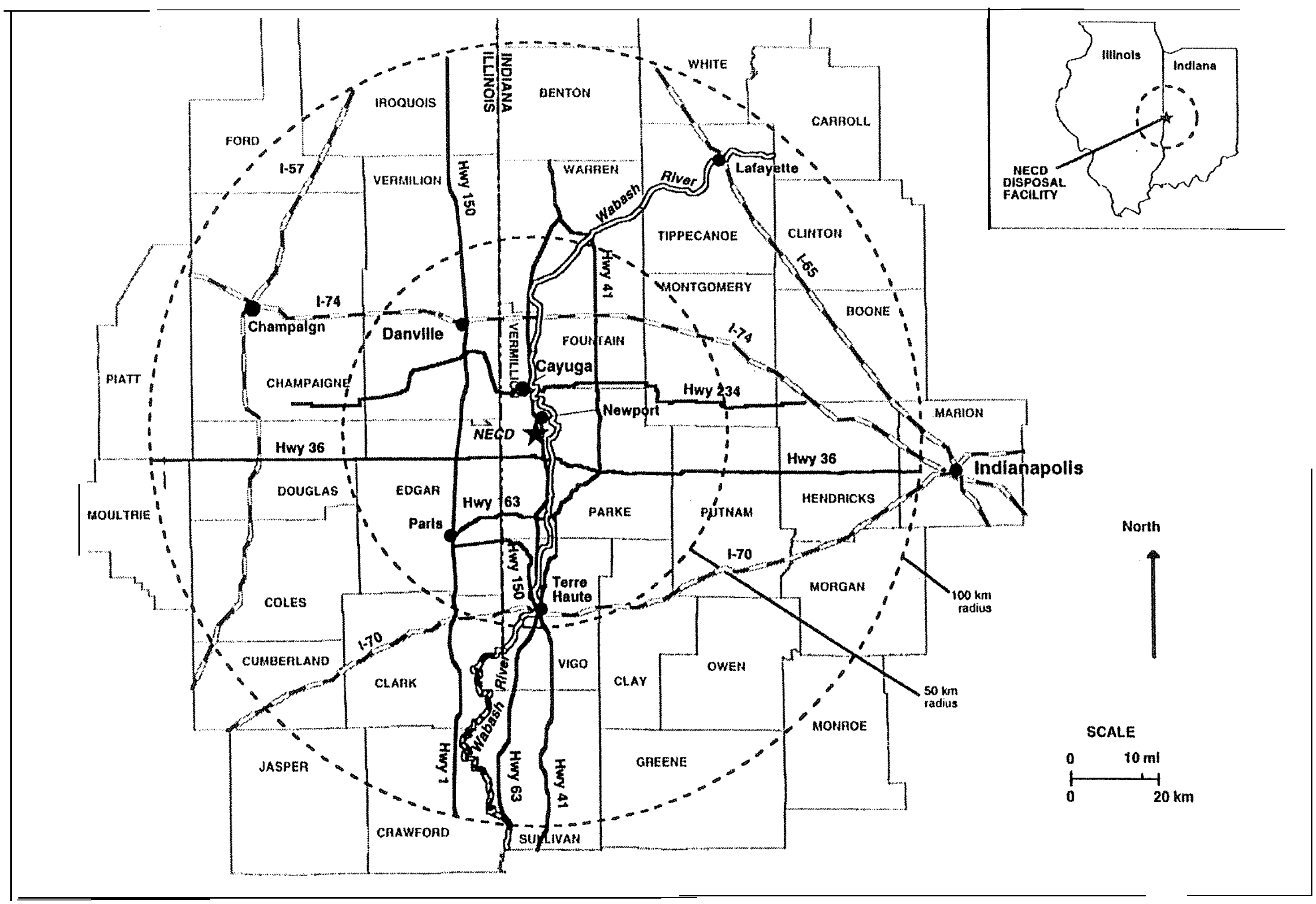

Fig. 3.1. Regional map of the Newport Chemical Depot area.

larger heavy-water plant was constructed in 1952. By 1957, employees were reduced to two or three guards and the plant was shut down.

A chemical plant to produce agent VX was constructed in from 1959 to 1961, using some of the foundation and "footprint" from the original heavy-water plant. All the agent VX manufactured for the U.S. defense stockpiles was made at NECD. Munitions were shipped to the site by rail, filled with chemical agent, then shipped out to various defense installations. Though NECD was never intended as a storage site, when chemical agent production was halted in 1968 and a moratorium on shipment declared in 1969, the final inventory of bulk agent VX was "trapped" on site.

Planning for a TNT (trinitrotoluene) plant began in 1968 when the Viet Nam conflict required new supplies of explosives for various shells and bombs. Construction of a five line production process began in 1970 and was completed. Only two of five production lines were ever operated. Only one production line was operated at a time. Production lasted one year, starting in 1973 and ending in 1974. The state-of-the-art facility was placed in lay-away status, pending future defense needs. Subsequently the Army began making plans for its disposal.

NECD is a government-owned, contractor-operated property. The U.S. Army Soldier and Biological Chemical Command, or SBCCOM, controls operation of the facility. A U.S. Army officer serves as Post Commander and Contracting Officer's Representative, assisted by a Civil Service staff of 10. A private company, Mason & Hanger - Silas Mason Company, Inc., is the operating contractor. Mason & Hanger provides security, fire protection, engineering, maintenance, operations, purchasing, inventory, chemical surety and administrative support for the installation with a staff of approximately 230.

Today, care, maintenance, and storage of the bulk agent VX continues as the primary mission at NECD. The chemical agent inventory at NECD consists of about 4 % , by weight, of the total U.S. chemical warfare agent stockpile. The NECD inventory consists of only agent VX in a non-explosive configuration — agent in bulk liquid form is contained in steel tanks (also known as ton containers). The preferred location of the proposed facility is west of and adjacent to Building 144 where the ton containers are stored (Fig. 2.1).

3.1.2 Facilities and Layout

The chemical agent storage area (Building 144), as well as the site of the proposed pilot plant, is located in the east central part of the NECD installation (see Fig. 2.1). Building 144 is approximately 0.8 km (0.5 mile) from the installation's eastern border; the site of the proposed pilot plant is approximately 0.3 km (0.2 mile) west of Building 144.

3.1.3 Existing On-Post Emergency Preparedness

Currently, NECD's emergency response capability for a chemical agent accident or incident is governed by the installation's Annex C [Chemical Accident and Incident Response and Assistance (CAIRA) plan to the NECD disaster control plan], which explains the policies, responsibilities, and procedures to control and minimize the effects of possible chemical accidents. It is reviewed annually and updated as required.

Trained personnel and equipment are readily available to respond rapidly to a chemical accident. Exercises are conducted at least quarterly to determine the effectiveness of accident response, and an annual federally evaluated exercise is conducted jointly with the affected off-post agencies.

3.2 METEOROLOGY, AIR QUALITY, AND NOISE

3.2.1 Climate and Meteorology

The climate around Newport is characterized by moderately cold winters and long summers. The nearest location for which temperature and precipitation records have been summarized is in Rockville, about 20 km (12 mi) southeast of NECD. Monthly average temperatures in Rockville range from -3°C (27°F) in January to 24.5°C (76°F) in July. Below-freezing temperatures occur during most nights of the three coldest months (December, January, and February) but temperatures below -18°C (0°F) occur on only 7 or 8 days in an average year. Summer temperatures reach 32°C (90°F) or higher on about 30 days during a typical summer, but temperatures of 38°C (100°F) are extremely rare.

January and February are the driest months, averaging about 6 cm (2.4 in.) per month. Precipitation is greatest during the growing season; June and July are the wettest months, averaging about 11.2 cm (4.4 in.) per month. Thunderstorms occur frequently during the summer months (on about one day in four during an average summer), but hail only occurs two to three times in an average year.

West-central Indiana lies within one of the most tornado-prone regions in the United States (Agee 1970, Grazulis, Schaefer and Abbey 1993, Schaefer et al. 1993). Hauer (1992) has summarized information from several data bases, in which Indiana was in the top 6 states in number of tornadoes, number of tornadoes per 100,000 mile*, and number of tornado-related fatalities.

Tornado probabilities are often expressed as the expected number of tornadoes per year in a 26,000 km^2 (10,000 $mile^2$) area. This area can be thought of as a circle of radius 91 km (56 mile). About 5 tornadoes per year occur within 91 km (56 mile) of Newport (Schaefer et al. 1993). For comparison, the expected tornado frequency per 26,000 km^2 (10,000 mile*) is about 9 per year in central Oklahoma and less than 1 per year in the mountainous western states and along the Pacific Coast (Schaefer et al. 1993).

Tornadoes occur in a wide range of sizes and strengths, which are typically classified into 6 categories ranging from 0 (least damage) to 5 (most damage). This classification is useful for identifying areas with relatively high probabilities of strong or unusually violent tornadoes (categories 2 through 5). One of the most likely parts of the United States to experience a tornado in category 2 or higher is north-central Indiana, not far northeast of Newport, where more than 2 such tornadoes are expected per 26,000 km^2 (10,000 mile*) per year (Schaefer et al., 1993).

Non-tornadic winds can also be particularly strong in central Indiana. Maximum sustained non-tomadic wind speeds for several cities in the United States have been published by the American Society of Civil Engineers (ASCE, 1990), for purposes of structural design. Central Indiana is represented by Indianapolis, for which the maximum sustained non-tornadic wind speed [42 m/s (93 mph)] is exceeded in only seven other cities, three of which are located in the Great Plains (Omaha, Nebraska; Fargo, North Dakota; and Abilene, Texas), and another three in coastal areas subject to hurricanes or other ocean storms (Cape Hatteras, North Carolina; Corpus Christi, Texas; and North Head, Washington).

Prevailing winds in the region around NECD are generally from the south and south-southwest. Annual average wind speed is about 4.5 m/s (10 mph), with monthly averages ranging from about 3.5 m/s (7.8 mph) during the summer months to about 5.5 m/s (12.3 mph) during the winter months. The wind rose for Cayuga, about 10 km (6 mi) north of NECD, is shown in Fig. 3.2. Cayuga is the nearest location for which thoroughly archived hourly wind data are available for periods of a year or longer. This station has been maintained by Public Service Indiana (PSI) since 1975. A tower supporting meteorological instruments exists in the northwestern part of NECD, and another is located near the current VX storage site. These towers were installed in the spring of 1991. Data obtained from these instruments are useful for real-time applications (e.g., emergency response).

3.2.2 Air Quality

National Ambient Air Quality Standards (NAAQS) exist for sulfur dioxide (SO,), nitrogen dioxide (NO,), ozone (O,), carbon monoxide (CO), lead (Pb), and two sizes of particulate matter: particles less than 10 micrometers (μm) in diameter, designated PM-10, and particles less than 2.5 μm in diameter, designated PM-2.5. The NAAQS are expressed as concentrations of these pollutants in the ambient air (i.e., in the outdoor air to which the general public has access [40 CFR 501(e)]). Primary NAAQS define levels of air quality which the Environmental Protection Agency (EPA) deems necessary, with an adequate margin of safety, to protect human health; secondary NAAQS are similarly designated to protect human welfare by safeguarding environmental resources (such as soils, water, plants, and animals) and manufactured materials. Primary and secondary NAAQS are presented in Table 3.1.

Indiana and Illinois have adopted the NAAQS as state standards. In addition, Indiana has retained the former (prior to July 31, 1987) NAAQS for total suspended particulate matter (TSP).

NECD lies within Vermillion County, Indiana, which is in attainment of all federal and state ambient air quality standards, except for 8 sections of Clinton Township [near a coal mine in the southern part of the county, about 24 km (15 mi) south of NECD] which are in moderate nonattainment for PM-10 (40 CFR 81.315). All other areas within 50 km (30 mi) of NECD are in attainment of all state and national ambient-air quality standards.

Table 3.2 provides a summary of recent air quality monitoring results for pollutants regulated by NAAQS or by state standards for ambient air quality for stations located nearest to NECD. Some standards for averaging periods of 24-hours or less (3-hour and 24-hour standards for SO,, l-hour and 8-hour standards for CO, and the 24-hour state primary standard for TSP) may be exceeded once per year, to allow for occasional anomalous values. Therefore, the second highest annual values are given in the table. Attainment of NAAQS for ozone and particulate matter is based on statistics derived-from three years of data, which tend to smooth out occasional anomalous values. The highest annual value for any three year period provides an upper-bound for the appropriate value to use for comparison with standards; therefore, the highest annual values are given in Table 3.2. As shown in Table 3.2, no ambient air standards were exceeded at the monitoring stations.

The nearest SO, monitor to NECD is in Fountain County, north of State Route 234 and slightly east of the PSI power plant, about 10 km (6 mi) north of NECD. The nearest

ORNL DWG 97KEB-128429

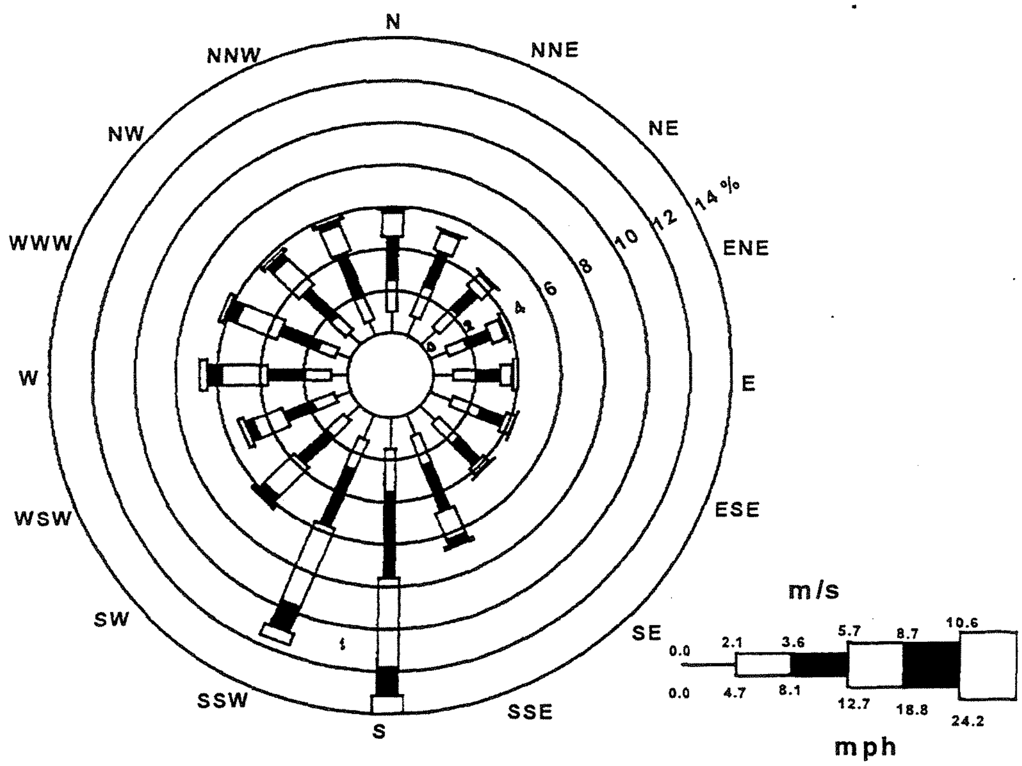

Fig. 3.2. Wind rose for Cayuga, Indiana for 1987-1991 (with 94.8% of possible data). The percentage of the time the wind is from each direction is plotted as a series of bar segments extending from the center of the diagram toward the direction *from* which the winds come. Wind-speed classes are represented by width and shading of the bar segments; the length of any segment indicates the percentage of all measurements for which the wind is from the indicated direction *and* ***also*** in the indicated wind-speed class. Winds were measured 60 m (200 ft) above ground level.

Table 3.1. Ambient Air Quality Standards

Pollutant	Averaging period	National Ambient Air Quality Standard’ Primary	National Ambient Air Quality Standard’ Secondary	Allowable Increment for Prevention of Significant Deterioration[a] Class I[b]	Allowable Increment for Prevention of Significant Deterioration[a] Class II[b]
Sulfur dioxide (SO,)	3-houf	—	***1300***	25	512
	24-houf	***365***		5	91
	annual	80	—	2	20
Nitrogen dioxide (NO_2)	annual	100	***100***	2.5	25
Ozone (0,)	1-hour[d]	235	235	—	—
	X-hour”	157	157		
Carbon monoxide (CO)	1-hour[c]	40,000	—	—	—
	8-hour[c]	10,000	—	—	—
Lead (Pb)	3-month[e]	1.5	1.5		—
PM-16	24-hour	150	150	8	30
	annual	50	50	4	17
PM-2.5[g]	24-hour	65	65		
	annual	15	15		
Additional Indiana Standard for Total Suspended Particulate Matter (TSP)					
TSP[h]	24-hour	260[c]	150[c]		
	annual	75’			

[a]All concentration are in units of micrograms per cubic meter.

‘Class I areas are specifically designated areas [e.g., national parks greater than 2,429 ha (6,000 acres) in area] in which the degradation of air quality is to be severely restricted; Class II areas (which include most of the United States) have a less stringent set of allowable increments.

“Not to be exceeded more than once per year, as per 40 CFR 50 and (for total suspended particulate matter) § 326 Indiana Administrative Code l-3-4.

[d]The current l-hour standard, not to be exceeded on more than 1 day per year on the average over 3 years as per 40 CFR 50, will be replaced, as early as year 2000 in some areas, by an 8-hour standard applicable to a 3-year average of the annual 4th-highest daily maximum 8-hour average concentrations *(Federal Register 62: 138,* Friday, July 18, 1997, page 38856 ff.).

‘Calendar quarter, the highest value for the four calendar quarters of each year is given.

[f]Particulate matter less than 10 micrometers in diameter.

“Particulate matter less than 2.5 micrometers in diameter. The annual standard applies to the average of the annual arithmetic means over a three-year period; the 24-hour standard applies to the average of the 98” percentile values of 24-hour average concentrations over a 3-year period. This standard became effective September 16, 1997 *(Federal Register* 62:138, Friday, July 18, 1997, page 38562 ff.); sufficient monitoring data are expected to be available for effective application of this standard in year 2001.

‘Total suspended particulate matter.

‘Geometric mean.

Table 3.2. Regional air quality monitoring data

Pollutant	Location	Averaging period	Year	Concentration ($\mu g/m^3$)[a]	Percent of standard
Sulfur dioxide (SO_2)	Fountain County	3-hour	1992	353[b]	27
			1993	460[b]	35
			1994	414[b]	32
			1995	487[b]	37
			1996	487[b]	37
		24-hour	1992	115[b]	32
			1993	207[b]	57
			1994	121[b]	33
			1995	128[b]	35
			1996	97[b]	27
		annual	1992	26	33
			1993	31	39
			1994	28	35
			1995	38	48
			1996	31	39
Nitrogen dioxide (NO_2)	Lafayette	annual	1992	21	21
	Lafayette		1993	21	21
	Indianapolis[c]		1994	36[c]	36
	Lafayette		1995	28	28
	Lafayette		1996	24	24
Ozone (0,)	Terre Haute	l-hour	1992	163	69
			1993	182	77
			1994	235	100
			1995	198	84
			1996	221	94
		8-hour[d]			
Carbon monoxide (CO)	Morgan County	l-hour	1992	1,725[b]	4
	Morgan County’		1993	1,380[b]	3
	Terre Haute		1994	5,520[b]	14
	Terre Haute		1995	5,175[b]	13
	Terre Haute		1996	5,060’	13
	Morgan County	8-hour	1992	1,265’	13
	Morgan County”		1993	1,150[b]	12
	Terre Haute		1994	3,450[b]	35
	Terre Haute		1995	3,335[b]	33
	Terre Haute		1996	2,990[b]	29

Table 3.2 (continued)

Pollutant	Location	Averaging period	Year	Concentration ($\mu g/m^3$)	Percent of standard
Lead (Pb)	Indianapolis I-70	3-month[f]	1992	0.26	17
				(0.03)'	(2)[f]
			1993	0.04	3
			1994	0.06	4
			1995	0.03	2
			1996	0.02	1
PM-10[g]	Vermillion county	24-hour	1992	84	56
			1993	67	45
			1994	61	41
			1995	64	43
			1996	57	38
		annual	1992	26	52
			1993	22	44
			1994	23	46
			1995	24	48
			1996	19	38
PM-2.5[h]		24-hour[h]			
		annual[h]			
TSP'		24-hour	1994	142[b]	55
			1995	142[b]	55
			1996	99[b]	38
		annual	1994	61	81
			1995	61	81
			1996	49	65

'Units are micrograms per cubic meter

[b]One exceedance per year is allowed; the 2nd highest value and its percentage of the corresponding standard are given. No NAAQS currently exist for TSP; percentages refer to the Indiana primary standard.

[c]Lafayette data were not available, this value was recorded at Indianapolis, which may at least partly explain why it is higher than values for the other years when Lafayette values were used.

'Data from year 1998 on will be used for determining compliance with the NAAQS.

Morgan County data stopped in 1994; the closest station is now Terre Haute which is a more urban area; therefore values are likely to be higher than at a rural monitor.

[f]Values given are the highest for any calendar quarter in a year. The high value for the third quarter of 1992 may have been due to activities involving metals near the-monitor (e.g., bridge repair, spillage of leaded material, or other type of accident). The values for the first and second quarters were 0.03 and 0.02, respectively, and the fourth quarter value was 0.02.

"Particulate matter less than 10 micrometers in diameter.

'Particulate matter less than 2.5 micrometers in diameter; the PM-2.5 standards are based on 3 years of monitoring data. Because a monitoring network has not yet been established, it is not expected that the required 3 years of data will be available until at least year 2001.

Table 3.2 (continued)

‘Total suspended particulate matter. This is an Indiana standard, however measurements are taken only in the southwestern and northeastern parts of the state. The nearest monitoring station is in Decatur, IL; the annual geometric mean during each of the last three years (1994-1996) is given. No exceedances of the primary standard for annual averages occurred. The secondary standard for 24-hour averages was exceeded once per year in 1994 and 1995, but one exceedance per year is allowed (§ 326 Indiana Administrative Code l-3-4); 2nd-highest values, given in parenthesis, were below the secondary standard for both years. The primary 24-hour standard was not exceeded during 1994- 1996).

monitoring for PM-10 is in Blanford, about 21 km (13 mi) south of NECD. Although TSP is regulated in Indiana, measurements are taken only in the southwestern and northeastern parts of the state. The nearest TSP monitoring station to Newport is about 130 km (80 mi) west, in Decatur, IL (although Illinois no longer has a TSP standard). The nearest monitoring for NO,, O_3, CO, and Pb is conducted in urban areas, where concentrations are likely to be higher than in the area around Newport. Concentrations of NO, are monitored in Lafayette, about 80 km (50 mi) northeast of NECD. Monitoring for 0, and CO is done in Terre Haute, about 45 km (28 mi) south of NECD. The nearest monitoring for Pb is near major roads around Indianapolis. Atmospheric concentrations of Pb have been declining in recent years, due largely to the reduced use of leaded gasoline.

In addition to ambient air quality standards, which represent an upper bound on allowable pollutant concentrations, there are national standards for the prevention of significant deterioration (PSD) of air quality (40 CFR 51.166). The PSD standards differ from the NAAQS in that the NAAQS specify maximum allowable *concentrations* of pollutants, while PSD requirements provide maximum allowable *increases in concentrations* of pollutants for areas already in compliance with the NAAQS. PSD standards are therefore expressed as allowable *increments* in the atmospheric concentrations of specific pollutants. Allowable PSD increments currently exist for three pollutants (NO,, SO,, and PM-10). PSD increments are particularly relevant when a major proposed action (involving a new source or a major modification to an existing source) may degrade air quality without exceeding the NAAQS, as would be the case, for example, in an area where the ambient air is very clean. One set of allowable increments exists for Class II areas, which cover most of the United States, and a much more stringent set of allowable increments exists for Class I areas, which are specifically designated areas where the degradation of ambient air quality is to be severely restricted. Class I areas include many national parks and monuments, wilderness areas, and other areas as specified in 40 CFR 5 1.166(e). Allowable PSD increments for Class I and Class II areas are given in Table 3.1.

The nearest Class I Prevention of Significant Deterioration (PSD) area, designated to greatly restrict the degradation of ambient air quality, is the Mammoth Cave National Park, Kentucky, located about 315 km (195 mi) south-southeast of the proposed facility.

3.2.3 Noise

The only impulse noise source at NECD is a firing range used to qualify plant security personnel in small arms use. The firing range is remotely located and is compatible with local land use patterns. The depot is in standby mode; noise sources such as open detonation could occur if, in a national emergency, NECD were to mobilize. The nearest residence is approximately 1.2 km (0.8 mi) east of the proposed facility site.

3.3 WATER RESOURCES

This section describes major surface water and groundwater resources located within 100 km (62 miles) of NECD which could be affected by overland flow of runoff and deposition from the atmosphere. Pathways are described along which contaminants could migrate if discharged into the hydrosphere, and water resources are identified that could be compromised by contaminants. Surface water pathways are determined by a consideration of topography, while groundwater pathways require an evaluation of geologic structure, lithology, stratigraphy, and geohydrologic conditions. Water quality, river and creek flow rates, well locations, groundwater consumption, and potential yield determine which water resources are important. Evaluation of the NECDF requires an identification of on-site and off-site pathways, and water resources that could be affected during upset conditions when accidental spills of VX and hydrolysate could occur.

3.3.1 Surface Water

3.3.1 .1 Flow and water quality

NECD is located within the drainage basin of the Wabash and Little Vermilion rivers (see Fig. 3.3). The Wabash River flows in a north-to-south direction along the eastern boundary of NECD, and ultimately receives all runoff leaving the installation. The southeasterly flowing Little Vermilion River originates in Illinois, drains the northern half of the installation, and empties into the Wabash River slightly east of Newport. The northwestern corner and north-central portions of NECD are drained by Jonathan and Little Verrnillion creeks, respectively, which are Little Vermilion River tributaries. Little Vermillion Creek also is known as Blake's Brook. Unnamed creeks drain the northeastern comer of NECD into the Little Vermilion and Wabash rivers. The four principal creeks that drain NECD are

1. Jonathan [with a 454.5ha (454.5-acre) drainage area and 0.6-m (2-ft) channel width];
2. Little Vermillion [1264.2-ha (3124-acre) drainage area, 0.9-2.4-m (3-8-e) channel width];
3. Buck [330.2-ha (816-acre) drainage area, 1.2-m (4-ft) channel width]; and
4. Little Raccoon [766. l-ha (1893-acre) drainage area and a well-incised channel-as much as 6.2 m (20 ft) into the subsurface].

The southeastern comer of NECD is drained by Little Raccoon Creek. The confluence of Little Raccoon Creek with the Wabash River occurs near Hillsdale, Ind., approximately 12 km (7.5 miles) south of Newport, Ind. The southwestern quadrant of NECD is drained by Buck Creek which is a Little Raccoon Creek tributary. Buck Creek at its headwaters also is known as Pheasant Creek. The site for the NECDF is located in the east-central part of NECD within the headwaters of the Little Raccoon Creek drainage basin (see Fig. 3.3). The headwater tributary of Little Raccoon Creek that drains the Royal Demolition Explosive (RDX) manufacturing area

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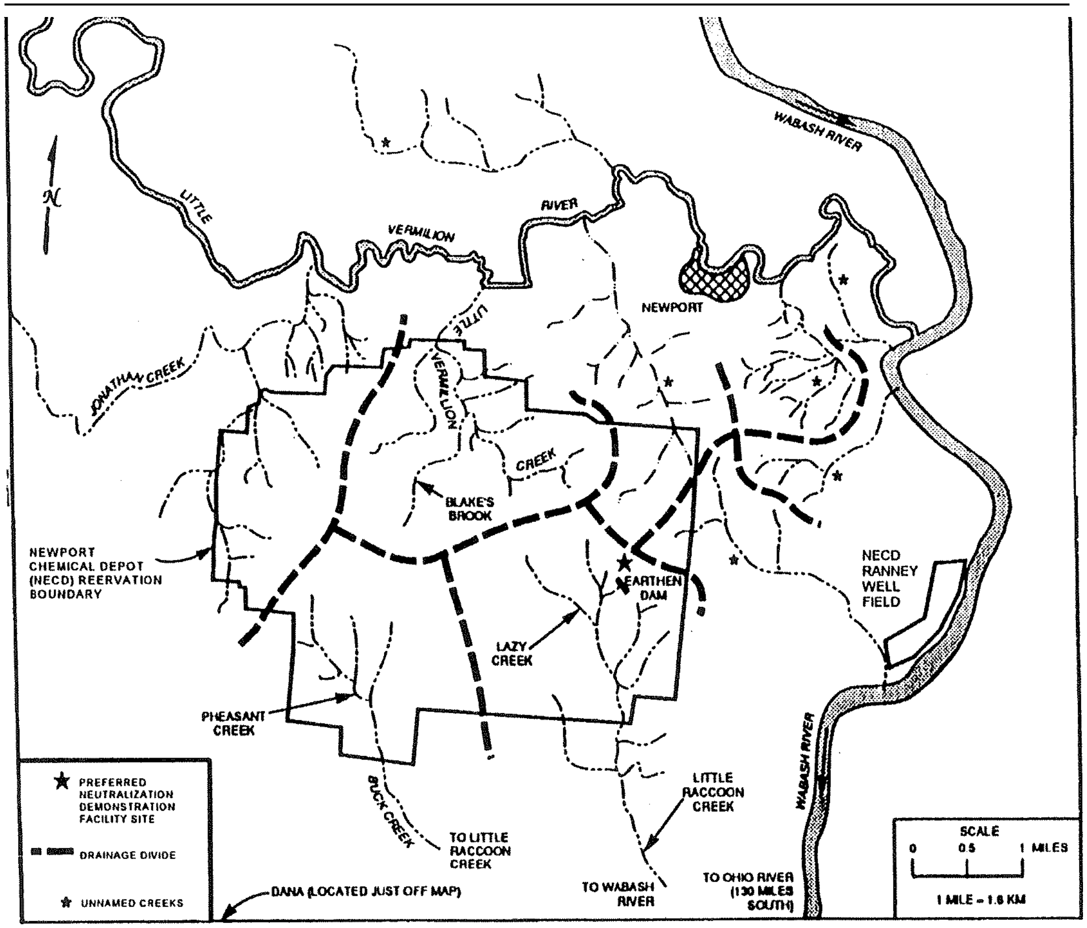

Fig. 3.3. Surface water drainage at Newport Chemical Depot.

is known as Lazy Creek. Water entering Little Raccoon Creek travels approximately 10 km (6 miles) to the Wabash River (U.S. Army 1988, Vol. 1, Sect. 4.3.4.4, p. 4-82).

The Wabash River flows southward along the eastern edge of Vermillion County, Ind., eventually emptying into the Ohio River at the extreme southwestern corner of the state. Spring and Jordan creeks, Coal and Dry branches, and the Vermilion River drain the northern part of the county north of NECD, while the Little Vermilion River drains the central part of the county where NECD is located. Little Raccoon, Norton, Feather, and Brouilletts creeks drain the southern portion of Vermillion County south of NECD into the Wabash River. Many of these watersheds originate in Illinois and flow in a southeasterly direction into the Wabash River.

The Wabash River serves as a hydrologic boundary between Vermillion County, and Parke and Fountain counties located to the east. Surface runoff leaving NECD would be carried southward and would not flow overland into Parke or Fountain counties. Coal Creek in Fountain County, and Sugar and Raccoon (also known as Big Raccoon) creeks in Parke County, flow in a southwesterly-to-westerly direction, intersecting the Wabash River in the vicinity of and across the river from NECD.

The 7-day, lo-year discharge (symbolized by $Q_{7,10}$) of the Wabash River due east of NECD (the location where the sewage treatment plant force main discharge occurs) is 34.3 m^3/s (1,210 ft^3/s) (IDEM 1997, p. 3 of briefing memo). The U.S. Geological Survey (USGS) operates a Wabash River gaging station (03340500) at Montezuma, Ind., immediately downstream at river km 386 (river mile 240) (USGS 1980, p. 120; also World Wide Web address http://water.usgs.gov/swr/?statnum=03340500). The average discharge for 52 years of record was 272 m^3/s (9,614 ft^3/s). The maximum flood discharge of 6,510 m^3/s (230,000 ft^3/s) occurred on March 27, 1913 (extreme outside of the period of record estimated from floodmarks), while the minimum daily flow recorded at the gage on September 24, 1941, was 16.2 m^3/s (571 ft^3/s). The flow of Little Raccoon Creek (particularly above its confluence with Buck Creek) is probably ephemeral.

Major bodies of water located within 100 km (62 miles) of NECD include Cecil Harden Lake (also known as Mansfield Reservoir) at Raccoon Lake State Recreation Area and east of Rockville, Ind. ; Lake Holiday southwest of Crawfordsville, Ind. ; Cataract Lake at Lieber State Recreation Area and southwest of Cloverdale, Ind.; Lake Vermilion at the northwest corner of Danville, Ill; Willow Slough west of Enos, Ind. (also see Table 3.3). Numerous farm ponds have been constructed for watering livestock in the agricultural region surrounding NECD.

No dams whose failure would impact activities at the proposed NECDF are located along the main stem of the Wabash River above NECD. Retarding basins are located on some tributaries in upper portions of the watershed (COE 1967, Sect. II, Fig. WA-l, p. 11-153). The basins provide partial control of the river during high flows and floods.

A small earthen dam [4.6 to 6.1 m (15 to 20 ft) in height] has been built in an uppermost tributary of Little Raccoon Creek near the chemical plant (see Fig. 3.3). A 61-cm- (24-in.-) diam. pipe serves as an overflow device for this-dam. The elevation of the top of the dam is approximately 190 m (625 ft) above mean sea level (amsl). The site for the NECDF is located upstream and above the top of the earthen dam. Dam failure would not affect the proposed NECDF. Only part of the drainage that runs off from Building 144 and the proposed NECDF would be intercepted and held up by the small earthen dam. The remaining portion of the runoff would flow overland into portions of Little Raccoon Creek that discharge below the dam.

Table 3.3 Major water bodies located within 100 km (62 miles) of Newport Chemical Depot

Indiana		Illinois	
Wabash River	Shirkie Mine Pond	Vermilion River[a,b]	Allen Lake
Vermilion River[a]	Green Valley Mine	Embarras River	Craig Lake
Eel River	Windemere Lake	Kaskaskia River	Sherwood Forest
Little Vermilion	Wanda Lake	Little Vermilion	Lincoln Trail Lake
Jonathan Creek[a]	Muscrat Pond	Jonathan Creek’	Newmans Lake
Brouilletts Creek[a]	Long Pond	Brouilletts Creek[a]	Martin Tarbell Lake
Little Raccoon	Turtle Creek	Coal Branch[a]	Lake Charleston
Little Vermillion	Greenfield Bayou	Lake Vermilion	Twin Lakes
Buck Creek	Hulmans Lake	Lake Oakland	Walnut Point Lake
Spring Creek	North Lake	Homer Lake	Iroquois River’
Jordan Creek	South Lake	Lake Mingo	
Dry Branch	Otter Creek	Windfall Lake	
Feather Creek	Thompson Ditch	Doughnut Pond	
Norton Creek	Lost Creek	Bayless Lake	
Coal Branch[a]	Little Lost Creek	Lake Iroquois	
Sugar Creek	Cecil Harden Lake’	Wesville Lake	
Cataract Lake	Raccoon Creek’	Athey Lake	
Lake Holiday	Coal Creek	Ridgeway Lake	
Lake Vermillion	Iroquois River”	Burcham Pond	
Horseshoe Lakes	Willow Slough	Newlin Lake	

‘These rivers and creeks flow from Illinois into Indiana.

“Two Vermilion Rivers originate in 111.: (1) a northwesterly flowing Illinois River tributary: and (2) a southeasterly flowing Wabash River tributary that enters Ind., and which is listed above in this table. The North and South Forks of the Vermilion River are Illinois River tributaries which are located at the edge of the 100 km (62 miles) impact zone (in Ill.).

[c]Also known as Mansfield Reservoir.

[d]Also known as Big Racoon Creek.

[e]The Iroquois River originates in Ind. And flows westerly into 111. Where it empties into the Kankakee River. The Kankakee River, in turn, discharges into the Illinois River which is a Mississippi River tributary.

Sources: DeLorme Mapping, *Illinois Atlas & Gazetteer*, First Ed., P. 0. Box 298, Freeport, Maine, 1991; Rand McNally & Co., *Rand McNally Road Atlas United States . Canada · Mexico*, 10 East 53rd St., New York, NY, 1987; U.S. Department of Agriculture (USDA), *Soil Survey of Vermillion County, Indiana*, Soil Conservation Service in cooperation with Purdue University Agricultural Experiment Station, 1978; F. A. Watkins, Jr., and D. G. Jordan, *Ground-Water Resources of West-Central Indiana, Preliminary Report: Vermillion County*, Bulletin No. 29 of the Division of Water Resources, prepared by the Geological Survey, U.S. Department of the Interior, in cooperation with the Division of Water Resources, Ind. Department of Conservation, Indianapolis, Ind., 196.5; Rand McNally & Co., *Indiana Road Map*, 10 East 53rd St., New York, NY, 1988; and, State of Illinois, *Illinois Official Highway Map 1989-90*, Department of Transportation, Springfield, Ill., 1989.

The highly turbid, very hard, slightly alkaline water of the Wabash River has been degraded by industrial, municipal, and agricultural wastewater discharges. Water quality in the river varies from moderately to heavily polluted (U.S. Army 1980). Fertilizers, pesticides, septic tank seepage, raw sewage, and soil runoff contribute to Wabash River water quality problems.

The water quality of the creeks that drain NECD is described as very hard and slightly polluted (U.S. Army 1980). Agricultural activities and the manufacture of explosives have contributed to wastewaters entering Little Vermillion, Buck, and Little Raccoon creeks. Water quality degradation in Jonathan Creek attributable to NECD industrial activities has been minimal, although agricultural runoff continues to affect the creek.

Water quality in Little Raccoon Creek has historically been degraded by discharges from the sewage treatment plant and power plant (refer to Sect. 3.3.1.3 for additional discussion); wastewaters generated during the production of heavy water, explosives, and nerve agent VX; and seepage and runoff from facilities that are no longer operational (U.S. Army 1980; USATHAMA 1991, Ch. 7). Since 1973 industrial and sanitary wastes have been discharged to the wastewater treatment plant for treatment prior to discharge to the Wabash River.

In the past, sanitary and industrial wastes were discharged into Little Raccoon Creek from the sewage treatment plant. The discharge of wastewaters from the TNT production facilities at this outfall resulted in elevated levels of nitrates and sodium. Secondary water treatment facilities have been installed at the sewage treatment plant and the TNT production facilities are no longer operational. Storm drains and cooling water from the chemical plant were also discharged directly into Little Raccoon Creek until the early 1970s. Wastewaters from heavy water (e.g., water enriched in deuterium) production during operation of the chemical plant from 1943-46 and 1952-57 were discharged into the creek. Retention basins 30007, 30008, and 30009 are located south of the chemical agent VX storage area. Coal ash was sluiced from the RDX powerhouse to basin 3009 in the 1940s. Water conditioning regeneration acids were pumped from the 103 powerhouse to this basin in the 1940s and 1950s. During production of heavy water all three basins received wastewater generated during the production process. During production of VX, water from all boiler drains and cooling water from the heat exchangers was pumped to these basins, which were used in series for monitoring prior to discharge into Little Raccoon Creek. These retention basins were not used to process industrial wastes from the manufacture of chemical agent VX.

Runoff from the dismantled chemical plant flows overland into Little Raccoon Creek. In addition, discharges into Little Raccoon Creek from the power plant historically included boiler blowdown, compressor cooling water, wastewaters resulting from the regeneration of zeolite water softeners, rinse waters, and possibly coal pile runoff. Wastewaters from the RDX manufacturing area were discharged into Little Raccoon Creek. Production of RDX has ceased. Runoff from the defunct RDX manufacturing area flows overland into Little Raccoon Creek. Potentially contaminated groundwater seeps from the chemical plant area, decontaminated waste burial ground, and closed sanitary landfill and discharges as baseflow into Little Raccoon Creek. Water quality measurements in Little Raccoon Creek confirm the presence of the volatile organics 1,2-dichloroethene and trichloroethene; the base-neutral and acid extractable organic 1,2-dichlorobenzene; 11 metals (aluminum, barium, calcium, iron, lead, magnesium, manganese, mercury, potassium, sodium, and zinc); 3 explosives (RDX, HMX, and 2,6-dinitrotoluene); total phosphorous; and 2 unidentified compounds.

Sediment sampling along Little Raccoon Creek has detected the volatile organics acetone, 1,2-dichloroethene, and trichloroethene; 1.5 base-neutral and acid extractable compounds (14 polynuclear aromatics containing two or more fused aromatics and 1,2,4-trichlorobenzene); 13 metals (aluminum, antimony, arsenic, barium, calcium, iron, lead, magnesium, manganese, mercury, potassium, sodium, and zinc); total phosphorous; 8 compounds which have been tentatively identified; and 37 unidentified compounds (USATHAMA 1991, Ch. 7). No explosives, pesticides, nerve agent VX, VX degradation products, or polychlorinated biphenyls were detected in these sediment samples.

No surface waters that flow across the NECD reservation are used as industrial, sanitary, or drinking water supplies (U.S. Army 1980). Surface-water withdrawals account for 90 % of the water consumption in Vermillion County (Crompton and Graves 1990).

Twenty-nine public surface water supply intakes have been identified downstream from NECD (EPA 1982, U.S. Army 1988, Vol. 1, Sect. 3.2.4.4, p. 3-64). None of these intakes are located along the Little Vermilion River or Little Raccoon Creek. These 29 public water supplies include 2 on the Wabash River, 5 on the Ohio River, and 22 on the Mississippi River. Terre Haute, Ind., and Mount Carmel, Ill., utilize the Wabash River as a source of drinking water 43.5 km (27 miles) and 151 km (94 miles) downstream from NECD, respectively.

3.3.1.2 Floodplain, flooding, and drought

Floodplain. The proposed site for the NECDF is located on an upland till plain (see Sect. 3.3.2.1) which has been deeply dissected by the Wabash River. The surface of the till plain is well above the FEMA 100-year floodplain of the Wabash River (U.S. Army 1992a, pp. B-3-3 to B-3-4). The only areas in the vicinity of NECD that have experienced Wabash River flooding are bottomlands located adjacent to the Wabash River (U.S. Army 1981).

Special flood hazard areas have been designated along Jonathon, Little Vermillion, and Little Racoon creeks (HUD 1978). All of these areas are located off-site from NECD, are relatively distant from the proposed NECDF site, and would be susceptible to flooding associated with the Wabash River backwaters. No jurisdictional (i.e., agency regulated) floodplains or special flood hazard areas have been identified that involve on-site surface waters that drain NECD.

Little Raccoon Creek is incised as much as 6.2 m (20 ft) below the surrounding ground surface at NECD (USATHAMA 1991, p. 7-5). The area surrounding the creek is covered with foliage and trees. Flooding and scouring have occurred along Little Raccoon Creek during periods of intense rainfall and the spring thaw (U.S. Army 1980). The proposed NECDF site is located within the headwaters of and upstream from Little Raccoon Creek. The NECDF would not be threatened by flooding that could occur along Little Raccoon Creek.

No natural or man-made drainageways would concentrate and direct runoff from other areas.at NECD through the proposed NECDF site (U.S. Army 1992a, pp. B-3-3 to B-3-4). A new engineered ditch would route storm water-received to the north and west of the proposed pilot plant to a discharge point into Little Racoon Creek located immediately below a planned storm water detention basin.

Flooding. The intense rains of May 1943 caused flooding along the Kaskaskia, Embarras, Sangamon, Vermilion, White, and Wabash rivers in central Illinois and Indiana (Glatfelter, Newman, Mann, and Beik 1991; Zuehls and Wendland 1991). Streamflows recorded at many gaging stations in these watersheds remain as the maximum of record, while flood recurrence intervals ranged from 5 to more than 100 years. The May 1943 flood ranks as the greatest crop-season flood since 1875. Levees failed along the Wabash River. Damage estimates totaled 54 million dollars in Indiana and Illinois. Most of the damage caused by the 1943 flood was confined to bottomlands.

Drought. Droughts have occurred in Indiana and Illinois during every decade from 1920 to 1980 (Glatfelter, Newman, Mann, and Beik 1991; Zuehls and Wendland 1991). Three droughts were severe enough to be statewide throughout both states: 1930-36, 1952-57, and 1962-67. The 1952-57 drought was the most severe in Illinois, while the most severe Indiana drought occurred 1962-67. A 1954 northern Indiana flood partially mitigated the 1952-57 drought. Public water supplies, electric power generating stations, and farmers were affected directly by these droughts.

3.3.1.3 Effluent discharges

NECD effluent discharges are regulated by limits specified in National Pollutant Discharge Elimination System (NPDES) permit IN 0003506 (USATHAMA 1991; IDEM 1997). Two discharge outfalls are located at (1) the sewage treatment plant (i.e., FOTW) (outfall 001); and (2) at the discharge from the pollution control center retention basin (outfall 101) that receives supernatant from both the red water ash basins and gypsum sludge basins. A 33-cm- (13-in.-) diam. force main (i.e., a pipeline) conveys the discharge from outfalls 001 and 101 into the Wabash River near km 391 (mile 243).

The NPDES permit specifies treated effluent limitations at sewage treatment plant outfall 001 for 5-day biological oxygen demand, total suspended solids, and total residual chlorine. Proposed changes of water treatment additives (which require an evaluation for potential toxicity) used in the NECD boiler and cooling tower also are reported. FOTW outfall 001 water samples are taken upstream from and prior to mixing with the discharge from outfall 101. The sewage treatment plant receives sanitary wastes, cooling tower blowdown, boiler blowdown, and is proposed to receive chlorinated rinse water from protective equipment worn by personnel to inspect the agent VX stockpile.

NPDES effluent limitations are specified for the pollution control center retention basin outfall 101 for total suspended solids, total dissolved solids, total nitrobodies, and pH. The concentration of total nitrobodies includes the summation of the several mono-, di-, and tri-isomers of nitrotoluene plus the explosives RDX and HMX. Outfall 101 water samples are obtained downstream from outfall 001 and after the effluents from outfalls 00 1 and 101 have mixed in the force main.

The sewage treatment plant has an emergency overflow outfall that discharges into Little Raccoon Creek. An overflow of treated effluent would occur only when electrical power was lost to the pump that sends effluent through the force main into the Wabash River. The backup generator for this pump also would have to fail before overflow would occur. The overflow outfall is subject to the same effluent limitations-that regulate the discharge from outfall 001. The emergency overflow outfall is located below the small earthen dam built in the uppermost tributary of Little Raccoon Creek near the chemical plant. The overflow outfall is subject to the same effluent limitations that regulate the discharge from the force main into the Wabash River.

NECD outfalls 002 and 003 discharge storm water runoff into Little Vermillion and Little Raccoon creeks, respectively. Outfall 002 receives runoff from the TNT and acid manufacturing area as well as the tank farm, while drainage from the old chemical weapons plant and shops area flows overland to outfall 003.

The TNT burning ground is located in the headwaters of Buck Creek which is a major Little Raccoon Creek tributary (see Figs. 3.1 and 3.3). Storm water runoff from the TNT burning ground flows overland into Buck Creek at outfall 004. The NPDES permit specifies effluent limitations at outfall 004 for total suspended solids, pH, and total nitrobodies.

In accordance with Sect. 402(p) of the Clean Water Act, EPA requires that storm water discharges associated with industrial activity comply with limits specified in a NPDES storm water permit [40 CFR Part 122.26(a)(1)(ii)]. If required, an NPDES permit application would be submitted to the Indiana Department of Environmental Management for the discharge of storm water from the proposed NECDF (U.S. Army 1992b, p. F-4-3).

The capacity of the existing NECD sewage treatment plant (i.e., the FOTW) was designed to accommodate the sanitary waste produced by 2,000 people (USATHAMA 1991, p. 7-3). Most NECD production processes are no longer operational. The number of employees working on-site has been reduced to approximately 300. The existing work force is too small to maintain the biological activity required by the activated sludge to digest the organic wastes. At these decreased throughputs, the sewage plant only can reduce suspended solids and provide chlorination of the wastewater effluent. Violations of the NPDES limits have occurred at NECD, and are attributed primarily to the insufficient flow of sanitary waste passing through the sewage treatment plant.

3.3.2 Geohydrology

3.3.2.1 Physiography and topography

NECD is located in the Till Plains section of the Central Lowland physiographic province (Blume 1987, p. 32). The relatively flat, upland, glacial till plain on which NECD resides is known as the Tipton Till Plain (Schneider 1966).

The till plain has been dissected by the Wabash River and its tributaries (see Fig. 3.4). An east-to-west trending surface water divide separates the southerly Little Raccoon Creek and northerly Little Vermilion River watersheds. Little Raccoon Creek exhibits broad shallow valleys relative to the steeper channel slopes of the Little Vermilion River. The western part of the NECD reservation is slightly depressional relative to the nearly level uplands to the east (USATHAMA 1991, p. 2-6).

Bottomlands adjacent to the Wabash River are separated from the till plain by a 15 to 30 m (50 to 100 ft) escarpment (U.S. Army 1988, Vol. 1, Sect. 3.2.4.4, p. 3-64). Elevations at the top of the escarpment and which includes the eastern part of NECD vary from 195 to 198 m (640 to 650 ft) amsl. Land elevations on the western part of the NECD reservation are lower and range from 189 to 192 m (620 to 630 ft) amsl. Elevations at the preferred site for the NECDF on the west side of and adjacent to existing Building 144 range from 193.5 to 195 m (635 to 640 ft) amsl (U.S. Army 1992a, Fig. B-3, p. B-9; USATHAMA 1991, Fig. A-4, p. A-21).

The bottomlands along the Wabash River are much lower at an approximate elevation of 143 m (470 ft) amsl. The NECD well field (groundwater supply) (see Sect. 3.3.2.4) is located in the Wabash River valley.

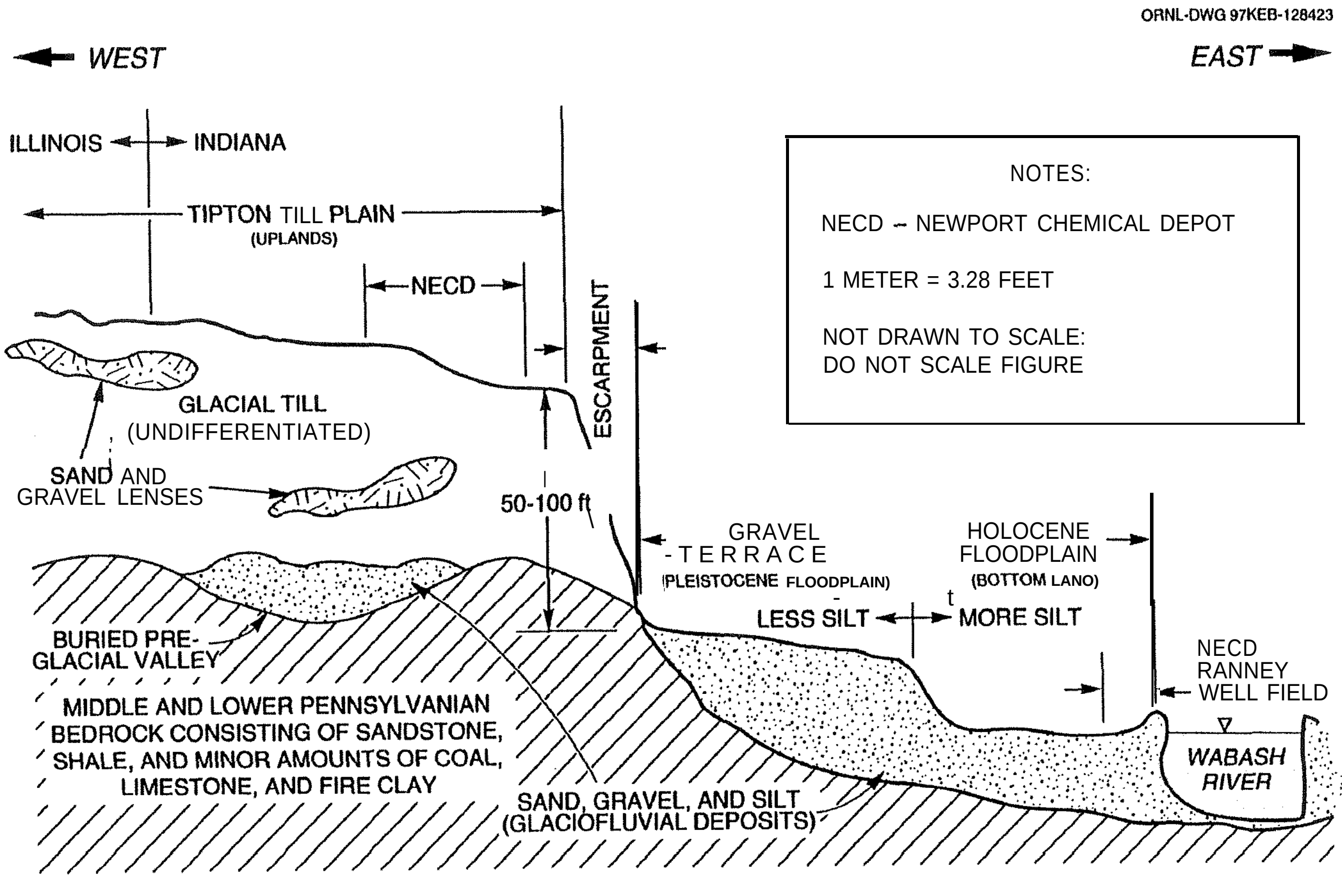

Fig. 3.4. Geologic cross section beneath Newport Chemical Depot.

3.3.2.2 Geology

The portion of the north-central U.S. in which NECD is located was covered completely and repetitively by glacial ice sheets during the Pleistocene Epoch between 10,000 and 2 million years ago (Flint 1957, Ch. 20). Surficial strata and topography have been strongly influenced by erosion and deposition that occurred during the late Wisconsin glacial stage and the current interglacial stage. Most of NECD, including the proposed site for the NECDF, is underlain by glacial till (see Table 3.4). Beneath the Wisconsin deposits, older glacial tills overlie much older Pennsylvanian bedrock that consists of alternating beds of shale, sandstone, limestone, clay, and coal. The presence of Illinoisan (Gray, Bleuer, Hill, and Lineback 1979; Blume 1987) and even older Kansan (USAEHA 1975; USATHAMA 1991) age tills has been reported.

The stratigraphic column for NECD and the proposed NECDF site is described in Table 3.4 and portrayed schematically in Fig. 3.4. The surficial layer of glacial drift (i.e., all materials deposited as a result of glacial activity) has a thickness of 25 m (82 ft). The drift is primarily till and consists of a poorly-sorted mixture of sand (15 % to 34%), silt (38% to 47%), and clay (25% to 38%) with some gravel, cobbles, and boulders (USATHAMA 1991, Table 2-1, p. 2-9).

The clay-mineral composition of the till is predominantly illite (64% to 83%). The cation exchange capacity (CEC) of illite is moderate, lying between the CEC of montmorillonite (higher) and kaolinite (lower) (Brady 1974, Table 4:3, p. 81). While the percentage of clay-sized particles is sufficient to provide for adsorption, the presence of illite, rather than montmoriilonite, limits the total cation exchange that could occur.

Glacial outwash consisting of well-sorted sand and gravel deposits has filled buried valleys where pre-glacial streams eroded into the underlying bedrock surface. The outwash deposits are buried below glacial drift such that surface expression of the buried valleys is minimal. Smaller bodies (i.e., lenses) of sand and gravel outwash deposits lie within the till. The lenses are surrounded and almost always covered by till.

The Wabash River valley east of NECD contains a mixture of glacial outwash, Pleistocene terrace deposits, and Holocene alluvium which collectively are referred to as glaciofluvial deposits.

3.3.2.3 Soils

Undisturbed soils at the proposed NECDF site belong to the Reesville-Ragsdale-Fincastle association (USDA 1978). These deep, nearly level, somewhat poorly drained to very poorly drained soils have formed in the loess (wind-blown dust) and loamy glacial till. These soils grade into the Sable-Flanagan association on the western portion of the NECD installation. These two soil associations are plagued by ponding during the winter and spring rains. Wetness presents such a severe limitation that the potential for residential and urban use is poor, although the potential for woodland development is fair. Drainage may be improved by placement of ditches and agricultural drain tile.

Well drained soils belonging to the Hennepin-Miami association have formed south of the proposed NECDF site along Little Raccoon Creek (USDA 1978). The slope of the loamy

Table 3.4. Stratigraphic column for Newport Chemical Depot

ORNL-DWG 97KEB-12842 4R

PERIOD	EPOCH	GLACIAL STAGE OR ROCK UNIT	THICKNESS[1] (m)	AGE[2,3]	LITHOLOGY	WATER-BEARING PROPERTIES[4,5]
QUATERNARY	HOLOCENE	GRAVEL, SAND, AND SILT	THIN	RECENT	FLOODPLAIN SEDIMENTS AND WINDBLOWN SAND	NOT IMPORTANT AS A WATER SUPPLY AT NAAP
	PLEISTOCENE (UNDIFFERENTIATED AT NAAP)	WISCONSIN	25	0.01 TO 0.07	GLACIAL TILL WITH DISCONTINUOUS LENSES OF SAND AND GRAVEL OUTWASH DEPOSITS. FLUVIAL AND GLACIO-FLUVIAL SAND AND GRAVEL DEPOSITS WHERE PRE-GLACIAL STREAMS HAVE ERODED VALLEYS IN BEDROCK SURFACE.	SMALL LOCALIZED WATER SUPPLIES OBTAINED FROM SAND AND GRAVEL LENSES; 10 TO 50 GALLON PER MINUTE. YIELDS AS HIGH AS 1200 GALLONS PER MINUTE FROM PRE-GLACIAL VALLEYS AND ALONG WABASH RIVER. GLACIAL TILL DOES NOT YIELD SIGNIFICANT QUANTITIES OF GROUNDWATER.
		SANGAMON		0.07 TO 2	INTER-GLACIAL SOIL HORIZON (UNRECOGNIZED AT NAAP)	
		ILLINOIAN AND OLDER			GLACIAL TILL WITH DISCONTINUOUS LENSES OF SAND AND GRAVEL OUTWASH DEPOSITS. FLUVIAL AND GLACIO-FLUVIAL SAND AND GRAVEL DEPOSITS WHERE PRE-GLACIAL STREAMS HAVE ERODED VALLEYS IN BEDROCK SURFACE.	SMALL LOCALIZED WATER SUPPLIES OBTAINED FROM SAND AND GRAVEL LENSES; 10 TO 50 GALLON PER MINUTE. YIELDS AS HIGH AS 1200 GALLONS PER MINUTE FROM PRE-GLACIAL VALLEYS AND ALONG WABASH RIVER. GLACIAL TILL DOES NOT YIELD SIGNIFICANT QUANTITIES OF GROUNDWATER.
	UNCERTAIN	UNDIFFERENTIATED		290 TO ~330	NO DEPOSITS AT NECD	
PENNSYLVANIAN	UPPER					
	MIDDLE (UNCERTAIN)	CARBONDALE GROUP	50		SHALE WITH ALTERNATING BEDS OF SANDSTONE, LIMESTONE, AND COAL	MAJOR GROUNDWATER SOURCE FOR DOMESTIC AND STOCK SUPPLIES. YIELDS RANGE FROM 1 TO 75 GALLONS PER MINUTE WITH SOME DRY HOLES REPORTED.
	LOWER	RACCOON CREEK GROUP				
MISSISSIPPIAN	UPPER	UNDIFFERENTIATED		~330 TO 360	NO DEPOSITS AT NECD	
	MIDDLE (UNCERTAIN)	SAINT LOUIS LIMESTONE	45 TO 60		FINE-GRAINED, DENSE, HARD, AND CHERTY LIMESTONE	NOT IMPORTANT AS A WATER SUPPLY AT NECD
		SALEM LIMESTONE			POROUS, SOFT, AND MASSIVE LIMESTONE	
		HARRODSBURG LIMESTONE			MASSIVE LIMESTONE IN UPPER PORTION. THIN BEDDED LIMESTONE IN LOWER PORTION	
		BORDON GROUP	200		SILTSTONE, SHALE AND MINOR AMOUNTS OF SANDSTONE. SOME LIMESTONE IN UPPER PORTION	
	LOWER	ROCKFORD LIMESTONE			DOLOMITIC LIMESTONE	
		NEW ALBANY SHALE			BLACK, FRIABLE SHALE HAVING A THICKNESS OF 25 m	
DEVONIAN		NORTH VERNON LIMESTONE	50	300 TO 410	MEDIUM TO COARSE GRAINED LIMESTONE	NOT IMPORTANT AS A WATER SUPPLY AT NECD
		JEFFERSONVILLE LIMESTONE			FINE TO MEDIUM GRAINED, DOLOMITIC, AND CHERTY LIMESTONE	
		GENEVA DOLOMITE			VUGGY DOLOMITE	
SILURIAN		UNDIFFERENTIATED	160	410 TO 435	VUGGY, FINE- TO MEDIUM-GRAINED, DOLOMITIC LIMESTONE THAT GRADES DOWNWARD INTO MEDIUM-GRAINED, VERY CHERTY LIMESTONE	NOT IMPORTANT AS A WATER SUPPLY AT NECD

NOTES:

1 3.20 FEET = 1 METER

2 EXPRESSED IN MILLIONS OF YEARS BEFORE PRESENT

3 THE TIME INTERVALS OR UNCONFORMITIES BETWEEN THE END OF THE ILLINOIAN GLACIAL STAGE AND THE BEGINNING OF THE UPPER PENNSYLVANIAN PERIOD, AS WELL AS THE END OF THE LOWER PENNSYLVANIAN PERIOD AND THE BEGINNING OF THE UPPER MISSISSIPPIAN PERIOD. ARE PERIODS OF EROSION OR NONDEPOSITION

4 264 GALLONS = 1000 LITERS

5 NECD-NEWPORT CHEMICAL DEPOT

SOURCES:

F.A. WATKINS, JR., AND D.G. JORDAN. 1965. *GROUND-WATER* RESOURCES *OF WEST-CENTRAL INDIANA PRELIMINARY REPORT: VERMILLION COUNTY.* BULLETIN NO, 29 OF THE DIVISION OF WATER RESOURCES. PREPARED BY THE U.S. GEOLOGICAL SURVEY, DEPARTMENT OF WATER RESOURCES. INDIANA DEPARTMENT OF CONSERVATION, BLOOMINGTON,INDIANA;

JACOBS ENGINEERING GROUP. 1987. *GEOLOGICAL-SEISMOLOGICAL INVESTIGATION OF EARTHQUAKE HAZARDS FOR A CHEMICAL STOCKPILE FACILITY AT THE NEWPORT ARMY AMMUNITION PLANT, INDIANA.* 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, OCTOBER:

INDIANA DEPARTMENT OF NATURAL RESOURCES (IDONR). UNDATED. *GENERALIZED GROUND-WATER AVAILABILITY IN* INDIANA. INFORMATION SHEET WIT" COLOR MAP COURTESY OF THE GOVERNOR'S WATER RESOURCE STUDY COMMISSION AS PREPARED BY THE IDONR, DIVISION OF WATER: AND

H.H. GRAY, N.K. BLEUER, J.R. HILL, AND J.A. LINEBACK 1070. *GEOLOGICAL WPOF THE 1° x 2° INDIANAPOLIS QUADRANGLE, INDIANA AN0 ILLINOIS, SHOWING BEDROCK ANDUNCONSOLIDATED DEPOSITS,* REGIONAL GEOLOGIC MAP NO. 1, INDIANAPOLIS SHEET. INDIANA GEOLOGICAL SURVEY, DEPARTMENT OF NATURAL RESOURCES.

glacial till near the creek varies from moderate to very steep. Excessive slope limits the potential for residential and urban development. The potential for woodland development is good.

NECD is located in an area that previously was used to grow crops. The use of agricultural drain tile by former landowners may have been extensive. All dram tile at NECD would have been installed before the U.S. Department of Agriculture's Soil Conservation Service was established; hence, complete records of drain tile installation are not available. Damaged drain tile segments may have remained partly intact at the proposed site for the NECDF. These segments would be removed before construction of the facility, or replaced to prevent future ponding. Excessive ponding would be undesirable during operation of the NECDF. In the unlikely event of an accidental spill onto the ground, unremoved drain tile segments at unknown locations could promote drainage of contaminants to nearby surface waters before cleanup could take place.

3.324 Groundwater

Aquifers and Groundwater Hydrology. Vermillion County, which includes NECD, has three principal aquifers which store and transmit relatively large, sustained quantities of groundwater: (1) glaciofluvial deposits along the Wabash River; (2) bedrock valleys eroded by pre-glacial streams that have since been partially filled with glaciofluvial deposits and subsequently buried by glacial till; and (3) sandstone within the Pennsylvanian bedrock. Sand and gravel lenses that lie within the glacial till are not viable municipal or industrial sources of groundwater, but are important in terms of the relatively large number of low-yield, privately-owned wells located near NECD. The water-bearing properties of these aquifers and water-bearing strata are summarized in Table 3.4. Groundwater accounts for 10% of the total water consumption in Vermillion County (Crompton and Graves 1990) and 100% of the consumption at NECD.

The glaciofluvial deposits along the Wabash River are capable of sustaining groundwater yields sufficient for large industrial and municipal supplies. The Ranney well field that supplies all water to NECD is located in these bottomlands adjacent to the Wabash River. Each Ranney well or collector consists of a central caisson installed vertically in the glaciofluvial deposits. Screens are driven radially outward from the caisson into the aquifer to promote the seepage of groundwater into the caisson. A vertical turbine pump moves the groundwater from the caisson to the distribution system. Large, sustained yields are achievable using Ranney wells. Groundwater is readily available from the glaciofluvial aquifer to meet the demand of the NECDF.

The water table of this unconfined, glaciofluvial aquifer is located from 1.5 to 7.3 m (5 to 24 ft) below the ground surface. The flow of groundwater is strongly coupled to the water level of the Wabash River. The water table responds within hours to changes in river stage. The river recharges the aquifer when the river stage is high, and groundwater from the aquifer enters the river when the stage is low. Near the Ranney well field, the large pumping rates induce river water to flow through the ground to the wells. The induced infiltration ensures that relatively large pumping rates can be maintained (except possibly during a prolonged drought).

The water-bearing sand and gravel deposited in buried, pre-glacial stream valleys also can sustain large yields of groundwater adequate for industrial and municipal supplies. Aquifers within three buried bedrock valleys in the vicinity of NECD have potentially high yields

(Watkins and Jordan 1965; Boneham 1980; Kempton et al. 1981). The Danville Valley extends westward from Shades State Park to Perrysville, Ind., where it turns northward toward Danville, Ill. The southwesterly-trending Montclair Valley passes through the southeastern corner of Vermillion County, Ind. The Mahomet Valley aquifer is located in northern Vermilion County, Ill., and is a candidate for expansion of the Danville, Ill., municipal water supply.

Recharge is provided to the buried-valley aquifers where creeks and rivers have eroded through the relatively thick, overlying glacial till. Portions of the buried Montclair Valley are traversed by the existing valleys of Little Raccoon and Brouilletts creeks, and the Wabash River (Watkins and Jordan 1965, p. 6).

The glacial till is not a significant water-bearing formation. However, irregularly-shaped sand and gravel lenses that could be located anywhere in the formation can serve as local aquifers. While some of these lenses may be extensive [as much as 9 m (30 ft) wide, 1 m (3 ft) thick, and 5 or 6 km (3 or 4 miles) long (Watkins and Jordan 1965)], large sustained yields usually cannot be maintained indefinitely without causing excessive water table declination and a corresponding degradation in groundwater quality.

The hydraulic conductivity of undisturbed glacial till at NECD is low, ranging from $1.77(10^{-8})$ to $3.63(10^{-7})$ cm/s [$5.81(10^{-10})$ to $1.19(10^{-8})$ ft/s] (USATHAMA 1991, p. 2-26). The presence of the glacial till limits seepage of water into the ground, inhibits hydraulic connection between sand and gravel lenses, and promotes runoff into nearby creeks.

The relatively high percentage of clay-sized particles in the glacial till moderately (see Sect. 3.3.2.2) retards the movement of solutes dissolved in the groundwater. Adsorption of dissolved species onto the soil matrix removes solutes from the liquid phase, reduces downgradient plume concentrations, and slows the movement of the contaminant front (Freeze and Cherry 1979, pp. 402-408).

The measured water table in the glacial till is displayed in Fig. 3.5 (USATHAMA 1991, Fig. 2-5, p. 2-22). The network of monitoring wells at NECD is shown in Fig. 3.6. Most of the shallow perched groundwater flows horizontally within the discontinuous sand and gravel lenses in the till. Locations of groundwater divides coincide with topographic highs (i.e., surface water drainage divides) (see Fig. 3.3). Perched groundwater beneath the proposed site for the NECDF discharges into Little Raccoon Creek.

The water table measured in the glacial till (see Fig. 3.5) represents average conditions. Geologic variations in the poorly-sorted glacial till cause the water table to be discontinuous. In turn, movement of the shallow perched groundwater is concentrated in some areas, and depleted in others. The presence of wells, impoundments, industrialized areas, and agricultural drain tile further complicate the flow of perched groundwater beneath NECD.

The sandstone aquifer within the Pennsylvanian bedrock supplies groundwater for domestic and stock use in Vermillion County (Watkins and Jordan 1965). Well depths range from 15 to 168 m (50 to 550 ft), averaging approximately 40 m (130 ft). Sustained yields are possible because the aquifer is areally extensive (i.e., continuous) and range from 4 to 284 L/min (1 to 75 gpm). The weight of overburden (glacial till) induces confining pressures that cause the water table in this artesian aquifer to rise to within 1 to 6 m (4 to 20 ft) of the ground surface from a depth of 24 to 56 m (80 to 185 ft) (U.S. Army 1980).

While deeper Mississippian, Devonian, and Silurian strata beneath the Pennsylvanian bedrock may yield small quantities of groundwater for stock or domestic use, water quality tends to deteriorate and drilling costs rapidly rise with increased depth. Poor water quality,

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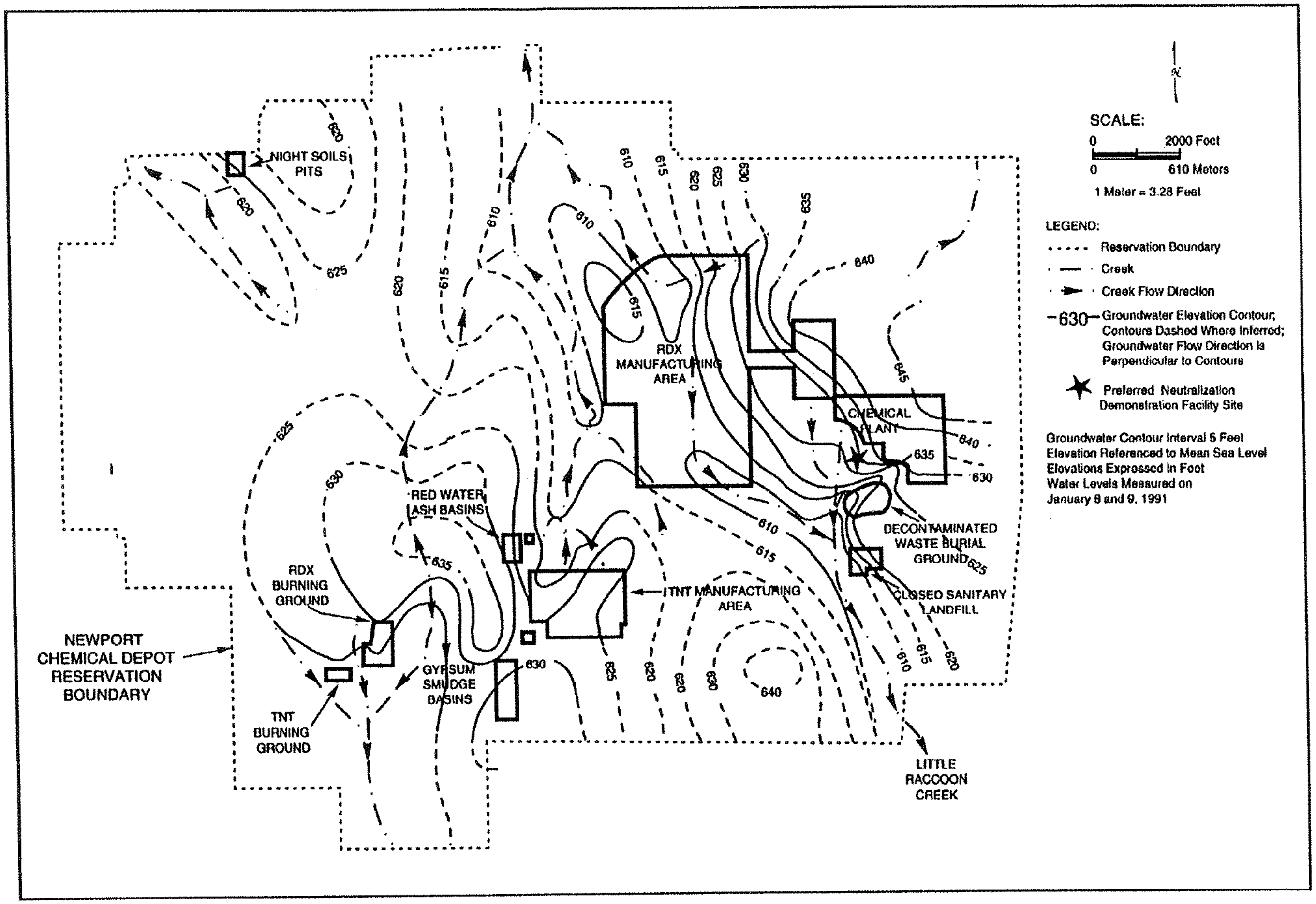

Fig. 3.5. Water table map measured in the glacial till underlying Newport Chemical Depot.

ORNL-DWG 97KEB-128426

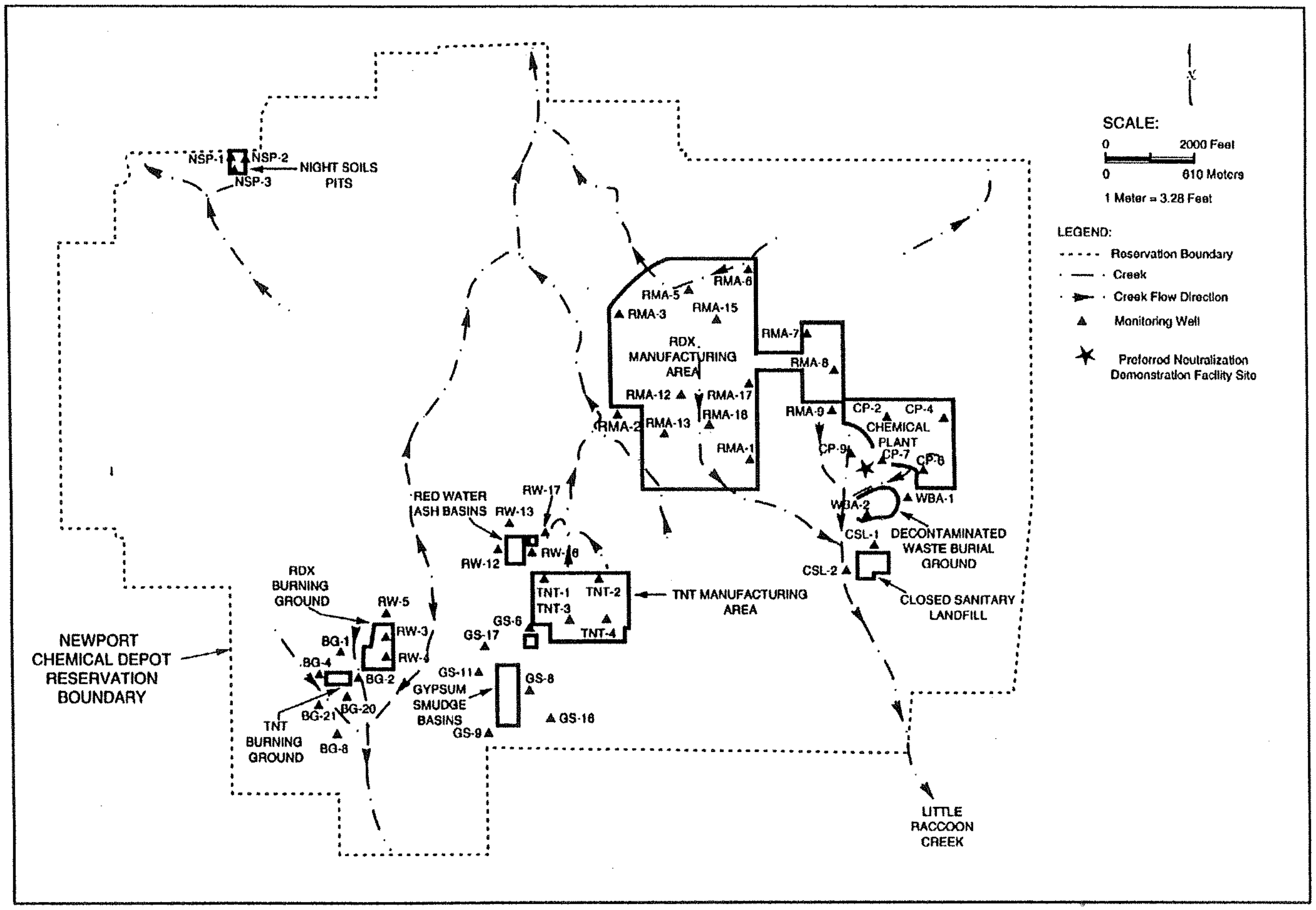

Fig. 3.6. Monitoring well locations in the glacial till at Newport Chemical Depot.

potentially low yields, and economic considerations make deeper aquifers beneath NECD unacceptable for most uses.

Groundwater Quality. Table 3.5 compares the quality of groundwater in the aquifers beneath NECD. Groundwater from the glaciofluvial aquifer has very good quality. Although very hard /hardness values exceeding 150 mg/L are designated as very hard (Freeze and Cherry 1979)], this potable water requires minimal treatment other than precautionary chlorination before use (U.S. Army 1980). The sand and gravel lenses in the glacial till exhibit groundwater quality similar to that of the glaciofluvial aquifer. The increased nitrates and decreased iron content in the glaciofluvial aquifer are indicative of the induced infiltration occurring along the Wabash River. Pollution in the river supplies the nitrates, while oxidizing conditions in the naturally aerated fluvial environment cause dissolved iron to settle out or be suspended rather than move through the ground to the Ranney well field.

Groundwater in the buried, pre-glacial valleys would be expected to be slightly higher in total dissolved solids, hardness, iron, and chloride but lower in nitrate than that in the sand and gravel lenses. The thickness of glacial till isolates the buried-valley aquifers from surficial influences (i.e., nitrates) while providing for reducing conditions that increase dissolved iron content. These water quality trends would be reversed at locations where the buried-valley aquifers are recharged by the Wabash River or its tributaries.

Total dissolved solids, chloride, and iron concentrations in the Pennsylvanian bedrock aquifer would be expected to exceed drinking water standards. Without treatment, groundwater from the bedrock aquifer would be suitable for livestock production and possibly crop irrigation only when the concentration of total dissolved solids did not exceed 700 mg/L (Freeze and Cherry 1979).

Groundwater Use. Forty-nine wells are located off-site and within 3.2 km (2 miles) of NECD (USATHAMA 1991, Sect. 2.2.8, pp. 2-29 to 2-34). Well depths range from 6.1 to 109.7 m (20 to 360 ft). Wells are classified as follows according to groundwater use: (1) 33 household domestic water supplies; (2) 8 public water supplies; (3) 2 livestock watering wells; (4) 1 industrial water supply (5) 3 test wells; and (6) 2 dry wells. More than 50% of these wells pump groundwater from sand and gravel lenses within the glacial till, are privately owned, and provide low yields.

3.3.2.5 Water supply and requirements

The NECD water distribution system consists of a covered reservoir, tanks, pumps, piping, and controls necessary to provide water for processes, utilities, and fire protection (U.S. Army 1992c, p. G-1-15). The Ranney well field consists of six wells and utilizes three pumps. One pump operates almost continuously, while the second starts and stops as necessary according to the demand for water. The third pump is an installed spare. The recommended groundwater withdrawal rate from the glaciofluvial deposits along the Wabash River ranges from approximately 27,300 to 32,700 m^3/day [7.2 to 8.64 Mgd (5,000 to 6,000 gpm)] with one pump operating (USAEHA 1975, p. 4; USATHAMA 1991, p. 2-28).

Table 3.5. Groundwater quality of aquifers beneath Newport Chemical Depot[a]

Dissolved constituent	Aquifer[b]			Primary or secondary drinking water standard
	Glaciofluvial deposits along Wabash River	Sand and gravel lenses in the glacial till	Sandstone in the Pennsylvanian bedrock	
Total dissolved solids	400-600	350-425	500–3,000[c]	500[d]
Total hardness[e] (as $CaCO_3$)	300-400	300-400	150–1,000[c]	[f]
Chloride	8-30	2.5-3.0	4–3,140[g]	250[d]
Iron	0.011-1.4	1.5-2.5	1-5[c]	0.3[d]
Nitrate (as N)	0.1-6	0.01-0.4	[h]	10[i]

[a]All concentrations are expressed in mg/L. Unless otherwise noted, groundwater quality data were obtained from K. J. Banaszak, "Indiana Ground-Water Quality," pp. 245–250 in *National Water Summary 1986—Hydrologic Events* and *Ground-Water Quality*, compiled by D. W. Moody, J. Carr, E. B. Chase, and R. W. Paulson, U.S. Geological Survey, Water-Supply Paper 2325, U.S. Government Printing Office, Washington, D.C., 1988.

[b]Groundwater in buried, pre-glacial valleys (located atop the Pennsylvanian bedrock surface and near the base of the glacial till) probably would be slightly higher in total dissolved solids, total hardness, iron, and chloride, but lower in nitrate, than groundwater in the sand and gravel lenses within the glacial till.

[c]D. C. Voelker and R. P. Clarke, "Illinois Ground-Water Quality," pp. 237-244 in *National Wafer Summary 1986—Hydrologic Events and Ground-Water Quality*, compiled by D. W. Moody, J. Carr, E. B. Chase, and R. W. Paulson, U.S. Geological Survey, Water-Supply Paper 2325, U.S. Government Printing Office, Washington, D.C., 1988.

[d]*Code of Federal Regulations* (40 CFR Part 143), Title 40: Environmental Protection Agency; Part 143: "National Secondary Drinking Water Regulations," U.S. Government Printing Office, Washington, D.C., pp. 470-473, July 1, 1996.

[e]R. A. Freeze, and J. A. Cherry, *Groundwafer*, Prentice-Hall, Inc., Englewood Cliffs, N.J., 1979, p. 387, define four classifications of total calcium carbonate ($CaCO_3$) hardness: (1) O-60 mg/L-soft; (2) 61-120 mg/L-moderately hard; (3) 121-180 mg/L-hard; and (4) greater than 180 mg/L-very hard. Hard water causes scale formation in pipes and does not produce lather without consuming excessive quantities of soap.

[f]There is no federal drinking water standard for hardness. According to J. D. Hem, Study *and Interpretation of the Chemical Characteristics of Natural Water*, third edition, third printing, U.S. Geological Survey, Water- Supply Paper 2254, U.S. Government Printing Office, Washington, D.C., 1989, p. 159, the World Health Organization suggests an upper limit of 500 mg/L.

[g]F. A. Watkins, Jr., and D. G. Jordan, *Ground-Water Resources of West-Central Indiana, Preliminary Report: Vermillion County*, Bulletin No. 29 of the Division of Water Resources, prepared by the Geological Survey, U.S. Department of the Interior, in cooperation with the Division of Water Resources, Ind. Department of Conservation, Indianapolis, 1965.

[h]The surficial layer of glacial till minimizes the seepage of nitrates from the surface into the underlying sandstone aquifer that resides in the Pennsylvanian bedrock.

[i]*Code of Federal Regulations* (40 CFR Part 141), Title 40: Environmental Protection Agency; Part 141: "National Primary Drinking Water Regulations," U.S. Government Printing Office, Washington, D.C., pp. 288-429, July 1, 1996.

3.3.3 Preexisting Contamination

Past and present missions at NECD have required the storage, handling, use, and disposal of toxic, hazardous, and radioactive chemicals. These activities have resulted in known and suspected areas of environmental contamination including soils, groundwater, surface water, and structures. The Army has instituted an Installation Restoration Program (IRP) to systematically identify, evaluate, and clean up abandoned sites on its facilities that could have been contaminated by toxic, hazardous, and radioactive chemicals, and that did not comply with recently enacted environmental legislation. The IRP is the Department of Defense equivalent to the EPA Superfund Program.

Potentially contaminated areas at NECD that could require corrective action (USATHAMA 1991; U.S. Army 1980; U.S. Army 1985) include the

- RDX[1] burning ground,
- RDX manufacturing area,
- chemical plant,
- gypsum sludge basins,
- decontaminated waste burial grounds,
- Little Raccoon Creek,
- TNT[2] burning ground,
- TNT manufacturing area,
- deep well injection point,
- red water ash basins,
- night soil pits,
- pollution control center retention basin, and
- closed sanitary landfill.

The RDX areas, sludge basins, TNT burning ground, ash basins, retention basin, and landfill are identified solid waste management units where a potential for contamination from past operations has been indicated.

At the chemical plant, burial ground, Little Raccoon Creek, TNT manufacturing area, and night soil pits, environmental contamination could have resulted from the use of potentially hazardous materials. Site investigations have been performed in each area to determine whether there has been a release and whether there is a substantial threat of a future release of hazardous substances, pollutants, or contaminants into the environment that could present an imminent and substantial danger to the public health or welfare.

The deep well was deactivated in 1971. Plugging and abandonment occurred in 1985 in accordance with a closure plan approved by the U.S. Environmental Protection Agency (U.S. Army 1985).

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[1]RDX or "Royal Demolition Explosive" is also known as (1) cyclonite, (2) cyclotrimethylene trinitramine, and (3) hexhydro-1,3,5-trinitro-1,3,5-triazine.

[2]TNT is trinitrotoluene.

Existing contamination that has resulted from actions associated with prior NECD missions could be a potential source of confusion and concern for cleanup if an accidental spill escaped containment.

Deep well injection was used until September 1969 to dispose of waste detoxification solution and wastewaters generated from equipment cleanup and industrial processes during operation of the chemical plant (U.S. Army 1980). The deep well was drilled to a depth of 1,878 m (6,160 ft) in 1960, and is located between the north wall of the chemical agent warehouse (i.e., Building 144) and the chemical plant. The well was deactivated in 1971. Plugging and abandonment occurred in 1985 in accordance with an EPA approved closure plan (U.S. Army 1985). Raw chemical agent never was injected into the well, and no CSDP activities would utilize the deep well.

The proposed site for the NECDF is located in the headwaters of Little Raccoon Creek with maintenance shops to the north, the former VX production facility (chemical plant) and current VX storage facility to the east, the decontamination waste burial grounds, closed sanitary landfill, and FOTW to the south, and farmland to the west. Environmental contamination has occurred at the chemical plant, decontaminated waste burial grounds, and closed sanitary landfill (see Sect. 3.3.1. 1). Site investigation and remediation to clean up contamination from previous activities may be required prior to construction and during construction of the proposed NECDF, as well as during proposed pilot testing. The actual proposed site of the NECDF does not require investigation or remediation.

3.4 ECOLOGICAL RESOURCES

This section describes natural areas, vegetation, fish, and wildlife occurring within a 100-km (62-mile) radius of NECD. Ecological resources occurring within this radius, which includes 23 counties or parts of counties in Indiana, and 15 in Illinois, could be affected by possible accidental releases of chemical agents. This area includes parklands, conservation areas, preserves (including Nature Conservancy areas), wildlife refuges and management areas, and wetlands. These areas often consist of large acreages of natural ecosystems or habitats and species of special interest or concern. Threatened and endangered species listed by the U.S. Fish and Wildlife Service are one group of ecological resources of particular concern because of their high vulnerability to extinction (see Section 3.4.4). The Endangered Species Act of 1973 (Pub. L. 93-205) requires federal agencies to ensure that their actions neither jeopardize the continued existence of endangered or threatened species nor destroy or adversely modify designated critical habitats for such species. The numbers of ecological resources of special concern within 100 km (62 miles) of NECD are given in Table 3.6, and locations of selected key resources are shown in Fig. 3.7. The distance and direction of those ecological resources which lie within the no-deaths distances from NECD for the most serious accidents associated with agent VX are summarized in Table 3.7.

Possible accidental releases of VX pose the greatest threat to ecological resources under any of the alternatives considered. The potential impact distances for ecological resources are assumed to be equivalent to the human health “no-effects” distances, which are approximately seven times greater than the calculated downwind human “no-deaths” distances for chemical agent release based on the most serious accident for each alternative under worst-case meteorological conditions (see Appendix E). The prevailing wind direction in the NECD

Table 3.6. Numbers of ecological resources of special concern within 100 km (62 miles) of Newport Chemical Depot

Resource	Number
National Historical Sites'	1
National Wildlife Refuges	1
Threatened and Endangered Species[b]	13
Nature Preserves	52
Natural Heritage Landmarks	3
State and Local Parks, Recreational Areas, and Reservoirs	20
State Forests, Conservation Areas. and Fish and Wildlife	18

"Managed by the National Park Service.
'Does not include proposed, candidate, or state listed species.

vicinity is generally from the south (see Section 3.2.1.1). Ecological resources of special concern that are located primarily to the north of NECD, therefore, would be within the prevailing downwind direction of the site; however, all ecological resources within the 100-km (62-mile) radius could potentially be affected by a worst-case accidental release of chemical agent.

Additional site-specific information that supports the following discussions can be found in the *Installation Assessment for Newport Army Ammunition Plant* (U. S . Army 1979), *Environmental Assessment of Newport Army Ammunition Plant Operations* (U.S . Army 1980), and the *Natural Resources Management Plan for the Newport Army Ammunition Plant* (Mason & Hanger - Silas Mason Co. 1991). Several surveys to document the biota of the NECD installation have been conducted: birds (Chandler and Weiss 1994); endangered bats (PRC 1997); endangered, threatened, and special concern fishes, amphibians, reptiles and mammals (Whitaker 1994); endangered and threatened plants and vertebrate animals (Jackson and Whitaker 1987); threatened, endangered and rare plants (Jackson 1976); natural areas and rare plants (Hedge and Bancoe 1994); and general terrestrial ecology (Pinkham et *al. 1976*). The wealth of information provided by these biological surveys has been utilized extensively in the preparation of the following sections.

3.4.1 Terrestrial Resources

The NECD, located in west central Indiana, Vermillion County, lies in the largest physiographic unit of Indiana, the Tipton Till Plain (Mallott 1922 in Hedge and Bancoe 1994). This is a broad, level plain created by glaciation. Locally there are a few small streams with their associated dissected topography. Thus, the land forms present within NECD include both a nearly level plain and a series of small, primarily forested, stream valleys. The region is composed of glacial deposits covered in many areas by loess, a layer of wind blown silt which covers the glacial materials (Hedge and Bancoe 1994). All soil types at NECD are deep and have high moisture-holding capacity. The uplands and slope/valley areas are moderately-to-poorly drained and have a moderately slow permeability. The floodplain soil group is well

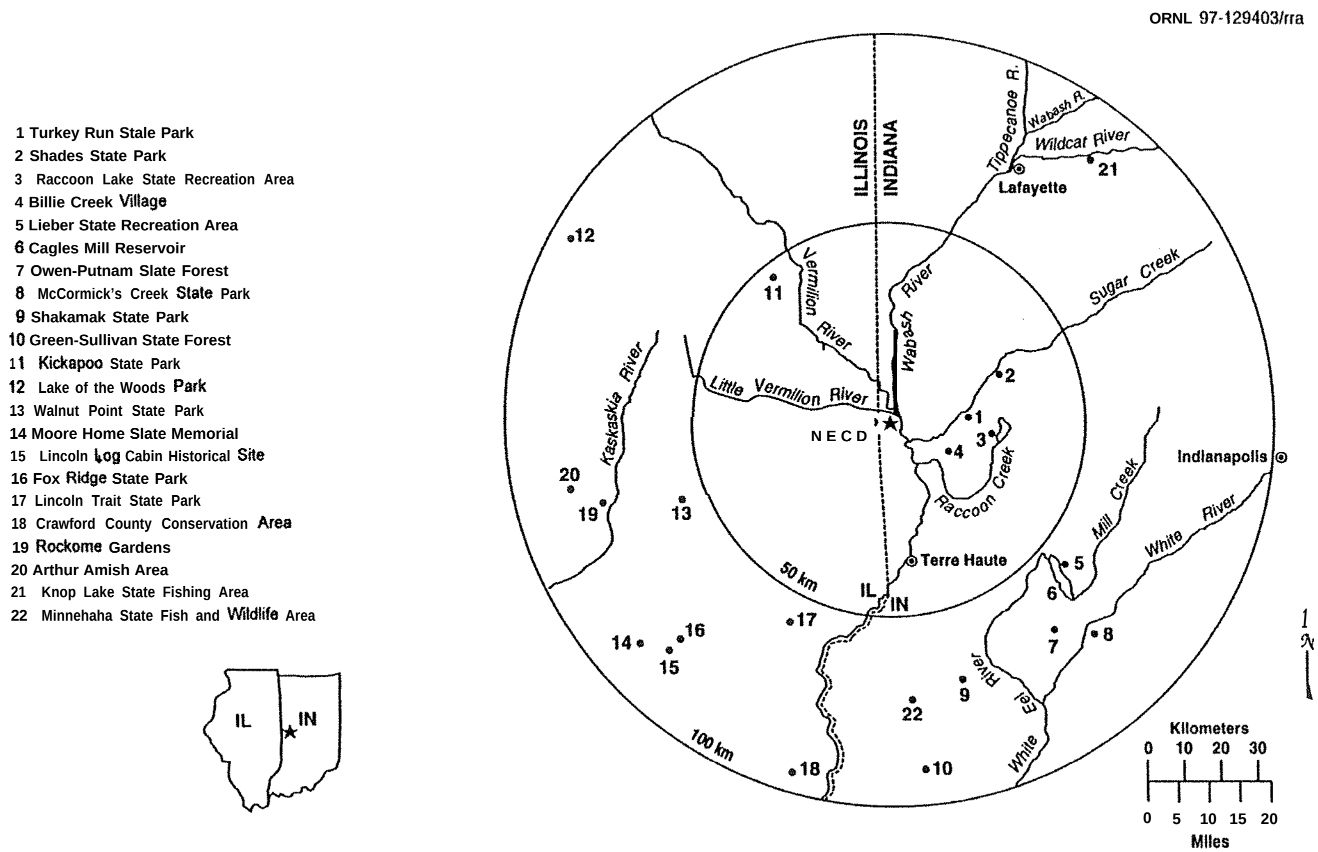

Fig. 3.7. Locations of selected key ecological resources near the Newport Chemical Depot.

Table 3.7. Ecological resources of special concern located within 100 km (62 miles) of Newport Chemical Depot

Resource'	Distance and direction from site[b]
National Historical Sites	
Lincoln Log Cabin Historical Site, IL	85 km SW
National Wildlife Refuges	
Muscatatuck National Wildlife Refuge - Restle Unit, IN	95 km SE
Nature Preserves (NP)	
American Beech Woods, IL	65 km S
Baber Woods, IL	45 km W
Bean Blossom Bottoms Natural Area, IN	95 km SE
Bean Blossom Bottoms NP, IN	9.5 km SE
Big Walnut Managed Area, IN	55 km E
Big Walnut NP, IN	55 km E
Blue Bluff NP, IN	95 km SE
Bradford Woods, IN	PO km E
Bryan (Eunice Hamilton) NP, IN	95 km NE
Calvert & Porter Woods NP, IN	70kmE
Dobbs (John G.) Memorial NP, IN	45 km S
Eagle Crest NP, IN	100 km E
Fairchild Cemetery Prairie & Savannah, IL	50kmNW
Fall Creek Gorge NP, IN	55kmN
Fern Cliff NP, IN	55 km SE
Flesher Memorial Woods NP, IN	60kmS
Forest Glen Seep, IL	25 km NW
Fowler Highway Prairie Management Area, IN	85kmN
Green's Bluff NP, IN	90 km SE
Hall (Oscar & Ruth) Woods NP, IN	55kmE
High Bridge Botanical Area, IN	75kmNE
Hoot Woods NP, IN	75 km SE
Horticultural Park Woods, IN	80 km NE
Indiana Veteran's Home Woods NP, IN	80 km NE
Jordan Seeps, IN	60kmSE
Kieweg Woods, IN	45 km S
Little Vermillion River NP, IL	25kmNW
Little Bluestem Prairie NP, IN	3okms
Lookout Point NP, IN	80 km NE
North Fork Vermillion River. IL	25 km N

Table 3.7 (cont'd)

Resource'	Distance and direction from site'
Nature Preserves (NP) (cont'd)	
Otterbein Highway Prairie Management Area, IN	75 km NE
Palestine Iresine Site NP, IL	100 km S
Pedestal Rock NP, IN	35 km E
Perdue - Baker Wildlife Area, IN	75 km NE
Pine Hills NP, IN	35kmE
Portland Arch NP, IN	40 km N
Prospect Cemetery Prairie NP, IL	95 km NW
Restle Natural Area, IN	100 km SE
Rocky Hollow - Falls Canyon NP, IN	25kmE
Ross Biological Reserve, IN	75 km NE
Rupert Cemetery Site NP, IN	60 km N
Salt Fork Vermillion River NP, IL	45kmNW
Soldiers Home Woods NP, IN	80 km NE
Spring Pond NP, IN	95 km E
Spring Creek Seeps NP, IN	50 km NE
Wabash Breaks NP, IN	80 km NE
Wabash River - Mount Carmel NP, IL	60 km S
Walnut Point NP, IL	100 km E
Wea Creek Gravel Hill Prairie NP, IN	80 km NE
Willow Creek Seep NP, IL	25 km NW
Windfall Prairie NP, IL	50 km NW
Wolf Cave NP, IN	90 km SE
Natural Heritage Landmarks	
Hillside Marsh, IL	75 km SW
Orchid Hill, IL	50 km NW
Sangamon River, IL	100 km NW
State and Local Parks, Recreational Areas, and Reservoirs	
Arthur Amish Area, IL	85kmW
Billie Creek Village, IN	18 km SE
Cagels Mill Reservoir, IN	65kmSE
Cumberland Woods, IN	80 km NE
Eagle Creek Reservoir and Park, IN	100 km E
Fontanet Woods, IN	40 km SE
Fox Ridge State Park, IL	85kmSW
Kickapoo State Park, IL	45 km NW
Lake of the Woods Park, IL	95 km NW

Table 3.7 (cont'd)

Resource'	Distance and direction from site'
State and Local Parks, Recreational Areas, and Reservoirs(cont'd)	
Liber State Recreation Area, IN	65 km SE
Lincoln Trail State Park, IL	60kmSW
McCormick's Creek State Park, IN	75 km SE
Moore Home State Memorial, IL	90 km SW
Raccoon Lake State Recreational Area, IN	30 km E
Rockome Gardens, IL	7.5 km w
Shades State Park, IN	30 km E
Shakamak State Park, IN	65 km S
Tippecanoe Battlefield State Memorial, IN	80 km NE
Turkey Run State Park, IN	20 km E
Walnut Point State Park, IL	60kmSW
State Forests, Conservation Areas, and Fish and Wildlife Areas	
Boone's Pond State Fishing Area, IN	80kmE
Brouillette Gamebird Habitat Area, IN	80 km N
Chinook State Fishing Area, IN	50 km s
Crawford County Conservation Area, IL	85 km s
Deno Gamebird Habitat Area, IN	95 km N
Green Valley State Fishing Area, IN	30kmS
Green - Sullivan State Forest, IN	90 km S
Greenwood Ditch Gamebird Habitat Area, IN	85 km N
Jefvert Gamebird Habitat Area, IN	95 km N
Knop Lake State Fishing Area, IN	80 km NE
McGinnis - Lauerman Gamebird Habitat Area, IN	95kmN
Metro - Sixty Gamebird Habitat Area, IN	95kmN
Middle Fork State Fish and Wildlife Area, IL	55 km NW
Minnehaha State Fish and Wildlife Area, IN	80 km s
State Forests, Conservation Areas, and Fish and Wildlife Areas	
Nickle Plate Gamebird Habitat Area, IN	95kmN
Owen - Putnam State Forest, IN	75kmSE
Pine Creek Wildlife Management Area, IN	100 km N
Vinegar Hill Gamebird Habitat Area, IN	95 km N

'Sources of this information include: Hellmich, R.P. 1997. Letter from Ronald Heilmich, Indiana Department of National Resources, Division of Nature Preserves, to H.D. Quarles, Oak Ridge National Laboratory, Oak Ridge, Tenn, September 2; Hostetler, H.C. 1997. Letter from Heather Hostetler, Illinois Department of Natural Resources, to H.D. Quarles, Oak Ridge, National Laboratory, Oak Ridge, Term., September 5.

'Multiply distance in km by 0.6214 to convert to miles.

drained and highly permeable. The southwest portion of NECD contains deep black prairie soils, whereas most to the rest of the area contains lighter soils associated with woodlands (Whitaker 1994). Precipitation averages about 100 cm (40 in.), and the area lies along a transition zone between deciduous forest to the east and tall grass prairie to the west.

Although the area was originally forest interspersed with patches of tall grass prairie, the plant and surrounding areas are now largely agricultural fields, second growth, and scattered small woodlands (Chandler and Weiss 1994). These hardwood forests are more fully developed in the more protected, mesic slopes and ravines (Hedge and Bancoe 1994). Little remains of the original prairie vegetation, although some big bluestem, Indian grass, and prairie dock can occasionally be found on roadsides within NECD. Much of the open land is leased to farmers for row crops, hay production, and grazing. Timber is harvested from the forested areas according to a management plan (Mason & Hanger - Silas Mason Co. 1991), and 2 to 8 ha (5 to 20 acres) of mixed hardwoods are planted per year. A prairie restoration program was begun on NECD in 1994, 1995, and 1996 with the planting of approximately 20 ha (48.5 acres). About 70% of the land in the 100-km (62 mile) zone around the site is used for agricultural crops. In order of importance the major crops are corn for grain or silage, soybeans, hay or grass, wheat, alfalfa, and oats.

The landscape diversity at NECD creates habitat for many wildlife species; among the more obvious are whitetail deer, wild turkey, pheasant, quail, and coyote (Whitaker 1994). Controlled deer hunts have been conducted at NECD since 1989. Other common mammals present include raccoons, cottontails, fox squirrels, red and gray fox, skunks, opossums, muskrats, chipmunks, and woodchucks. Additional gamebirds include woodcock and mourning dove (Mason & Hanger - Silas Mason Co. 1991). A terrestrial ecological survey of NECD documented the presence of additional mammal species such as short-tailed shrew, meadow vole, house mouse, white-footed mouse, and southern bog lemming; amphibians and reptiles present include box turtle, five species of frogs, and the two-lined salamander (Pinkham et al. 1976). A survey for birds concluded that NECD is an ornithologically rich area: the presence of 137 species was documented including Great blue heron, Cooper's hawk, eastern bluebird, chimney swift, and several state-listed species (Chandler and Weiss 1994).

Some areas of NECD are recognized as having special value because they contain important natural communities and rare plants. An inventory of such areas was undertaken by the Indiana Department of Natural Resources, Division of Nature Preserves (Hedge and Bancoe 1994). Five exceptional areas and two special interest natural areas were identified based on various combinations of natural community features and the presence of some of five Indiana "watch list" species: large yellow lady's slipper, goldenseal, American ginseng, American pinesap, and Wood's hellebore. Recommendations were given for the management and preservation of these special sites (Hedge and Bancoe 1994). None of these areas lies within or adjacent to the proposed pilot test facility site.

3.42 Aquatic Resources

Five small warmwater stream systems drain the NECD site. Jonathan Creek, Little Vermilion Creek, and an unnamed creek drain roughly the northern half of the site, flowing into the Little Vermilion River and thence to the Wabash River approximately 3 km (2 miles) to the east of the site, the largest stream in the area (Figure 2.1). Little Raccoon Creek and Buck Creek drain the southern half of the site, also to the Wabash River. The Wabash River flows to the Ohio River. The only other surface waters in the immediate area are smaller tributaries of these streams, and several small natural and man-made ponds.

The Wabash River, a large, turbid, very hard, and slightly alkaline stream, has been moderately to heavily polluted by industrial, municipal, and agricultural wastewater discharges, including septic tank seepage, raw sewage, fertilizers, pesticides, and soil runoff (U.S. Army 1980). Several of the streams draining the NECD site are considered slightly polluted by agricultural activities and past explosives manufacturing at the site (U.S. Army 1980). The proposed site for the pilot test facility lies adjacent to the headwaters of Little Raccoon Creek, which has been polluted by wastewaters discharged from the sewage treatment plant (FOTW); the power plant; the facilities for production of heavy water, explosives, and VX in past years; and surface runoff (U.S. Army 1980; Bender and Pearson 1975). Creek waters and sediments are contaminated by a variety of metals and organic compounds. Sect. 3.3.1 provides further details and discussion of surface water quality and hydrology of Little Raccoon Creek and other on-site and area streams.

The assemblage of fish species found in streams draining the NECD site is not untypical of other warmwater streams of the region. Most common within the NECD property are the redbelly dace, the silverjaw minnow, the bluntnose minnow, and the orangethroat darter (Whitaker 1994). Other numerically important species include the stoneroller, creek chub, white sucker, and Johnny darter. Table 3.8 lists fish species known to occur in site streams, including minnows, suckers, darters, and sunfish, as well as in the Wabash River.

No freshwater mussels nor their shells were found during a 1984 survey for mussels at the NECD site (Miller 1984). Miller concluded that their absence was probably not due to degraded water quality, but rather to the small size of the on-site streams - most unionid mussels require fairly large streams. Six species (two alive) were found in the Little Vermilion River north of the NECD, and shells of 25 species of mussel (i.e., none were alive) were collected from the Wabash River in the vicinity of the NECD site. These shells were believed to have originated from gravel bars upstream and then deposited in the reach near the site following periods of high river flows. An earlier study identified several non-mussel molluscs, including finger nail clams, pond snails, river snails, and orb snails (Bender and Pearson 1975). Other invertebrates found in streams draining the NECD site by Bender and Pearson (1975) include oligochaetes, crayfish, and many species of aquatic insects. Beetles, true bugs, midges, horseflies, craneflies, mayflies, stoneflies, caddisflies, dragonflies, and damselflies were important members of the benthic community. Many of these organisms are important prey organisms for the various fish species inhabiting these streams.

3.4.3 Wetlands

NECD contains a relatively small amount of wetland acreage. There are streams with associated forested floodplains which are found in the northern, more dissected portion of the property; depressional wetlands, some of which-are forested, are found in the more level portions of the property (Hedge and Bancoe 1994). There are also several impoundments which contain wetland vegetation, including marshes with cattails. Some circumneutral seep springs (which occur when ground water oozes through a muck soil in a diffuse manner creating habitat suitable for species such as marsh marigold, skunk cabbage, jewelweed, sedges, purple-stem aster, roughleaf goldenrod, black ash, and white turtlehead) are also present (Hedge and

Table 3.8. Fish species found in NECD streams and the Wabash River

Common Name	Scientific name
Fish of NECD and nearby streams[a,b]	
S toneroller	*Campostoma anomalum*
Silverjaw minnow	*Ericymba buccata*
Southern common shiner	*Luxilus chrysocephalus*
Striped shiner	*Notropis chrysocephalus*
Spotfm shiner	*Notropis spilopterus*
Emerald shiner	*Notropis atheronoides*
Sand shiner	*Notropis stramineus*
Redfm shiner	*Notropis umbratilis*
Steelcolor shiner	*Notropis whipplei*
Suckermouth minnow	*Phenacobius mirabilis*
Southern redbelly dace	*Phoxinus erythrogaster*
Blacknose dace	*Rhinichthys atratulus*
Creek chub	*Semotilus atromaculatus*
White sucker	*Catostomus commersoni*
Northern hogsucker	*Hypentelium migricans*
Mottled sculpin	*Cottus bairdi*
American brook lamprey	*Lampetra lamottei*
Johnny darter	*Etheostoma nigrum*
Orangethroat darter	*Etheostoma spectabile*
Greenside darter	*Ethostoma blennioides*
Fantail darter	*Etheostoma jlabellare*
Blackside darter	*Percina maculata*
Warmouth	*Lepomis gulosus*
Bluegill	*Leposmis macrochirus*
Green sunfish	*Lepomis cyanellus*
Mud pickerel	*Exox americanus*
Yellow bullhead catfish	*Ictalurus natalis*
Fish of the Wabash River[c]	
Gizzard shad	*Dorosoma cepedianum*
Carp	*Cyprinus carpio*
Carpsuckers	*Carpiodes* spp.
Redhorse suckers	*Moxostoma* spp.

Table 3.8 (cont'd)

Common Name	Scientific name
Fish of the Wabash River [c] (cont'd)	
Blue sucker	*Cycleptus* elongatus
Buffalo suckers	*Ictiobus spp.*
Longnose gar	*Lepisosteus osseus*
Shortnose gar	*Lepisosteus platostomus*
Spotted gar	*Lepisosteus oculatus*
Goldeye	*Hiodon alosoides*
Mooneye	*Hiodon tergisus*
Skipjack herring	*Alosa chrysochloris*
Flathead catfish	*Pylodictis olivaris*
Channel catfish	*Ictalurus punctatus*
Blue catfish	*Ictalurus furcatus*
White bass	*Morone chrysops*
Smallmouth bass	*Micropterus dolomieui*
Spotted bass	*Micropterus punctulatus*
Largemouth bass	*Micropterus salmoides*
White crappie	*Pomoxis annularis*
Longear sunfish	*Lepomis megalotis*
Bluegill	*Lepomis macrochirus*
Rock bass	*Ambloplites rupestris*
Sauger	*Stizostedion canadense*
Walleye	*Stizostedion vitreum*
Logperch	*Percina caprodes*
Freshwater drum	*Aplodinotus grunniens*
Shovelnose sturgeon	*Scaphirhynchus platorhynchus*
Bowfin	*Amia calva*
American eel	*Anguilla rostrata*
Paddlefish	*Polyodon spathula*
Silver lamprey	*Ichthyomyzon unicuspis*

[a]Mason & Hanger - Silas Mason Company, Inc. 1991. Natural Resources Management Plan for the Newport Army Ammunition Plant. Part IV: Fish and Wildlife Management. Newport, IN.

[b]Whitaker, J.O. 1994. Survey of Endangered, Threatened, and Special Concern Fishes, Amphibians, Reptiles and Mammals of the Newport Army Ammunition Plant, Newport Indiana. Report to Mason & Hanger - Silas Mason Company, Inc. Newport Army Ammunition Plant, Newport Indiana.

[c]Gammon, J. R. 1991. The Environment and Fish Communities of the Middle Wabash River. Report for Eli Lily and Company, Indianapolis, and PSI Energy, Plainfield, IN.

Bancoe 1994). U.S. Fish and Wildlife Service National Wetland Inventory maps indicate that there are no wetlands in the immediate vicinity of the construction project (D. Hudak, FWS, personal communication to H. D. Quarles, ORNL, Oct. 28, 1997). The maps do indicate that wetland areas of the following classifications may be present in the surrounding vicinity: riverine; palustrine, forested; palustrine, unconsolidated; palustrine, scrub-shrub; and palustrine, emergent.

3.4.4 Threatened and Endangered Species

Thirteen federally listed threatened and endangered species have been identified by the U.S. Fish and Wildlife Service (R. Nelson, FWS, personal communication to H. D. Quarles, ORNL, Sept. 2, 1997; R. Nelson, FWS, personal communication to V.R. Tolbert, ORNL, Sept. 24, 1992; R. Wilson, FWS, personal communication to L. L. Sigal, ORNL, June 17, 1986; D. Hudak, FWS, personal communication to H. D. Quarles, ORNL, Oct. 28, 1997; D. Hudak, FWS personal communication to M. Satrape, PMCD, March 30, 1992; D. Hudak, FWS, personal communication to L. L. Sigal, ORNL, June 17, 1986; D. Hudak, FWS, personal communication to L. L. Sigal, ORNL, Jul. 11,1986) as potentially occurring within 100 km (62 miles) of NECD. These species are listed in Table 3.9 (see also Appendix D). The federally listed endangered and threatened species identified include one mammal, one bird, nine freshwater mussels, and two plants. Over 100 Indiana-listed endangered and Illinois-listed threatened and endangered plant and animal species also potentially occur in the 100-km (62-mile) zone around NECD (H. Hostetler, Illinois Department of Natural Resources, personal communication to H.D. Quarles, ORNL, Sept. 5, 1997; R. Hellmich, Indiana Department of Natural Resources, personal communication to H. D. Quarles, ORNL, Sept. 2, 1997).

The federally listed endangered mammal, the Indiana bat, is known to occur on NECD. Two maternity colonies have recently been discovered to the northeast and northwest of the proposed pilot test facility (PRC 1997). One Indiana-listed endangered mammal, badger, based on two reliable site records, is known to occur at NECD (Whitaker 1994). The federally listed threatened bird species, bald eagle, uses stretches of the Wabash River immediately east of NECD, and throughout Park, Fountain, and Warren counties, Indiana, as wintering areas (D. Hudak, FWS, personal communication to H. D. Quarles, ORNL, Oct. 28, 1997). Eagles are often sighted moving through these reaches of the Wabash from January through March. A pair was reported building a nest along the river across from NECD in 1992 by the Indiana Department of Natural Resources (D. Hudak, FWS, personal communication to M. Satrape, PMCD, March 30, 1992), but the nest has never been used (D. Hudak, FWS, personal communication to H. D. Quarles, ORNL Oct. 28, 1997). Bald eagle wintering areas also occur along large rivers in Moultrie and Jasper counties, Illinois, about 100 km (62 miles) southwest of NECD (R. Nelson, FWS, personal communication to V.R. Tolbert, ORNL, Sept. 24, 1992). Five Indiana-listed endangered-bird species-the upland sandpiper, osprey, the sandhill crane, sedge wren, and Henslow's sparrow-have also been recorded at NECD (Chandler and Weiss 1994, personal communication of Kevin Rudduck, NECD Environmental Engineer, to H.D. Quarles of Oak Ridge National Laboratory, Oak Ridge, Tenn., at NECD on July 1, 1997.). Two federally listed threatened plant species are located in Illinois about

Table 3.9. List of federal threatened, endangered, proposed threatened, and proposed endangered species identified by the U.S. Fish and Wildlife Service as occurring within 100 km (62 miles) of Newport Chemical Depot

	Status[a]
Mammals	
Indiana bat (*Myotis sodalis*)	E
Birds	
Bald eagle (*Hiliaeetus leucocephalus*)	T
Mussels	
Fanshell mussel (*Cyprogenia stegaria*)	E
Clubshell mussel (*Pleurobema clava*)	E
White wartyback mussel (*Plethobasus cicatricosus*)[b]	E
Orange-footed pimpleback mussel (*Plethobasus cooperianus*)	E
Rough pigtoe mussel (*Pleurobema plenum*)	E
Fat pocketbook pearly mussel (*Potamilus capax*)[b]	E
Pink mucket pearly mussel (*Lampsilis orbiculata*)[b]	E
Tubercuied-blossom pearly mussel (*Epioblasma torulosa torulosa*)[b]	E
White cats paw pearly mussel (*Epioblasma obliquata perobliqua*)	E
Plants	
Eastern prairie fringed orchid (*Platanthera leucophaea*)	T
Mead's milkweed (*Asclepias meadii*)	T

[a]T=Threatened, E=Endangered

'Presence based on, D. Hudak, FWS, personal communication to L. L. Sigal, ORNL, June 17, 1986 and R. Nelson, FWS, personal communication to L. L. Sigal, ORNL, June 17, 1986.

[c]No recent collections of this species. - -

100 km (62 miles) northwest of NECD. The eastern prairie fringed orchid occurs in wet grasslands in Iroquois county, and Mead's milkweed occurs in virgin prairies in Ford county (R. Nelson, FWS, personal communication to V.R. Tolbert, ORNL, Sept.24, 1992).

Six federally designated endangered aquatic species have been reported within 100 km of the NECD site (Hudak 1997; Hudak 1986): the fanshell (*Cyprogenia stegaria*), clubshell (*Pleurobema clava*), and white wartyback (*Plethobasus cicatricosus*) mussels, and the fat pocketbook (*Potamilus capax*), pink mucket (*Lampsilis orbiculata*), and tuberculed-blossom (*Epioblasma torulosa torulosa*) pearly mussels. However, recent information (see the Biological Assessment, Appendix D) indicates that only two endangered mussels, the fanshell and the clubshell, currently reside within 100 km of the site. The nearest reported occurrence of the fanshell and clubshell mussels is in Tippecanoe County, Ind., 50 km (31 mi) or more away from the site. Three additional species, the orange-footed pimpleback (*Plethobasus cooperianus*) and rough pigtoe (*Pleurobema plenum*) mussels, and the white cats paw pearly mussel (*Epioblasma obliquata perobliqua*) may occur within the State of Indiana, but have not been collected in recent years (Hudak 1986). A total of five endangered mussels have been collected in the past from the Wabash River, but none from the reach nearest the NECD nor from the smaller streams such as Little Raccoon Creek which drain the NECD property (Miller 1984; Bender and Pearson 1984).

There are numerous aquatic species within 100 km of the NECD site listed as endangered, threatened, rare, or as species of special concern by the States of Illinois and Indiana. These include the popeye shiner (*Notropis ariommus*; found in the past in Vigo and Parke Counties), and the bluebreast darter (*Etheostoma camurum*; collected from Sugar Creek, Parke County)(Whitaker 1994). Species of special concern include the blue sucker (*Cycleptus elongatus*; found all along the Wabash River, but not a likely resident or visitor in the small upland streams on and near the site), the river redhorse (*Moxostoma carinatum*; collected from the Wabash River near Terre Haute), the greater redhorse (collected in Vigo County), and the eastern sand darter (*Ammocrypta pellucida*; found near the site but less common than in earlier years) (Whitaker 1994).

3.5 LAND USE

3.5.1 Land Use Within NECD

NECD covers about 2,860 ha (7,100 acres) of relatively flat land. Facilities and grounds at NECD occupy about 260 ha (640 acres), with the remaining area consisting mainly of cropland, pasture, and forest. The chemical agent storage building is located about 1.1 km (0.7 mile) west of SR 63 and about 4 km (2.6 miles) south and west of Newport. The future use of NECD is highly uncertain. Currently, there is no land use plan specifying how the depot will be used after all the agent stored on site is destroyed.

3.5.2 Land Use Outside NECD

Table 3.10 shows the percentage of each county in the impact area that is farmland. The five county region is heavily agricultural, with the proportion of land in farms ranging from a high of 90.5 % (Fountain County) to a low of 63.8 % (Parke County). Parke County has less land in farms than the other four counties because it has over 28,000 ha (70,000 acres) of

Table 3.10. Land in farms in the socioeconomic impact area

Location	Land in farms (acres)	Total land area (acres)	Land in farms (%)
Fountain Co., Ind.	229,097	253,264	90.5
Parke Co., Ind.	181,653	284,685	63.8
Vermillion Co., Ind.	119,318	164,418	72.6
Indiana	15,618,831	22,956,800	68.0
Edgar Co., 111.	354,480	399,095	88.8
Vermilion Co., Ill.	488,215	575,438	84.8
Illinois	27,250,340	35,579,520	76.6

Source: U. S. Bureau of *the* Census 1992. 1992 U.S. *Census of Agriculture.*

woodlands, mainly deciduous trees located on land that is too hilly to be farmed (Parke County Emergency Management 1996). To put the agricultural character of the impact area in perspective, only 41.8% of U.S. land overall is in farms (U.S. Bureau of the Census 1992).

3.6. COMMUNITY RESOURCES

Data on community resources are relevant to estimate the potential socioeconomic impacts from population growth and other activities associated with the construction and pilot testing of the proposed NECDF. The effects on population and economic activity associated with the project would take place within an area within approximately 20 km (12.5 miles) of the site. This socioeconomic impact area includes parts of five counties in two states: Vermillion County (in which NECD is located), Parke County, and Fountain County in Indiana, and Edgar County and Vermilion County in Illinois (Fig. 3.8). The analysis focuses on three towns within this area because of their proximity to the site and their special positions within their counties. These towns are: Newport, Indiana (the county seat of Vermillion County and the town closest to the site), Clinton, Indiana (the largest municipality in Vermillion County), and Rockville, Indiana (the county seat and largest town in neighboring Parke County).

Outside of the 20-km impact area are two medium-sized cities that could provide substantial numbers of workers for the proposed construction and operations activities at NECD. They are Danville, Illinois (population 33,289) and Terre Haute, Indiana (population 60,200), each of which is located approximately 50 km (30 miles) from the proposed site (Fig. 3.1). Indianapolis (population 752,279), the largest city in the state, is located about 110 km (70 miles) from NECD.

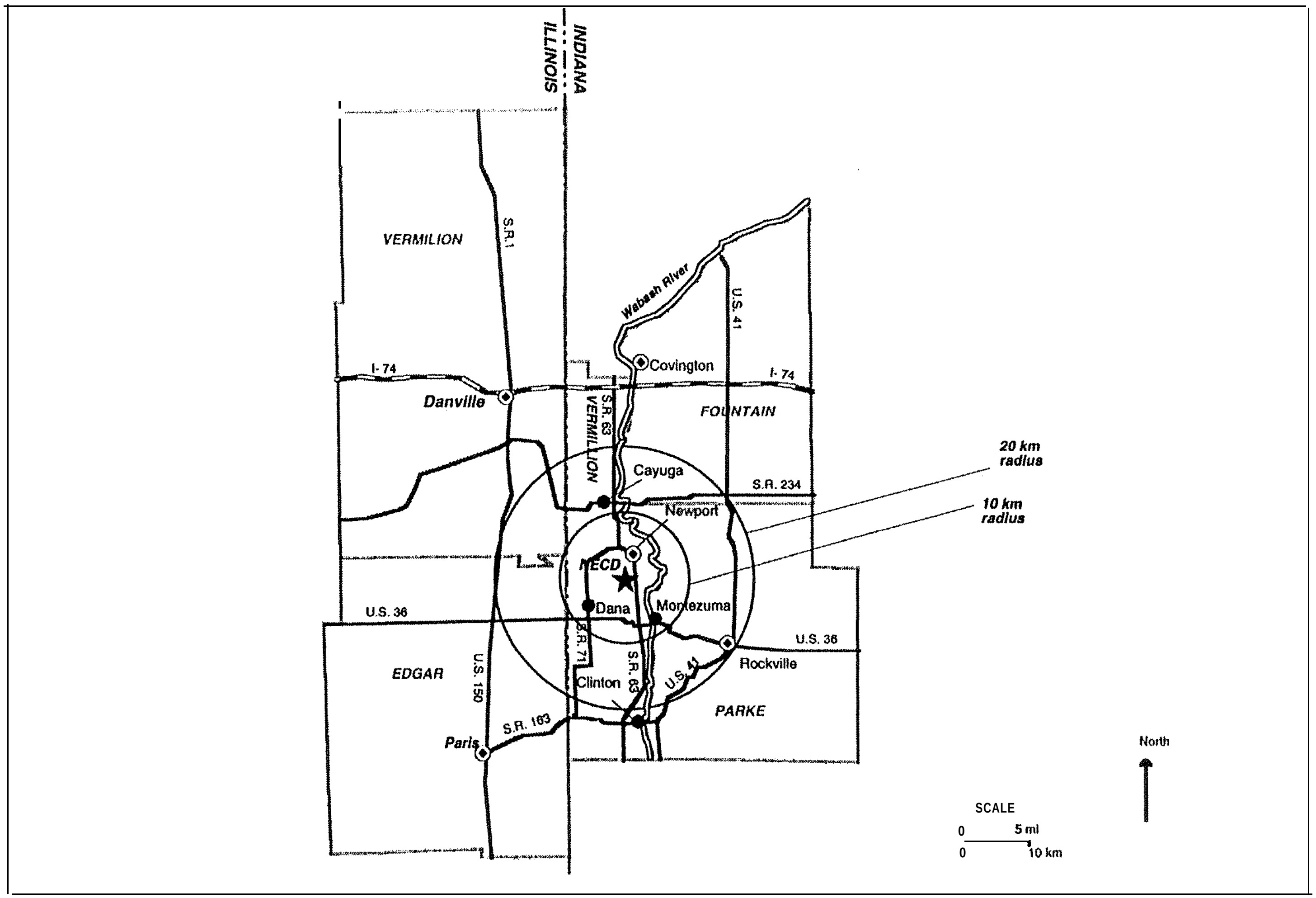

Fig. 3.8. Reference map to 20-km radius from Newport Chemical Depot.

3.6.1, Population

3.6.1 .1. Residential population

Table 3.1 I shows current populations and changes in population over time for the five impact area counties and three towns listed above, as well as for the states of Indiana and Illinois. All the Indiana counties and Edgar County, Illinois, are roughly similar in size, with populations ranging from 16,339 (Parke County) to 20,106 (Edgar County). The one exception is Vermilion County, Illinois, which is home to over 85,000 residents. Each of the five counties experienced population declines between 1980 and 1990. However, since 1990 this trend has been reversed in all but Vermilion County, Illinois. This recent growth has been greatest in Parke County (6.0%) and least in Vermillion County, Indiana (0.1%).

The three towns that are discussed most in the socioeconomic sections of this document are all relatively small, ranging in population from 643 (Newport) to 5,074 (Clinton). In addition to being the largest of the three towns, Clinton is also the largest town in the three Indiana counties that are part of the socioeconomic impact area. Clinton and Rockville are the only towns located within 20 km (12.5 miles) of the proposed site that have more than 2,000 residents. Like the counties in which they are located, these towns all saw their populations decrease between 1980 and 1990. In Clinton and Newport, some growth has occurred since 1990, but Rockville has continued to experience a slight decline in its population.

Table 3.11. Current population and change over time for counties, selected towns, and states in the socioeconomic impact area

Location	1980 population	1990 population	Percent change 1980-1990	1994/1996[a] population	Percent change 1990 - 1994/1996
Fountain Co., Ind.	19,033	17,808	- 6.4	18,207	2.2
Parke Co., Ind.	16,372	15,410	- 5.9	16,339	6.0
Rockville	2,785	2,706	- 2.8	2,670	- 1.3
Vermillion Co., Ind.	18,229	16,773	- 8.0	16,791	0.1
Clinton	5,267	5,040	- 4.3	5,074	0.7
Newport	704	627	- 10.9	643	2.6
Indiana	5,490,224	5,544,156	1.0	5,840,528	5.3
Edgar Co., Ill.	21,725	19,595	- 9.8	20,106	2.6
Vermilion Co., Ill.	95,222	88,257	- 7.3	85,260	- 3.4
Illinois	11.426.518	11.430.602 - -	0.0	11,846,544	3.6

[a] County and state populations are estimates for 1996; town populations are estimates for 1994.

Sources: U. S. Bureau of the Census 1981; U.S. Bureau of the Census 1991; U. S. Bureau of the Census 1995; U. S. Bureau of the Census 1997.

3.6.1.2. Transient population

Although the counties and towns located within 20 km of the proposed site have relatively small year-round populations, special events occur at various times of the year that bring substantial numbers of visitors to the local area. Typical attendance at the largest special events held in this area are shown in Table 3.12. The Parke County Covered Bridge Festival, held over a IO-day period in October, is by far the largest, attracting approximately 2,000,000 visitors annually. The Newport Antique Hill Climb draws about 100,000 visitors during the first weekend in October, and the Little Italy Festival hosts over 85,000 visitors over the Labor Day weekend. The Parke County Maple Syrup Festival is the largest winter festival, hosting about 20,000 guests during February and March. The remainder of the special events are considerably smaller and are held mostly during the summer months.

In addition to the festivals described above, there are two attractions that bring visitors to the local area year round. The first is the Turkey Run State Park, located near Annapolis, Indiana, in Parke County, which receives approximately 2 million visitors a year (M. Cole,

Table 3.12. Attendance at largest special events within 20 km of NECD

Event	Location"	Time period	Approximate attendance
Parke Co. Covered Bridge Festival	Parke Co.	10 days in October	2,000,000
Newport Antique Hill Climb	Newport	First weekend in October	100,000
Little Italy Festival	Clinton	Labor Day weekend	> 85,000
Parke Co. Maple Syrup Festival	Parke Co.	February and March	20,000
Billie Creek Village's School Days	Parke Co.	April and May	6,000
Ernie Pyle Festival	Dana	Late August	4,000
Billie Creek Village's Civil War Days	Parke Co	June	3,200
Parke Co. Arts and Crafts Days	Parke Co.	August	2,500
4-H Fair	Rockville	July and August	2,500
Vermillion Co. Fair	Cayuga	July	2,000

[a]All locations are in Indiana.

Sources: Parke County Convention and Visitors Bureau 1992; P. Sanders, Parke Co., Inc., personal communication to M. Schweitzer, ORNL, Sept. 18, 1997; S. Treaster, Vermillion Co., Ind., Economic Development Council, persona1 communication to M. Schweitzer, ORNL, Sept. 19 and Oct. 22, 1997.; Vermillion County Improvement Association 1992.

Turkey Run State Park, personal communication to M. Schweitzer, ORNL, Sept. 22, 1997). The other local attraction is the Ernie Pyle State Historic Site in Dana, Indiana, which is located near NECD in Vermilion County. In addition to the 4,000 visitors who attend the annual festival in late August, about 15,000 people visit at other times during the year (S . Treaster, Vex-million Co., Ind., Economic Development Council, personal communication *to* M. Schweitzer, ORNL, Sept. 19 and Oct. 22, 1997).

3.6.2. Public Services/Infrastructure

3.6.2.1. Education

The number of schools, teachers, and students and the teacher:student ratio for the five counties and selected subcounty school systems are given in Table 3.13. Within the entire impact area, there are 78 schools, 2,074 teachers, and 27,587 students. The teacher:student ratio varies from a low of 1:12.2 in Vermilion County, Illinois, to a high of 1:16.8 in Rockville.

3.6.2.2. Utilities

Despite the rural character of the five county impact area, many of the towns are served by centralized water and sewer systems. As shown in Table 3.14, water systems are more common than sewer systems, but many communities have both. Vermilion County,' Illinois, which is by far the most populous county in the impact area, has nearly 20 towns with water systems and almost as many with centralized sewerage. Vermillion County, Indiana has the fewest towns with municipal water and sewer systems.

Table 3.15 focuses on existing water and sewer facilities in the towns of Clinton, Newport, and Rockville, Indiana. As shown, Newport is not served by either centralized water or sewerage systems. Accordingly, Newport residences and businesses get their water from individual wells and utilize individual septic systems to dispose of their wastewater, as do all other structures in the impact area that are located in rural areas and small towns not served by centralized systems. In both Rockville and Clinton, average and maximum water use are substantially less than the peak capacity of their water treatment plants. Accordingly, no improvements are currently planned for these facilities, but the Clinton water utility has identified the need to build a new 750,000 gallon storage tank (D. Hayes, Clinton Water Plant, personal communication to M. Schweitzer, ORNL, Sept. 29, 1997). In the area of sewage treatment, wastewater flow during periods of heavy rain can substantially **exceed** plant capacity in both Rockville and Clinton due to infiltration and inflow of storm runoff. In response, Rockville plans to build an equalization basin by the end of 1999 that will allow exceptionally high peak flow to be held and released to the treatment plant gradually. Prior to that, the city plans to build a clarifier to catch solids and return them to the treatment facility (B. White, Rockville Sewage Treatment Plant Operator, personal communication to M. Schweitzer, ORNL Sept. 29, 1997). Clinton is also planning improvements to its sewage system. The city has just completed a preliminary expansion study and will probably increase plant capacity to 1.5 MGD in the next four or five years (L. Beard, Clinton Sewage Treatment Plant, personal communication to M. Schweitzer, ORNL, Oct. 1, 1997).

Table 3.13. Educational resources in the five-county socioeconomic impact area”

Location	Number of schools	Number of teachers	Number of students	Teacher: student ratio
Fountain Co., Ind.	7	211	3,331	1:15.8
Parke Co., Ind.	7	164	2,626	1:16.0
Rockville	2	53	892	1:16.8
Vermillion Co., Ind.	7	198	2,993	1:15.1
N . Vermillion	2	62	880	1:14.2
S. Vermillion	5	I36	2,113	1:15.5
Edgar Co., Ill.	12	288	3,881	1:13.5
Vermilion Co., Ill.	45	1,213	14,756	1:12.2

‘Data for Indiana are from 1995-96; data for Illinois are from 1997-98.

Source: K. Lane, Indiana Department of Education, personal communication to M. Schweitzer, ORNL, Sept. 24, 1997; L. Oakley, Region 11 Office of Education, personal communication to M. Schweitzer, ORNL, Sept. 25, 1997; J. Trask, Region 54 Office of Education, personal communication to M. Schweitzer, ORNL, Sept. 24, 1997.

3.6.2.3. **Solid waste**

Three of the five counties in the socioeconomic impact area-Fountain and Parke counties in Indiana and Edgar County in Illinois-have no operating landfill at this time and truck their refuse to other jurisdictions (B. Moffett, Fountain County Emergency Management Department, personal communication to M. Schweitzer, ORNL, Sept. 22, 1997; S. Milliken, Parke County Planning and Zoning Department, personal communication to M. Schweitzer, ORNL, Sept. 22, 1997; W. Brown, Edgar Co. Emergency Services and Disaster Agency, personal communication to M. Schweitzer, ORNL, Sept. 23, 1997). Vermillion County, Indiana, has two contiguous non-hazardous landfills; one is a sanitary landfill and the other is a construction demolition landfill. Both are privately owned for public use (J. Kanizer, Land Fills, Inc., personal communication to M. Schweitzer, ORNL, Sept. 25, 1997). In Vermilion County, Illinois, there also are two active landfills, which have substantial capacity at this time. These landfills handle locally-generated waste as well as refuse from Champaign and Edgar counties in Illinois and several Indiana counties (K. Riggle, Vermilion Co., Illinois Health Department, personal communication to M. Schweitzer, ORNL, Sept. 22, 1997).

Table 3.14. Towns with centralized water and sewer systems in the socioeconomic impact area

Location	Centralized water system	Sewer system
Fountain Co., Ind.		
Attica	X	X
Covington	X	X
Hillsboro	X	X
Kingman	X	X
Veedersburg	X	X
Parke Co., Ind.		
Bloomingdale	X	
Lyford	X	
Marshall	X	
Mecca	X	
Montezuma	X	
Rockville	X	X
Rosedale	X	X
Vermillion Co., Ind.		
Cayuga		Under construction
Clinton	X	X
Fairview Park	X	
Edgar Co., 111.		
Brocton	X	
Chrisman	X	X
Hume	X	
Kansas	X	
Metcalf	X	
Oliver	X	
Paris	X	X
Redmon	X	
Vermilion	X	
Vermilion Co., Ill.		
Alberton	X - -	
Alvin	X	
Belgium	X	X
Bismarck	X	
Catlin	X	X
Danville	X	X
Fairmount	X	

Table 3.14. (continued)

Location	Centralized water system	Sewer system
Fithian	X	X
Georgetown	X	X
Hoopeston	X	X
Indianola	X	
Oakwood	X	X
Potomac	X	X
Rankin	X	X
Ridge Farm	X	X
Rossville	X	X
Side11	X	
Tilton	X	X
Westville		

Source: G. Ball, Parke County Health Department, personal communication to M. Schweitzer, ORNL, Sept. 22, 1997; W. Brown, Edgar Co. Emergency Services and Disaster Agency, personal communication to M. Schweitzer, Sept. 23, 1997; D. Hayes, Operator, Clinton Water Plant, personal communication to M. Schweitzer, ORNL, Sept. 29, 1997; S. Milliken, Parke County Planning and Zoning Department, personal communication to M. Schweitzer, ORNL, Sept. 22, 1997; B. Moffett, Fountain County Emergency Management Department, personal communication to M. Schweitzer, ORNL, Sept. 22, 1997; K. Riggle, Vermilion Co., Illinois Health Department, personal communication to M. Schweitzer, ORNL, Sept. 22, 1997; H. Taylor, Chief, Paris, Illinois Fire Department, personal communication to M. Schweitzer, ORNL, Sept. 29, 1997; S. Treaster, Vermillion Co., Ind., Economic Development Council, personal communication to M. Schweitzer, ORNL, Term., Sept. 19 and Oct. 22, 1997.

3.6.2.4. Transportation

State Route (SR) 63, which provides access to NECD, is a four-lane divided highway with two 12-foot-wide paved lanes running in each direction. The shoulders are asphalt and are 10 feet wide on the outside and four feet wide on the inside (D. Carpenter, Crawfordsville District Office, Indiana Department of Transportation, personal communication to M. Schweitzer, ORNL, Sept. 25, 1997). The segment of SR 63 directly in front of NECD had average daily bidirectional traffic of 7,590 vehicles in 1993 (Indiana Department of Transportation 1993). Using the Indiana Department of Transportation estimate that traffic volume has grown 2 % annually (M. Gustafson, Indiana Department of Transportation, personal communication to M. Schweitzer, ORNL, Sept. 24, 1997), the average daily number of vehicles on the segment in question would be 8,216 in 1997. Using the highly conservative estimate that peak hourly traffic is 15% of the average daily count (C. Klika, Indiana Department of Transportation, personal communication to M. Schweitzer, ORNL, Sept. 25, 1997), the peak number of vehicles in 1997 would be 1,233 in one hour. If these were distributed equally in both directions, 617 vehicles would be traveling each way during the peak traffic hour. Because this is a four-lane highway, roughly 310 vehicles would be using each lane. According to the Transportation Research Board's *Highway Capacity* Manual (1994), a multi-lane rural highway

Table 3.15. Capacity and use of water and sewer systems in selected towns

	Clinton, Ind.	Newport, Ind.	Rockville, Ind.
	Water system		
Average use	0.9 mgd	N/A[a]	0.5 mgd
Maximum use	1.2 mgd	N/A	0.7 mgd
Water treatment plant capacity	5.0 mgd	N/A	1.2 mgd
	Sewage system		
Average flow	0.5 mgd	N/A[b]	0.8 mgd
Peak flow	2.5 mgd[c]	N/A	5.0 mgd[c]
Sewage treatment plant capacity	1.0 mad	N/A	I.8 mgd

[a]Newport does not have a centralized water system; water is provided by individual wells.
[b]Newport does not have a sewage system; all structures are served by individual septic systems.
[c]Flows approach this level only during periods of heavy rain, due to inflow and infiltration.
Source: L. Beard, Operator, Clinton Sewage Treatment Plant, personal communication to M. Schweitzer, ORNL, Oct. 1, 1997; M. Alice Bemis, Newport Town Clerk, personal communication to M. Schweitzer, ORNL, Sept. 29, 1997; D. Hayes, Operator, Clinton Water Plant, personal communication to M. Schweitzer, ORNL, Sept. 29, 1997; J. Montgomery, Rockville Water Plant Operator, personal communication to M. Schweitzer, ORNL, Sept. 30, 1997; S. Treaster, Vermillion Co., Ind., Economic Development Council, personal communication to M. Schweitzer, ORNL, Sept. 19 and Oct. 22, 1997; B. White, Rockville Sewage Treatment Plant Operator, personal communication to M. Schweitzer, ORNL, Sept. 29, 1997.

like SR 63 can accommodate up to 660 passenger cars per hour per lane with traffic moving at 55 miles per hour and still maintain a Level of Service (LOS) of A (the best rating possible and means that traffic is flowing freely without any disruptions or impediments to maneuverability). Current usage of this segment of SR 63 could double from current levels and LOS would remain at A.

The north gate to NECD, which is expected to be used by construction workers and possibly by operations workers as well, can be accessed from SR 63 by both northbound and southbound vehicles. There is no traffic light on SR 63 in the vicinity of the depot and the state of Indiana has no plans to install such a device (telephone conversation between Kevin Ruddick, Newport Chemical Depot, and Martin Schweitzer, Oak Ridge National Laboratory, Oak Ridge, Term., November 10, 1997). For vehicles approaching NECD from the north, there is a right turn lane on southbound SR 63 that is approximately 61 m (200 ft) long, allowing vehicles to enter the depot without backing up traffic on the highway. For vehicles approaching NECD from the south, there is a left turn Iane on northbound SR 63 that is currently around 76 m (2.50 ft) long. The Army Corps of Engineers plans to lengthen this before construction of the proposed neutralization facility begins so that it has 58 m (190 ft) of taper and 152 m (500 ft) for vehicle storage. For traffic Ieaving NECD and turning onto SR 63, there are no acceleration lanes for either northbound or southbound traffic, meaning that vehicles have to wait until traffic is sufficiently clear to allow them to merge onto the highway (telephone conversation between Mike Goodman, Army Corps of Engineers, Louisville, Kentucky, and Martin Schweitzer, Oak Ridge National Laboratory, Oak Ridge, Tenn., November 10, 1997).

3.6.3 Labor Force

The size of the resident Iabor force is roughly similar for four of the five counties in the socioeconomic impact area, the one exception being Vermilion County, Illinois, whose labor force is larger than that of the other four counties combined (Table 3.16). All five counties have unemployment rates higher than their respective states, but unemployment is substantially higher in Vermillion County, Indiana, and Vermilion County, Illinois, than in the other three counties. County per capita income in 1994 ranged from a low of $16,280 in Fountain County, Indiana, to a high of $18,098 in Vermilion County, Illinois. In all cases, county income was substantially less than the statewide average.

Table 3.17 shows how the people employed in each of the five impact area counties were distributed by economic sector. The proportion of manufacturing jobs was largest in Fountain and Vermillion counties, Indiana, but this sector was important throughout the five county area. Retail trade also was important in all five counties. Employment in the services sector was relatively low in Fountain County and relatively high in the two Illinois counties. While government employment was important everywhere, it was especially high in Parke County.

3.6.4. Housing

Key housing data for all five counties and selected towns in the impact area *are* provided in Table 3.18. This information, which comes from the 1990 decennial census, is the latest complete set available for the jurisdictions under study. The proportion of housing units occupied by renters varied from a little less than one-fifth in the town of Newport to just over one-third in Rockville. The median value of an owner-occupied unit and median rent were both lowest in the town of Newport. The median value of a home was highest in Rockville, while

Table 3.16. Employment and income for residents of the socioeconomic impact area

Location	Labor force[a]	Employed[a]	Unemployed[a]	Unemployment rate[a] (%)	Per capita income[b] ($)
Fountain Co., Ind.	8,505	8,070	435	5.1	16,280
Parke Co., Ind.	7,700	7,300	400	5.2	16,762
Vermillion Co., Ind.	8,115	7,505	610	7.5	16,652
Indiana	3,072,000	2,945,300	126,700	4.1	20,520
Edgar Co., Ill.	9,690	9,171	519	5.4	17,843
Vermilion Co., Ill.	39,602	36,409	3,193	8.1	18,098
Illinois	6,100,431	5,778,144	322,287	5.3	23,611

[a]All data related to labor force and employment are 1996 annual averages.
[b]Per capita income is for 1994.
Sources: Illinois Department of Employment Security 1997b; Parker 1997; University of Illinois 1996.

Table 3.17. Employment by economic sector in the five-county socioeconomic impact area[a]

Economic sector	Fountain Co., Ind. (%)	Parke Co., Ind. (%)	Vermillion Co., Ind. (%)	Edgar Co., Ill. (%)	Vermilion Co., Ill. (%)
Mining-Construction	2.3	2.2	4.1	2.8	3.0
Manufacturing	36.9	17.6	28.7	21.8	22.0
Transportation and utilities	2.1	5.0	7.0	4.5	4.2
Wholesale trade	3.3	2.5	1.7	7.5	5.8
Retail trade	20.5	17.3	21.5	18.0	20.2
Finance, insurance and real estate	4.6	6.2	2.7	5.5	4.3
Services	12.4	17.3	15.3	20.5	20.6
Federal, state, and local government	18.0	31.9	19.0	19.4	19.8
Total	100.1[b]	100.0	100.0	100.0	99.9

[a] Excludes agricultural employment. Data are annual averages for 1995 for Indiana counties and 1996 for Illinois counties.
[b] Total does not = 100% due to rounding.
Sources: Illinois Department of Employment Security 1997a; Indiana Department of Work Force Development 1997

Table 3.18. Housing data for the five-county socioeconomic impact area[a]

Location	Number of occupied housing units	Percent of units occupied by owner	Percent of units occupied by renter	Number of vacant housing units	Number of vacant units for sale	Number of vacant units for rent	Median value owner-occupied unit ($)	Median rent ($)
Fountain Co., Ind.	6,858	76.7	23.3	486	57	105	37,000	183
Parke Co. Ind.	5,845	79.0	21.0	1,344	67	107	37,900	193
Rockville	1,226	65.3	34.7	118	13	36	41,300	200
Vermillion Co., Ind.	6,638	80.2	19.8	650	74	130	32,300	186
Clinton	2,142	71.1	28.9	217	24	63	29,600	181
Newport	234	82.5	17.5	29	2	14	24,700	169
Edgar Co. Ill.	7,859	72.8	27.2	874	114	146	33,200	187
Vermilion Co., Ill.	34,072	71.2	28.8	2,989	409	1,011	38,700	223

[a] All data are for 1990.

Source: U.S. Bureau of the Census 1991.

rent was highest in Vermilion County, Illinois. In the entire five county area, there were 721 vacant units for sale and 1,499 for rent.

3.6.5 Cultural, Archaeological, and Historic Resources

An archaeological survey of the NECD property was performed in 1982. This survey used a 10.8% stratified sample of the plant area and found 144 archaeological sites. It also predicted the existence of 1,200-1,500 others (Reseigh, Cochran, and Wepler 1982). The proposed location of the NECDF is in a previously disturbed area. None of the 144 archaeological sites is within the proposed NECDF site. Ten of the 144 sites were thought to be potentially eligible for the National Register of Historic Places, but none of them have been determined to be eligible to date. A tour was conducted for NECD in 1991 by the Indiana Division of Historic Preservation and Archaeology and found no individual structures or districts that were eligible for inclusion in the National Register (Ralston 1991). More recently, the Indian Division of Historic Preservation and Archaeology has determined that there are no known historical or archaeological sites listed in or eligible for inclusion in the National Register of Historic Places that would be affected by any projects at NECD (see Appendix F).

Table 3.19 shows the number and types of sites in the five-county area that are listed on the National Register of Historic Places. Each county has several individual historic sites that are significant enough to be listed in the Register, but Parke County has twice as many listings as the other four counties combined. Thirty-two of the historic sites in Parke County are covered bridges, representing one of the highest concentrations of covered bridges anywhere in the country and constituting a significant tourist attraction. Four of the five sites in Vermillion County, Indiana, also are covered bridges, while none of the other counties have bridges listed in the Register. In addition *to* the individual historic sites, Fountain County has four historic districts, Parke County has two, and Vermilion County, Illinois, has one. There are no individual archaeological sites listed in any of the five impact area counties and only one archaeological district, which is located in Vermilion County, Illinois.

Table 3.19. Sites in the five-county socioeconomic impact area listed on the National Register of Historic Places

Location	Individual historic sites	Individual archaeological sites	Historic districts	Archaeological districts
Fountain Co., Ind.	5	0	4	0
Parke Co., Ind.	39	- - 0	2	0
Vermillion Co., Ind.	5	0	0	0
Edgar Co., Ill.	5	0	0	0
Vermilion Co., Ill.	4	0	1	1

Source: National Park Service 1997.

3.6.6 Environmental Justice

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (February 11, 1994)*, requires all federal agencies to identify and address, as appropriate, disproportionately high and adverse human health conditions or environmental effects of their programs, policies, and activities on minority and low-income groups. In the same Executive Order 12898 (hereafter referred to as the Order), EPA was directed to convene an interagency Federal Working Group on Environmental Justice. The Working Group has established draft criteria for identifying such vulnerable populations, but has not issued final guidelines. The Department of Defense's environmental justice strategy is being developed in accordance with the guidelines of the Order, in keeping with the established schedule.

The Order does not define minority groups. The Bureau of the Census provides the basis for identifying racial groups. The Census racial statistics use five basic racial categories: American Indian or Alaska Native, Asian or Pacific Islander, Black, White, and an "Other race" category that allows respondents a write-in entry. The concept of race reflects the self-identification by respondents and is not intended to reflect any biological or anthropological definition. Persons of Hispanic origin are identified as an ethnic group and may be of any race. In the 1990 census, persons of Spanish/Hispanic origin categories were asked to classify themselves in one of the specific Hispanic origin categories — Mexican, Puerto Rican, Cuban, or Other Spanish/Hispanic origin (U.S. Bureau of the Census, *Statistical Abstract of the U.S.* 1995).

The need to examine potential health impacts on children are also discussed in Executive Order 13045 of April 21, 1997, *Protection of Children From Environmental Health Risks and Safety Risks*. The Order established that each Federal agency

(a) shall make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children; and

(b) shall ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.

Environmental health and safety risks are those "attributable to products or substances that the child is likely to come in contact with or ingest . . ." The same executive order established a task force, but no planning guidance has yet been issued.

The size of the minority and low income populations residing in the socioeconomic impact area is shown in Table 3.20. The percentage of minority residents in each Indiana county and municipality within the impact area is a small fraction of the minority population living in the state as a whole. Similarly, Edgar County has a-very small minority population compared to the state of Illinois. The proportion of minorities in Vermilion County, Illinois, is much larger than in any of the other counties in the impact area, but even here the percentage of minority residents is substantially lower than the statewide average.

Contrary to the situation with ethnic minorities described above, most of the local jurisdictions shown in Table 3.20 have a higher percentage of low income residents than their states as a whole. The exceptions are Fountain and Vermillion counties in Indiana, where the percent of residents living below the poverty level is less than for the entire state. The percentage of low income residents in Parke County is only slightly higher than the statewide

Table 3.20. Minority and low income populations residing in the five-county socioeconomic impact area (in percent)

Location	Black	Native American	Asian	Other race	Hispanic	Poverty status
Fountain Co., Ind.	< 0.1	0.1	0.2	0.2	0.5	9.8
Parke Co., Ind.	0.8	0.3	0.1	0.1	0.6	12.2
Rockville	0.1	0.5	0.0	0.0	0.6	15.6
Vermillion Co., Ind	0.1	0.2	0.2	0.1	0.4	11.7
Clinton	0.2	0.4	0.1	< 0.1	0.5	14.6
Newport	0.0	0.0	0.3	0.2	0.5	19.8
Indiana	7.8	0.2	0.7	0.7	1.8	12.0
Edgar Co., Ill.	0.4	0.1	0.1	0.1	0.3	16.0
Vermilion Co., Ill.	8.9	0.2	0.6	0.9	1.6	15.2
Illinois	14.8	0.2	2.5	4.2	7.9	13.5

“All data are for 1990 except for poverty status, which is for 1989.
Source: U. S. Bureau of the Census 1991.

average, but the poverty rate is considerably greater in the three towns examined. In Illinois, both impact area counties have higher-than-average numbers of residents classified as having poverty status.

3.7. SEISMICITY

Seismic information plays a role in this EIS through the consideration and evaluation of accidents that could be initiated by earthquakes. This section summarizes the seismic information relevant to earthquake-induced accidents at NECD. Additional, more detailed information on the deterministic seismic hazards and the probabilistic seismic risks can be found in Appendix G.

According to Blume (1987) a near-field (less than 10 km away) earthquake in the central United States “seismic source zone” would produce the *largest* expected ground motion at NECD. However, the more recent findings in Weston (1996) suggest that the most *likely* contributor to seismic ground motions would be a moderately large event occurring at considerable distance from the NECD site.

The Weston (1996) report also includes a probabilistic seismic hazards analysis. The Weston analysis was conducted to estimate the-annual likelihood of occurrence of seismic ground-motion events at the NECD site. The Weston report provides a range for the mean annual probability of exceeding peak ground accelerations at NECD for three types or categories of soils.

In the Weston report, the seismic hazards were found to be consistent with other hazard estimates made previously for the U.S. mid-continent. The findings from the Weston report have been integrated into the design of structures and subsystems to be constructed as part of the proposed facilities at NECD.

3.8 REFERENCES

Ace-Federal Reporters, Inc. 1988. *Transcript of Proceedings: Public Hearing on the Final Environmental Impact Statement (FEIS) by Department of the Army, Clinton, Indiana, Tuesday, January 26, 1988.*

Ace-Federal Reporters, Inc. 1992. *Transcript of Proceedings: Public Scoping Meeting for the Proposed Newport Chemical Agent Disposal Facility, Vermillion Co., Indiana, Friday, April 3, 1992.*

Agee, E. M. 1970. *The Climatology of Indiana Tornadoes*, Proceedings of the Indiana Academy of Science for 1969, Volume 79.

ASCE (American Society of Civil Engineers), 1990. *Minimum Design Loads for Buildings and other Structures* (ASCE Standard, approved by the American National Standards Institute, ANSI), ANSI/ASCE 7-88, American Society of Civil Engineers, New York, New York, 94 pp.

Banaszak, K. J. 1988. "Indiana Ground-Water Quality," pp. 245–250, in *National Water Summary 1986—Hydrologic Events and Ground-Water Quality*, compiled by D. W. Moody, J. Carr, E. B. Chase, and R. W. Paulson, U.S. Geological Survey, Water-Supply Paper 2325, U.S. Government Printing Office, Washington, D.C.

Bender, E. S., and J. G. Pearson. 1975. Results from Aquatic Ecological Surveys at Newport Army Ammunition Plant, Newport Indiana. Edgewood Arsenal Technical Report EB-TR-75044. Dept. Army, Headquarters, Edgewood Arsenal, Aberdeen Proving Ground, MD.

Blume (Jacobs Engineering Group, Inc., and URS/John A. Blume and Associates, Engineers) 1987. *Geological-Seismological Investigation of Earthquake Hazards for a Chemical Stockpile Disposal Facility at the Newport Army Ammunition Plant, Indiana,* contractor report to the U.S. Army Engineer Division, Huntsville, Ala., prepared under contract number DACA87-86-D-0085 by the Jacobs Engineering Group, Inc., San Francisco, and URS/John A. Blume and Associates, Engineers, San Francisco.

Boneham, R. F. 1980. "Environmental Geology of Fountain, Parke, and Vermillion Counties, Indiana," pp. 3 10–3 19, in *Proceedings of the Indiana Academy of Science for 1979*, Vol. 89, 1980.

Brady, N. C. 1974. *The Nature and Properties* of Soils, eighth edition, Macmillan Publishing Co., Inc., New York.

Chandler, CR., and Weiss, R.A. 1994. *Avifauna of the Newport Army Ammunition Plant with Emphasis on Endangered, Threatened and Candidate Species*, Report submitted to NAAP 28 September, 1994.

COE (U.S. Army Corps of Engineers) 1967. "Flood Control in the Ohio River Basin," Appendix M, *Ohio River Basin Comprehensive Study*, Volume XIV, U.S. Army Engineer Division, Ohio River Corps of Engineers, Cincinnati, Ohio, December.

Code of Federal Regulations (40 CFR Part 141). 1996. Title 40: Environmental Protection Agency; Part 141: "National Primary Drinking Water Regulations," U.S. Government Printing Office, Washington, D.C., July 1, pp. 288-429.

Code of Federal Regulations (40 CFR Part 143). 1996. Title 40: Environmental Protection Agency; Part 143: "National Secondary Drinking Water Regulations," U.S. Government Printing Office, Washington, D.C., July 1, pp. 470-473.

Crompton, E. J., and Graves, T. 1990. "Indiana Water Supply and Use," pp. 243-250, in *National Water Summary 1987—Hydrologic Events and Water Supply and Use,* compiled by D. W. Moody, J. Carr, E. B. Chase, and R. W. Paulson, U.S. Geological Survey, Water-Supply Paper 2350, Federal Center, Denver.

EPA (U.S. Environmental Protection Agency) 1982. *STORET User Handbook*, Water Quality Control Information System, EPA, Washington, D.C.

Flint, R. F. 1957. *Glacial and Pleistocene Geology*, John Wiley & Sons, Inc., London · Chapman & Hall, Ltd.

Freeze, R. A., and Cherry, J. A. 1979. *Groundwater,* Prentice-Hall, Inc., Englewood Cliffs, N.J.

Gammon, J. R. 1991. The Environment and Fish Communities of the Middle Wabash River. Report for Eli Lilly and Company, Indianapolis, and PSI Energy, Plainfield, IN.

Glatfelter, D. R., Newman, J. E., Mann, M., and Beik, S. 1991. "Indiana Floods and Droughts," pp. 271-278, in *National Water Summary 1988-89—Hydrologic Events and Floods and Droughts,* compiled by R. W. Paulson, E. B. Chase, R. S. Roberts, and D. W. Moody, U.S. Geological Survey, Water-Supply Paper 2375, Books and Open-File Reports Section, Federal Center, Denver.

Gray, H. H., Bleuer, N. K., Hill, J. R., and Lineback, J. A. 1979. *Geologic Map of the 1 % and 2 % Indianapolis Quadrangle, Indiana and Illinois, Showing Bedrock and Unconsolidated Deposits*, Regional Geologic Map No. 1, Indianapolis Sheet, Ind. Geological Survey, Department of Natural Resources, Bloomington, Ind.

Grazulis, T.P., J. T. Schaefer, and R.F. Abbey, 1993. Advances in tornado climatology, hazards, and risk assessment since Tornado Symposium II, pp. 409-426 in: *The Tornado: Its Structure, Dynamics, Prediction, and Hazards*, C. Church, D. Burgess, C. Doswell, and R. Davies Jones, eds., Geophysical Monograph 79, American Geophysical Union.

Hauer, J. M., 1992. Letter to Brigadier General Walter M. Busbee, U.S. Army Program Manager for Chemical Demilitarization, from Jerome M. Hauer, Director, State Emergency Management Agency and Department of Fire and Building Services, June 15. 1992.

Hedge, C.L., and Bancoe, J. A. 1994. *Inventory of Natural Areas and Rare Plant Species within the Newport Army Ammunition Plant,* Indiana Department of Natural Resources, Report submitted to NAAP June 1994.

Hem, J. D. 1989. *Study and Interpretation of the Chemical Characteristics of Natural Water*, third edition, third printing, U.S. Geological Survey, Water-Supply Paper 2254, U.S. Government Printing Office, Washington, D.C.

HUD (U.S. Department of Housing and Urban Development) 1978. *Flood Hazard Boundary Map, Vermillion County, Indiana, Unincorporated Areas*, Federal Insurance Administration, Community-Panel Number 180449 0003 A, p. 3 of 4, effective date, November 24.

IDEM (Indiana Department of Environmental Management) 1997. *National Pollutant Discharge Elimination System (NPDES) Permit No. IN 0003506, U.S. Army Newport Chemical Depot, Mason & Hanger* Corp., Indianapolis, Indiana, cover letter, 24 pp. to permit, and briefing memo (May 1).

Illinois Department of Employment Security 1997a. *Labor Force and Establishment Data*, Springfield, Ill.

Illinois Department of Employment Security 1997b. *Local Area Unemployment Statistics*, Springfield, Ill.

Indiana Department of Transportation 1993. 1993 *Annual Average Daily Traffic, Vermillion County*, Indianapolis, Ind.

Indiana Department of Workforce Development 1997, *Covered Employment and Wages*, Indianapolis, Ind.

Jackson, M.T. 1976. *Assessment of Endangered, Threatened, and Rare Plant Species in the Vicinity of the Newport Army Ammunition Plant, Vermillion County, Indiana*. Unpublished Report to Edgewood Arsenal, Aberdeen Proving Ground.

Jackson, M.T. and Whitaker, J. O. 1987. *Endangered and Threatened Pants and Vertebrate Animals of the Newport Army Ammunition Plant* (NAAP), unpublished manuscript June 30, 1987.

Kempton, J. P., Ringler, R. W., Heigold, P. C., Cartwright, K., and Poole, V. L. 1981. *Ground-Water Resources of Northern Vermilion County, Illinois,* Environmental Geology Notes 101 (PB82-140468), 111. State Geological Survey, Champaign, Ill.

Mallott, C . A. 1922. *The Physiography of Indiana*; in Hedge and Bancoe 1994.

Mason & Hanger - Silas Mason Co. 1991. *Natural Resources Management Plan for the Newport Army Ammunition Plant*. Contract No. DAAA09-90-Z-0002, revised November 25, 1991.

Miller, A.C. 1984. A Mollusc Evaluation at the Newport Army Ammunition Plant, Newport Indiana. Department of the Army Waterways Experiment Station, Corps of Engineers. Vicksburg, MS.

National Park Service 1997. *National Register Information System* (http://www.nr.nps.gov/) July.

Parke County Convention and Visitors Bureau 1992, *List of Events in Parke County in 1992*.

Parke County Emergency Management 1996. *Parke Co., Indiana Emergency Operations Plan*, Rockville, Ind.

Pinkham, C.F.A., Herbert, H.D., Fuller, J. J., Stiles, D.A., Worthey, E.G., and Pearson, J. G. 1976. *Terrestrial Ecological Surveys at Newport Army Ammunition Plant, Indiana*, Edgewood Arsenal Technical Report.

PRC Environmental Management, Inc. (PRC) 1997. *Biological Survey of Federal Endangered Bats Newport Chemical Depot,* Army Material Command Contract No. DAAA08-94-D-0007, Delivery Order 0022.

Ralston, P. R. 1991. Letter from P. R. Ralston, Indiana Department of Natural Resources, Division of Historic Preservation and Archaeology, to D. A. Lichtenberger, Newport Army Ammunition Plant, Sept. 30.

Reseigh, W. E., D. R. Cochran, and W. R. Wepler 1982. *An Archaeological Survey of the Newport Army Ammunition Plant, Vermillion County, Indiana: Predicting the Archaeological Potential of an Upland Forest—Prairie Edge in West Central Indiana*, Archaeological Resources Management Service, Department of Anthropology, Ball State University, Muncie, Ind .

Schaefer, J. T., R. L. Livingston, F. P. Ostby and P. W. Leftwich, 1993. The stability of climatological tornado data, pp 459-466 in: *The Tornado: Its Structure, Dynamics, Prediction, and Hazards*, C. Church, D. Burgess, C. Doswell, and R. Davies Jones, eds., Geophysical Monograph 79, American Geophysical Union.

Schneider, A. F. 1966. "Physiography," pp. 40–56 in *Natural Features of Indiana*, ed. A. A. Lindsey, Ind. Academy of Science, Ind. State Library, Indianapolis.

Transportation Research Board 1994. *Highway Capacity Manual, Special Report 209, Third Edition*, National Research Council, Washington, D .C.

University of Illinois 1996. *1996 Illinois Statistical Abstract*, Urbana-Champaign, Ill.

U.S . Department of the Army 1979. *Installation Assessment for Newport Army Ammunition Plant*, Report No. 142, U.S. Army Toxicity and Hazardous Materials Agency, Aberdeen Proving Ground, Md.

U.S . Army 1980. *Environmental Assessment of Newport Army Ammunition Plant Operations,* prepared for the U.S. Army by Uniroyal, Inc., Newport, Ind.

U.S. Army 198 1. *Final Programmatic Environmental Impact Statement, Binary Chemical Munitions Program,* ARCSL-EIS-8101, U.S. Army, Aberdeen Proving Ground, Md.

U.S. Army 1985. *Proposed Closure Plan for Deep Disposal Well No. 1 at the Newport Army Ammunition Plant, Newport, Indiana,* prepared for Uniroyal, Inc., by Ken E. Davis Associates, KEDA Project No. 10-489.

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

U.S. Army 1992a. *Construction Permit Application for the Department of the Army Newport Army Ammunition Plant Chemical Stockpile Disposal System*, submitted to the Ind. Department of Environmental Management, Indianapolis, by Newport Army Ammunition Plant, Newport, Ind. (June).

U.S. Army 1992b. *Resource Conservation and Recovery Act Hazardous Waste Permit Application for the Army Newport Army Ammunition Plant Chemical Stockpile Disposal System*, Volume I, submitted to the Ind. Department of Environmental Management, Office of Solid and Hazardous Waste Management, Indianapolis, by Newport Army Ammunition Plant, Newport, Ind. (June).

U.S. Army 1992c. *Resource Conservation and Recovery Act Hazardous Waste Permit Application for the Army Newport Army Ammunition Plant Chemical Stockpile Disposal System*, Volume III, submitted to the Ind. Department of Environmental Management, Office of Solid and Hazardous Waste Management, Indianapolis, by Newport Army Ammunition Plant, Newport, Ind. (June).

USAEHA (U.S. Army Environmental Hygiene Agency) 1975. *Water Quality Study, Newport Army Ammunition Plant, Newport, Indiana 47966, 15 April — 3 May 1973, 29 January — 8 February 1974*, written by J. T. Watson and J. W. Bauer, Water Quality Engineering Special Study No. 24-026-73175, Aberdeen Proving Ground, Maryland.

USATHAMA (U.S. Army Toxic and Hazardous Materials Agency) 1991. *Draft Site Investigation Report for the Night Soils Pits, TNT Manufacturing Area, Chemical Plant, Decontaminated Waste Burial Ground, and Little Raccoon Creek*, Volume 1 of 2: Text, Appendices A-B, Contract No. DAAA 15-88-D-0008, Task No. 0010, prepared by Dames & Moore, Bethesda, Maryland, for USATHAMA, Aberdeen Proving Ground, Maryland (October).

U.S. Bureau of the Census 1981, *1980 Census of Population and Housing*.

U.S. Bureau of the Census 1991, *1990 Census of Population and Housing*.

U.S. Bureau of the Census 1992. *1992 U. S. Census of Agriculture*.

U.S. Bureau of the Census 1995, *Time Series of Resident Population of Places: April 1, 1990 to July 1, 1994*.

U.S. Bureau of the Census 1997, *Estimates of the Population of Counties: July 1, 1996*.

USDA (U.S. Department of Agriculture) 1978. *Soil Survey of Vermillion County, Indiana,* Soil Conservation Service in cooperation with Purdue University Agricultural Experiment Station, Indianapolis.

USGS (U.S. Geological Survey) 1980. *Water Resources Data for Indiana, Water Year 1979*, Report No. USGS/WRD/HD-80/052, Water Resources Division, Indianapolis, Ind., available from the National Technical Information Service, Springfield, Virginia (June).

Vermillion County Improvement Association 1992, *Special Events in Vermillion County in 1992*.

Voelker, D. C., and Clarke, R. P. 1988. "Illinois Ground-Water Quality," pp. 237-244 in *National Water Summary 1986—Hydrologic Events and Ground- Water Quality*, compiled by D. W. Moody, J. Carr, E. B. Chase, and R. W. Paulson, U.S. Geological Survey, Water-Supply Paper 2325, U.S. Government Printing Office, Washington, D.C.

Watkins, F. A., Jr., and Jordan, D. G. 1965. *Ground-Water Resources of West-Central Indiana, Preliminary Report: Vermillion County*, Bulletin No. 29 of the Division of Water Resources, prepared by the Geological Survey, US. Department of the Interior, in cooperation with the Division of Water Resources, Ind. Department of Conservation, Indianapolis.

Weston 1996. *Probabilistic Seismic Hazard Analysis of the Newport AAP, Indiana, Chemical Agent Demilitarization Facility (Final Report)*, prepared for Science Applications International Corp., Abington, Md., by Weston Geophysical Corp., Northboro, Mass., December.

Whitaker, J.O., 1994. *Survey of Endangered, Threatened, and Special Concern Fishes, Amphibians, Reptiles and Mammals at the Newport Army Ammunition Plant, Newport Indiana*, Report to Mason & Hanger - Silas Mason Co., Inc., June 1, 1994.

Zuehls, E. E., and Wendland, W. M. 1991. "Illinois Floods and Droughts," pp. 263-270, in *National Water Summary 1988-89—Hydrologic Events and Floods and Droughts,* compiled by R. W. Paulson, E. B. Chase, R. S. Roberts, and D. W. Moody, U.S. Geological Survey, Water-Supply Paper 2375, Books and Open-File Reports Section, Federal Center, Denver.

4. ENVIRONMENTAL IMPACTS

This chapter identifies the potential health and environmental impacts of (1) the proposed action — construction and pilot testing of the full-scale Newport Chemical Agent Disposal Facility (NECDF) and (2) no action — continued storage of agent VX at NECD. For both alternatives, potential impacts are analyzed under routine (i.e., incident-free, daily operation) activities and under the unlikely event of an accidental release of agent VX. As noted in Sect. 1.4, any use of the proposed NECDF beyond pilot testing is beyond the scope of this EIS and would be addressed in future NEPA documentation.

4.1 PILOT TESTING OF THE NECDF ALTERNATIVE

This section presents the impacts of construction and pilot testing of the NECDF alternative — chemical neutralization followed by supercritical water oxidation (SCWO). The impacts from construction are detailed in Sect. 4.1.1; the impacts from routine pilot testing of the NECDF are presented in Sect. 4.1.2, and the impacts from accidents occurring as a result of pilot testing are presented in Sect. 4.1.3.

4.1.1 Construction Impacts

Construction of the pilot testing facility at NECD would require approximately 16 ha (40 acres) for the physical plant structure and support facilities (such as the personnel maintenance building), and between 4 and 12 ha (between 10 and 30 acres) for a new access road and utilities (including water lines, sewage lines, power lines, power substation, and underground communications cable) (see Sect. 2.2.2). Construction would result in vehicle exhaust emissions, fugitive dust, destruction of wildlife habitat and native vegetation, increased employment, increased demand for public services and utilities, and occupational health hazards. The following subsections describe these impacts from construction in further detail.

4.1.1.1 Impacts on land and water use

Local land use and zoning would not be affected by construction because the proposed pilot testing facility would be built on an Army installation. No major off-site construction would be required to build the facility although some off-site upgrades to utilities may be necessary. Any off-site construction of utilities, if required, could involve both public and private lands. Easements would be sought for the right-of-way for any required off-site utility construction. No noticeable changes in the general character of off-site land uses (i.e., neither agricultural, urban, nor other non-agricultural uses) are anticipated as a result of facility or utilities construction.

Excavation and earthwork during construction of the pilot testing facility would alter the land surface. Construction would disturb soils and increase the potential for on-site runoff, erosion, seepage, and sedimentation. Standard engineering practices such as the installation of earthen and straw berms, liners, covers, and plastic sheeting as well as grading of the land surface, would partially control runoff, erosion, seepage, and sedimentation. All excavation and earthwork would be performed in accordance with an approved erosion and sedimentation control plan.

Minimal, intermittent, uncontrolled runoff and associated sediments would flow overland from the pilot testing facility site into the Little Raccoon Creek watershed. Part of this drainage would be intercepted and detained by the settling basin formed by the small earthen dam across Little Raccoon Creek. The remaining portion of the runoff would flow overland into portions of the Little Raccoon Creek watershed located below the dam. Coarse-grained sediments would sink to the bottom of the settling basin. The ephemeral flow of the creek would provide some dilution of contaminants and dispersion of fine-grained sediments during the rainy season in the winter and spring. The natural flow of the creek would be minimal or nonexistent during the summer and fall. Dilution and dispersion would not occur until contaminants and fine-grained sediments were carried downstream into the Wabash River. The relatively large perennial flow of the Wabash River would rapidly dilute runoff and disperse construction-related sediments to acceptable levels.

If required, effluent from construction dewatering activities and storm water runoff would be directed to a lined detention basin prior to discharge into the Little Raccoon Creek watershed. The basin would minimize overland flow of uncontrolled runoff and partially retain sediments. Perennial species (i.e., grass) suitable for the climate would be planted as soon as possible after completion of construction to prevent further damage. No permanent adverse impacts to land use or surface water would be expected to occur during construction. Construction-related chemicals deposited along the streambed of the Little Raccoon Creek during drier times would be flushed out and carried to the Wabash River during the rainy season in the winter and spring.

Construction materials including solvents, paint, sealer, diesel fuel, oil and grease, caulk, and other, as yet, unidentified materials that could contain hazardous chemicals would not affect water resources during routine construction activities. However, construction materials could contaminate surface water or groundwater if a major spill occurred. Accidental spills involving construction materials would be similar in behavior to spills of chemical agent, but would have much less severe environmental consequences. The impacts of accidental spills of chemical agent are discussed in further detail in Sect. 4.1.3.2. Accidental spills of construction materials into the surface water and groundwater regimes would be contained and cleaned up in a timely manner, and in accordance with the spill prevention, control, and countermeasures plan (U.S. Army 1990; 1996), such that permanent off-site environmental impacts would not be expected to occur.

Inevitably, some construction-related chemicals would seep into the glacial till. A portion of these chemicals would be adsorbed onto solids (i.e., clays) in the till, and a portion would enter sand and gravel lenses (in the till). Most contaminants entering the sand and gravel lenses would migrate downgradient parallel to the ground surface (see Fig. 3.5) and discharge as baseflow into Little Raccoon Creek. Some contaminants would remain stagnant in the lenses, while some contaminants could be induced to flow towards off-site consumers of groundwater. The potential for off-site contamination would depend on the lateral extent of the lenses, the degree of hydraulic communication between lenses, and whether lenses that are pumped by consumers of groundwater are present beneath the pilot testing facility site.

Small quantities of construction-related seepage that discharged into Little Raccoon Creek would be diluted to acceptable levels during the rainy season in the winter and spring. During the dryer summer and fall, seepage that entered Little Raccoon Creek would flow undiluted downstream into the Wabash River, where dilution to acceptable levels then would occur.

Seepage of construction-related chemicals into the groundwater would be minimized by storing solvents in approved containers and refueling equipment in controlled areas. Abandoned wells, if encountered during construction, would be closed in a manner approved by EPA and the State of Indiana. Abandoned agricultural drain tiles would be removed if encountered during construction.

Water use during construction would include rinsing of equipment, structures, and materials; mixing of concrete aggregate, grout, and mortar; preparation of construction materials that would be combined with water prior to use; and potable drinking water for construction workers. Water would be available to extinguish accidental fires that could occur during construction.

Water for potable and nonpotable use would be obtained from the NECD Ranney well field adjacent to the Wabash River (see Sect. 3.3.2.5). Enormous reserve water supply capacity is available from the Ranney well field. The demand for water during construction would be intermittent and probably could be satisfied by storage routinely available in the existing water supply system. Drinking water for construction workers would be provided using bottled water in addition to potable water originating from the Ranney well field.

Sanitary waste, the only liquid effluent routinely collected during construction, would be handled in the existing on-site NECD sewage treatment plant. The total number of workers on-site at NECD during construction of the pilot testing facility would be approximately 700 (400 workers for construction plus 300 for other NECD activities), while the existing sewage treatment plant is capable of handling the sanitary waste produced by 2,000 people. Improved compliance with the NPDES permit limits would be expected to occur because the rate at which sanitary waste passes through the sewage treatment plant would be closer to the design capacity. Portable toilets also would be provided by the on-site architect/engineer and/or the COE. No adverse environmental impacts would be expected from the treatment and disposal of sanitary waste during construction of the pilot testing facility.

4.1.1.2 Air quality and noise impacts

Air **Quality Impacts.** Temporary and localized increases in atmospheric concentrations of nitrogen dioxide (NO_x), carbon monoxide (CO), sulfur dioxide (SO_x), volatile organic compounds (VOCs), and particulate matter (TSP, PM-10, and PM-2.5) would result from exhaust emissions of worker's vehicles, heavy construction vehicles, diesel generators, and other machinery and tools. Construction vehicles and machinery would be equipped with standard pollution-control devices to minimize-emissions. These emissions would be very small compared to thresholds typically used by regulators to determine whether further air-quality impact analysis is necessary.

Fugitive dust would result from excavation and earthwork. The impacts of this dust on off-site ambient-air concentrations of particulate matter were modeled using the EPA-recommended Industrial Source Complex Short-Term (ISCST3) air dispersion model (U.S. EPA 1995). An average emission factor of 1.02 grams of total suspended particulate matter per hectare per second (1.2 tons per acre per month) was assumed (U.S. EPA 1985). Of these emissions, 30% of the mass is expected to consist of particles less than 10 micrometers (μm) in diameter (PM-10), and 15% is expected to consist of particles less than 2.5 μm in diameter (PM-2.5) (Kinsey and Cowherd, 1992). The maximum area disturbed at any one time was assumed to be 8 ha (20 acres). It was further assumed that sprinkling with water would reduce fugitive dust by 50% (U.S. EPA 1985), and that all construction would occur during daylight hours.

Meteorological input consisted of hourly data from Cayuga, about 10 km (6 mi) north of NECD. This is the nearest location for which surface meteorological data are routinely archived and formatted for use in atmospheric dispersion models. Estimates of mixing height were obtained from surface wind speed and atmospheric stability using the method suggested for screening models by EPA (1988). Because the ground surface around NECD is relatively flat and homogeneous, meteorological conditions affecting dispersion at NECD are similar to those at Cayuga. Data for 1988 were readily available and were used as a typical year in the modeling.

Concentrations of TSP, PM-10, and PM-2.5 were modeled at 100-m (328-foot) intervals along the site boundary closest to the proposed facility, and at greater intervals along other parts of the site boundary. To assure that the analysis included the point of maximum impact, concentrations were also modeled at several locations outside the site boundary. Maximum modeled increases in particulate-matter concentrations that would be expected to result from construction of the proposed facility are given in Table 4.1. The highest modeled concentration increases occurred along the southern and eastern site boundaries.

Existing on-site sources of particulate matter include diesel generators, a waste water incinerator, and a degreasing facility. It is expected that deconstruction of the existing TNT plant would occur during construction of the proposed facility. Modeling of these sources indicated that they have negligible effects (e.g., less than 1 $\mu g/m^3$ for a 24-hour average) on pollutant concentrations at the site boundary.

Results of adding upper-bound estimates of existing background concentrations to the maximum modeled increases from construction of the proposed facility indicated that the maximum expected (combined) annual average PM-10 concentration during construction would be 28 $\mu g/m^3$, and the maximum expected (combined) 24-hour average would be 120 $\mu g/m^3$ (Table 4.1). Both of these values are less than 90% of NAAQS. It is concluded from this very conservative analysis that no exceedance of NAAQS for PM-10 would result from construction.

Cumulative PM-2.5 impacts cannot be evaluated because this standard has only recently been enacted, and a network of monitoring stations is not expected to be in place before the end of 1998. The proposed construction would not be expected to cause annual PM-2.5 concentrations to increase by more than 3 % of NAAQS, or maximum 24-hour average concentrations to increase by more than 23 % of NAAQS.

Upper-bound estimates of TSP concentrations (modeled increases plus estimated background) were less than the Indiana primargstandards at all off-site locations. One exceedance per year of the 24-hour standard is allowed. The estimated maximum 2nd-highest 24-hour concentration equaled the standard at one location along the southern site boundary, where it runs closest to the location of the proposed construction. Estimated 2nd-highest 24-hour average concentrations were less than 95 % of the standard at all off-site locations.

Table 4.1. Maximum expected off-site concentrations of par-ticulate matter during construction

Averaging period	Concentrations ($\mu g/m^3$) Maximum modeled increase[a]	Estimate of existing background[b]	Total"	Applicable standard[d]	Total as percent of standard
		PM-10[d]			
24-hour	31	89	120	150	80
annual	1	27	28	50	56
		PM-2..5[d,e]			
24-hour	15	--	> 15	65	> 23
annual	0.5	--	> 0.5	15	> 3
		TSP[d]			
24-hour	103	157	260	260	100
annual	4	64	68	75	91

"The maximum modeled concentration increase associated with the proposed action at any location off site or along the site boundary.

[b]This value includes monitoring results from Table 4.1 plus the modeled contributions from off-site and on-site sources as explained in the text. Background values of hazardous materials (CS, and agent VX) are assumed to be zero.

'The sum of the preceding two columns, for comparison with the applicable ambient-air standard or guideline.

[d]National Ambient Air Quality Standards (NAAQS) exist for particulate matter equal to or less than 10 μm diameter (PM-IO) and equal to or less than 2.5 μm in diameter (PM-2.5). Indiana standards apply to TSP, which is not regulated by NAAQS. The NAAQS and the Indiana standards are listed in Table 4.1.

'The NAAQS for PM-2.5 have only recently been enacted; EPA has not yet established a network of monitoring stations for estimating background concentrations.

Earthwork as intense as that considered in the modeling would not be expected to last for an entire year. Therefore, the annual averages of particulate-matter concentration are expected to be less than indicated in this upper-bound analysis.

Noise impacts. Earthwork and associated activities would result in generation of noise due to the operation of vehicles and heavy equipment. Maximum noise levels from such activities typically range from 85 to 90 dB(A) at a distance of about 16 m (50 ft) from the source (U.S. EPA 1978). Estimated noise levels decrease by 6 dB for each doubling of the distance from the source if no absorption of sound energy occurs. At the distances involved, structures, vegetation, and terrain features would absorb some of the sound energy. Therefore, expected noise levels from construction of the proposed facility would be less than 54 db(A) at the nearest site boundary, and even less at the nearest residence. It is concluded that maximum expected noise levels at the nearest residence would be well below the level of 55 dB(A) identified by EPA as a yearly average, which, if not exceeded, would prevent activity interference and annoyance (U.S. EPA 1978).

4.1.1.3 Human health impacts

No deleterious effects to the health of workers are expected from construction. The potential for human health. impacts because of construction of the demilitarization facility would be limited to occupational hazards. Off-site impacts to human health are not expected. Safety hazards would be present during the operation of heavy construction vehicles and machinery.

Occupational health impacts from construction would not be significant during routine activities because standard procedures, construction practices, and protective clothing and equipment would be used by workers to minimize exposure to unhealthy levels of noise and airborne emissions.

4.1.1.4 Ecological impacts

Aquatic Resources. Wetlands and surface waters close to the construction site may be adversely, but temporarily, affected by sedimentation or spills related to construction activities. These activities include soil disturbance from earth moving activities, generation of wastewater from, for example, equipment washing, and small leaks and spills of liquids such as oils and fuels from vehicles (probably no more than a few liters per incident).

The effects of increased suspended solids and siltation on aquatic biota are well documented and include reduction of light penetration and photosynthesis, impairment of respiration (gill function) and feeding, obliteration of spawning sites and microhabitats such as the interstitial spaces of bottom substrates, smothering of benthos and demersal fish eggs, alterations in species composition, and lowered fish production. Accidental spills could introduce potentially toxic oils, cleaning wastes, or other undesirable liquids into nearby surface waters.

Under the proposed alternative, adverse effects of facility construction and associated activities would probably be minimal, because of the small volume of spills or sediment-laden runoff likely to be generated, and the great dilutive capability of the Wabash River nearby. A sizeable spill of oil or wastewater could adversely but temporarily affect Little Raccoon Creek and its aquatic biota. Even these minor impacts can be prevented or substantially reduced through the proper use of runoff control measures including careful grading practices, interception and retention of runoff in adequately sized settling basins, stabilization of soils promptly after disturbance, and use of sediment barriers such as silt fences.

Terrestrial Resources. No significant impacts on terrestrial ecology at or adjacent to the site would be expected from construction of the project. Approximately 16 ha (40 acres) would be disturbed by the construction of the physical plant structure and support facilities (such as the personnel maintenance building), and between 4 and 12 ha (10 and 30 acres) for utility rights-of-way. The vegetation in these areas is primarily fescue-dominated pasture interspersed with occasional small clumps of brush. No rare or unique plant or animal species, or natural communities are known to exist within the pilot test facility or support facility construction site. No wetlands are present in the project and support facility areas. Utilities would be routed to avoid wetlands and known locations of rare species and natural communities. Standard erosion and sedimentation controls would be employed to prevent introduction of suspended solids into wetlands and streams. Due to the distances of the proposed site from sensitive ecological resources, impacts to them from construction are considered unlikely. Construction of the pilot test facility and its support facilities would, however, eliminate pasture habitat and thereby displace some associated small birds and mammals. This loss of habitat will reduce populations of these species to a small extent; however, effects on these species would not be significant because the species are common and there is abundant similar habitat surrounding the site. If any jurisdictional wetlands under Sect. 404 of the Clean Water Act or other authorities would be displaced, then all applicable regulatory requirements would be met.

Threatened and Endangered Species. There are no federally designated threatened or endangered species or state designated endangered species within the boundaries of the proposed pilot test facility. Closed canopy riparian woodland comprising suitable Indiana bat foraging habitat extends up the headwaters of Little Raccoon Creek into the southern section of the proposed facility area. Approximately 2.7 ha (6.6 acres) of this habitat will be cleared for construction of a lined storm-water detention basin. No Indiana bat has been captured in the area to be cleared; the closest capture location is approximately 0.5 km (0.3 miles) to the south (Whitaker 1998). The closest roost site for Indiana bats is 1.5 km (0.9 miles) from the proposed pilot test facility, [based on maps in PRC (1997)]. The roost site is probably too distant from the site of the proposed facility to be directly affected by impacts of construction which would be localized.

Utilities would be routed away from roost sites, and foraging habitat. If it is necessary to route utility rights-of-way through bat foraging habitat the area cleared will be minimized. The effects of the loss of potential foraging habitat from the clearing for the detention basin should be minimal. The 2.7 ha (6.6 acres) that would be lost is less than 10 % of the foraging range of just one juvenile bat, and less than 2% of that for one postlactation female (Garner and Gardner 1992). There is extensive nearby deciduous riparian vegetation comprising suitable foraging habitat further downstream in the Little Raccoon Creek drainage, as well as suitable upland habitat. In addition, forestry programs at NECD are underway which involve periodic replanting of deciduous trees creating areas that will mature into foraging habitat; 40 acres have recently been planted (K. Rudduck, Assistant Environmental Engineer for NECD, personal communication to H. Quarles, ORNL, August 25, 1998). Use of existing underutilized habitat and maturing new habitat should offset the effects (if any) to Indiana bats due to the loss of foraging habitat caused by construction of the pilot test facility.

The closest bald eagle nest is across the Wabash River about 4.6 km (2.8 miles) from the site of the proposed facility, and this nest is believed never to have been used (D. Hudak, FWS, personal communication to H. Quarles, ORNL, Oct. 28, 1997). Because impacts due to construction, if any, would be very localized, there should be no adverse impacts on threatened or endangered species.

4.1.1.5 Waste impacts

No significant impacts are expected from disposal of construction solid wastes. Construction would generate solid waste primarily in the form of excavation spoils and building material debris. Small amounts of liquid waste such as solvents, cleaning solutions, and paint waste would also be generated.

Wastes would be collected and disposed of in accordance with U.S. Army, state, and federal regulations. Any wastes that are listed as hazardous in the RCRA regulations would be stored and disposed of as prescribed by the EPA and applicable state and local regulations.

Sanitary waste, the only liquid effluent expected during construction, would either be hauled off the site by the construction contractor or routed to the on-site NECD sewage treatment plant.

4.1.1.6 Socioeconomic impacts

Construction of the chemical neutralization facility would begin in late 1999 and end in 2002. Approximately 400 construction workers would be employed on site during this period. In addition to the jobs that would result directly from plant construction, a number of *indirect* jobs would be created as a result of the purchases of goods and services by the project sponsor and the 400 construction workers. Based on past experience in similar rural areas (U.S. Nuclear Regulatory Commission 1996), it can be assumed that each direct job would lead to the creation of 0.5 indirect jobs within the five-county socioeconomic impact area, for a total of 200 indirect jobs.

Based on worker behavior at similar sites (U.S. Nuclear Regulatory Commission 1996) and taking into account the relatively small size of the work force and the relative brevity of the construction period, it can be assumed that up to 30% of the direct workforce (i.e., 120 workers) could move to the area during the construction period. Because many construction workers would probably choose to commute from Terre Haute, Danville, and other communities within a 60-to-90 minute drive of the site, it is likely that the actual number of inmigrating workers would be substantially less than 120. However, that number is used throughout this analysis as a reasonable upper bound. Past experience (U.S. Nuclear Regulatory Commission 1996) indicates that approximately 60% of inmovers (i.e., 72 workers) would be accompanied by families, while the remaining 40% (48 workers) would come alone. If the inmoving construction workers have an average family size of 3.02—the average for the five counties in the impact area (U.S. Bureau of the Census 1991)—the local population would increase by 265 residents in 120 households due to direct employment. This breaks down into 48 workers unaccompanied by family, 72 workers accompanied by family, and 145 family members of construction workers.

Indirect jobs generally are less specialized than direct jobs and are more likely to be filled by existing area residents. Accordingly, it can be assumed that only 10% of the indirect work force (i.e., 20 workers) would move to the impact area during the construction period. Once again assuming that 60% of inmovers (12 workers) would bring families and that their average family size would be 3.02, we get an upper bound of 44 new residents in 20 households as a result of indirect employment.

Combining direct and indirect inmigration yields a total of 309 new residents in 140 households as an upper bound. Unaccompanied workers would live in 56 of these households while the other 84 households would consist of workers and their families. Based on the five-county average of 0.73 school age children per family, it is expected that 61 additional children would be added to the local schools. --

Population. Workers who move to the impact area during the construction period would probably be distributed throughout the five counties, with the largest concentration in the Indiana counties of Vermillion and Parke because they are closest to the proposed project site. The precise distribution of inmovers would be determined by a number of factors, including proximity to the site and the availability of housing and public services. The 309 new residents used in this analysis as an upper bound would represent an increase of 0.2% to the combined population of the five-county socioeconomic impact area. If all of these inmigrants located in a single county, the population increase would be as follows: 1.9 % in Parke County; 1.8 % in Vex-million County, Indiana; 1.7% in Fountain County; 1.5% in Edgar County; or 0.4% in Vermilion County, Illinois. While growth of this magnitude could be accommodated without disrupting the affected communities, it is very unlikely that all new residents would settle in a single county.

Housing. The 140 new households used as an upper bound in this analysis would represent 6.3 % of the vacant housing units that were for sale or rent in the five county socioeconomic impact area in 1990 (the most recent year for which data are available). Even if all project-induced inmovers settled in a single county, which is highly unlikely, it would not exceed the number of vacant units for sale or rent in any given county. Accordingly, any housing impacts are expected to be minimal.

Education. The addition of 61 new school-age children would increase enrollment in the five-county area by only 0.2 %. Even in the highly unlikely event that all inmovers would locate in a single county, the increases in enrollment would be relatively small: 2.3 % for Parke County; 2.0% for Vermillion County, Indiana; 1.8 % for Fountain County; 1.6 % for Edgar County; or 0.4% for Vermilion County, Illinois. Even in the least populous county in the impact area (Parke County), such an increase would mean an average of only 0.4 extra students per teacher. Accordingly, impacts to education would be minimal.

Utilities. The addition of 140 new households and 309 residents is not expected to strain existing water and sewer systems within the impact area. There are many centralized systems in the area's communities, and the rural areas and small towns not served by such systems could accommodate new households with individual wells and septic systems. As indicated in Table 3.17, the water systems serving the towns of Clinton and Rockville have the capacity to handle all plant-induced inmigrants. This table also indicates that 140 new households would not appreciably contribute to Clinton's and Rockville's existing sewage treatment burden. Both towns have problems with infiltration and inflow in their sewage treatment systems during periods of heavy rain, but not from the amount of household-generated sanitary waste. Both towns have plans to improve their sewage treatment systems.

Solid Waste. The solid waste generated by the proposed project and the addition of 140 new households to the local area is expected to be easily accommodated by existing landfills.

Transportation. The construction work force is expected to enter and leave NECD via the North gate at SR 63. As explained in Section 3.6.3.5, traffic on SR 63 in front of NECD is currently flowing freely without any disruptions or impediments to maneuverability, and the road could accommodate substantially more traffic without falling below a Level of Service (LOS) of A (see Sect. 3.6.3.5). If there is no car pooling by construction workers and 400 additional vehicles use SR 63 at morning and evening shift change times, an LOS of A would still be maintained even if all 400 vehicles travel in a single direction. Vehicles turning into NECD from SR 63 at the start of the work day are not expected to slow the flow of traffic on SR 63 because of the existence of a right turn-lane for southbound commuters and a left turn lane for northbound commuters. The planned lengthening of the left turn lane on northbound SR 63 would further diminish the possibility that through traffic could be disrupted by commuting construction workers, although these workers may face a wait in the left turn lane until they can turn into NECD.

At the end of the work day, it is likely that construction workers would experience some delay in getting back onto SR 63, especially if all 400 workers end their shift at the same time.

Because there is no traffic light at the point where vehicles leave NECD and turn onto SR 63 and there are no acceleration lanes for either northbound or southbound commuters, construction workers would have to wait until traffic is sufficiently clear to allow them to merge onto the highway. In addition to creating delays for construction workers, the daily merging of 400 vehicles onto SR 63 during a compressed time period would increase the risk of accidents at this intersection, which represents a small to moderate impact to the local transportation network. Possible mitigation measures, such as staggering work shifts and promoting car and van pooling, may be considered. Other mitigation measures-including the installation of a traffic light and the construction of northbound and southbound acceleration lanes-may also be considered in consultation with the Indiana Department of Transportation.

Land Use. The construction of a chemical neutralization facility in close proximity to the chemical storage building on the NECD site is not expected to appreciably change the nature of land use within the depot boundaries. Off site, the influx of 309 assumed new residents in 140 households is not expected to change the heavily agricultural nature of the impact area.

Economic Structure. Because the construction work force (direct and indirect) would be relatively small and the construction period would be relatively short, the effect of the proposed project on the economic structure of the local area would be small. The unemployment rate could fall slightly in the impact area counties due to the potential hiring of current residents and the inmigration of project employees. In addition, the number of construction workers employed in Vermillion County, Indiana, would increase temporarily.

Community Concerns. Although residents of the surrounding area still appear to have some concern with health and safety issues related to the disposal of chemical agent, recent expressions of local opinion indicate that construction of the proposed neutralization facility would probably be viewed as a preferable alternative to incineration and would not generate widespread opposition (see Appendix B).

4. 1. 1.7 Impacts to cultural, archaeological, and historic resources

Land clearing and disturbance during project construction could result in some impacts to on-site archaeological resources. Under Section 106 of the National Historic Preservation Act, the Indiana State Historic Preservation Officer must be consulted to determine whether there are properties present that require protection and whether any additional resource inventory is needed (see Appendix F). Project-induced inmigration would be relatively small and short-lived and is not expected to have any adverse impacts on the off-site historic and archaeological resources described in Chapter 3.

4.1.2 Impacts from Routine Pilot Testing

This section identifies the impacts of routine pilot testing of the proposed NECDF at NECD. Routine pilot tests are defined as those which occur without an accidental release of chemical agent into the environment. Pilot testing involves all of those steps necessary to process the chemical agent VX, including handling at the existing storage site, on-site transport from the storage site to the pilot testing facility, and full-scale pilot plant testing.

The impacts of concern from routine, incident-free pilot testing include potential exposure to low-but permitted-levels of chemical agent, air quality impacts, socioeconomic impacts to community resources and well being, impacts to plants and animals, environmental justice, waste disposal, human health, and land and water use.

4.1.2.1 Impacts on land and water resources

Routine pilot testing would involve the release of permitted quantities of air emissions into the atmosphere and permitted quantities of liquid effluents into surrounding waters, and would result in minimal secondary effects on land use. Substantial changes to surrounding land use, other than the land occupied by the NECDF itself, would not be expected to occur during routine pilot testing of the NECDF. Land use on or off the NECD reservation would not be affected by routine pilot testing. The farmland currently surrounding NECD (see Sect. 3.5), which is used to grow crops and graze animals, would not be affected by routine pilot testing of the NECDF. There are no prime or unique farmlands as defined by the Farmland Protection Policy Act (7 CFR Part 685) located in the area surrounding NECD.

Water use at the NECD would increase during pilot testing of the NECDF because additional process and potable water would be required to operate the plant. The average continuous demand from the NECD water system would increase by approximately 265 m^3/day (0.07 Mgd) for up to 21 months (12 months during the systemization test and 9 months during pilot testing with agent VX feed). This short term increased demand for both process and potable water would be supplied by the existing NECD water system which pumps groundwater from a Ranney well field located on the western bank of the Wabash River.

The glaciofluvial aquifer would not be overpumped while supplying the increased demand for groundwater that would occur during pilot testing. NECD currently consumes approximately 380 m^3/day (0.1 Mgd) (estimated from the total outfall 001 discharge) (IDEM 1997, attachment I to briefing memo). The recommended groundwater withdrawal rate from the glaciofluvial deposits along the Wabash River ranges from approximately 27,300 to 32,700 m^3/day (7.2 to 8.64 Mgd) with one pump operating (two pumps are available with a third one that serves as an installed spare) (USAEHA 1975; USATHAMA 1991). The relatively large water supply that is available at NECD is largely unused because production facilities are no longer active. Heavy water production, that had previously required enormous volumes of water, has ceased at NECD.

The NECDF would generate approximately 46 m^3/day (12,510 gpd) (daily average) of sanitary wastewater which would be routed to the existing NECD sewage treatment plant. The existing sewage treatment plant has sufficient existing capacity to accommodate the NECDF discharge of sanitary wastewater and would not require expansion. The treatment plant has the capability to treat the sanitary waste produced by 2,000 people. The present on-site work force of about 300 would increase by approximately 400 under the proposed action. The additional sewage would increase biological activity within the treatment plant and potentially reduce the impact of NECD (as a whole) on the Wabash River because efficient treatment cannot occur unless the level of biological activity is properly-maintained.

Little Raccoon Creek would receive runoff from parking lots and roofs (and routine contaminants from those locations, such as oil and grease) during precipitation events. Part of this runoff would be held up in the basin formed by the small earthen dam across the uppermost tributary of Little Raccoon Creek, while the remainder would flow overland and discharge into Little Raccoon Creek below the dam. No chemical agent related materials would have an opportunity to reach stormwater. A new storm water detention basin would be built in conjunction with the NECDF. Runoff from pavement and buildings would be routed to the basin to minimize surface water impacts attributable to contaminants mobilized by rainwater. If a new detention basin is not required, contaminants whose flow was not influenced by the dam would migrate downstream in Little Raccoon Creek and eventually discharge into the Wabash River. Minimal impacts are expected because the relatively large perennial flow of the Wabash River would rapidly dilute the contaminants.

The new stormwater detention basin would be built across and collect runoff from two small tributaries that form Little Racoon Creek (U.S. Army 1997b). Both of these lesser tributaries define the extreme headwaters of Little Racoon Creek. The dam that forms the new detention basin spans the wye where the two tributaries coalesce. The easternmost and smaller tributary drains the site for the proposed pilot plant, while the westernmost leg extends northward past the proposed pilot plant. The dam would cut off the flow emanating from the extreme headwaters of Little Racoon Creek except during periods of increased precipitation when excess rainwater would discharge over the spillway of the dam.

A new ditch would be constructed in conjunction with the stormwater detention basin (U.S. Army 1997b). The ditch would convey runoff from other parts of the depot located to the north and west of the proposed pilot plant to a discharge point into Little Racoon Creek, immediately downstream from the dam that forms the new stormwater detention basin. While the new ditch ensures that a flow would be routed into Little Racoon Creek below the dam, some reduction is anticipated. The more ephemeral flow of precipitation-induced runoff from the ground surface would be reduced by an estimated 25 % because the flow from the smaller easternmost tributary draining the proposed pilot plant collects behind the dam. The depth of the engineered ditch is approximately 50% less than the naturally incised depth of Little Racoon Creek. Hence, the more perennial flow of groundwater received from the glacial till, as well as sand and gravel lenses within the till, also would be reduced by approximately 50%.

The proposed pilot plant, planned stormwater detention basin, and new engineered ditch are not located on jurisdictional (i.e., agency regulated) or special flood hazard areas (associated with backwaters of the Wabash River that occur during extreme floods) as identified by the Department of Housing and Urban Development (HUD 1978). No jurisdictional floodplains or special flood hazard areas would be impacted by the proposed action.

During an unlikely extreme situation that involved a low probability, very intense storm, the headwaters of Little Racoon Creek could overbank. The large unrestricted area1 expanse of the till plain would allow the rainwater to spread and not achieve any appreciable depth. While the proposed pilot plant could experience some nuisance flooding, no VX ton containers would be endangered. If the conveyance capacity of the detention basin spillway were exceeded, the dam would overtop and potentially fail. The proposed pilot plant would not be threatened because the dam-break flood wave would flow downstream into the Wabash River (i.e., away from the facility). Likewise, no VX ton containers would be threatened.

The NECDF would generate process effluent at a relatively low average rate of 3 L/min (0.8 gpm) (U.S. Army 1997a, Vol. I, SWEC Dwg. No. NE-D-34-0401, Rev. A). This effluent would come from an evaporator/crystallizer unit (see Sect. 2.2.3.3) and would be similar to distilled water. As shown in Table 2.10, a variety of chemical constituents could be in the NECDF process effluent. This effluent would be piped to the existing NECD sewage treatment plant, combined with discharge from the pollution control center detention basin, and then discharged into the Wabash River.

For the purpose of analysis in this EIS, a set of dilution factors (see Table 4.2) can be applied to the constituent concentrations in Table 2.10 in order to estimate the concentrations that would be discharged into the Wabash River. The dilution factors provided in Table 4.2 include the NECDF process effluent mixing with the wastewater currently being fed to the NECD sewage treatment plant, as well as the flow discharged from the existing pollution control detention basin. The analysis does not, however, consider the presence of additional constituents in the wastewaters independent of NECDF operation. Additional dilution could also be provided by the discharge of sanitary wastewater from the proposed NECDF; however, this dilution is not included in the table in order to provide an upper-bound estimate of the concentrations that could be discharged into the Wabash River. Additional detail about the dilution factors in Table 4.2 is presented below.

The 7-day, lo-year low flow of the Wabash River near NECD is 34.3 m^3/s (1,210 ft^3/s) (IDEM 1997, p. 3). The 7-day, IO-year low flow is determined at a lo-year recurrence interval obtained from a frequency curve of annual values of the lowest mean river flow for seven consecutive days (i.e., the 7-day low flow). One fourth of the 7-day, lo-year low flow is routinely used for design work and environmental assessment of discharges entering public waters in Indiana, and is a requirement imposed by Indiana environmental regulators. The dilution that would be provided by this low flow is calculated using a mixing box approach (Thomann and Mueller 1987). The dilution after complete mixing in the Wabash River is equivalent to the NECDF discharge divided by the sum of: one-fourth of the 7-day, lo-year low flow; the outfall discharge that would normally occur without the NECDF; and the NECDF discharge.

Table 4.2. Dilution factors applicable to concentrations of constituents in the process effluent discharged from the NECDF

Applicable Location for Effluent	Associated Dilution Factor
Between the NECDF” and the discharge at the existing NECD outfall[b]	62[c]
Between the NECDF[a] and after being fully mixed in the Wabash River[d]	174,000’

[a]NECDF process effluent discharge is taken at the exit of the evaporator/crystallizer unit. Concentrations at this location are given in Table 2.10.

[b]The existing NECD sewage treatment plant outfall is at the end of a 13-inch pipe at Wabash River Mile 243.

‘Numerical value includes dilution through the existing NECD sewage treatment plant and includes the discharge from the NECD pollution control center detention basin, that flows from outfall 101 into outfall 001. The concentrations of constituents originating from the NECDF can be divided by 62 to obtain the concentrations at the discharge point into the Wabash River.

[d]The 7-day, IO-year low flow of the Wabash River is equal to 34.3 m^3/s (1,210 ft^3/s). Indiana regulations require use of one quarter (1/4) of this flow for calculation of the dilution factor that accounts for complete mixing in the Wabash River.

The concentrations of constituents originating from the NECDF after being diluted by the flow from the NECD sewage treatment plant and the Wabash River can be obtained by dividing the concentrations shown in Table 2.10 by 174,000.

The size of the mixing area in the Wabash River for the outfall discharge plume is uncertain. Mixing in natural channels, particularly at low flows, is strongly influenced by irregular depths, localized channel curvatures, sidewall irregularities-such as groins or points of land and islands that would be submerged at higher flows-and the precise design of the discharge outfall (Fischer et al. 1979). During normal flows (50% of the time), the affected portion of the Wabash River may extend no more than 1,000 m (3,300 ft) downstream from the discharge point. However, at low flows, available evidence from rivers which have average annual flows of approximately the same order of magnitude as the Wabash indicates that the affected area could extend downstream as far as 10 to 15 km (6 to 9 miles) (Johnson 1996).

The constituents and concentrations in Table 2.10 can be combined with the dilution factors in Table 4.2 to assess the potential for water quality impacts to the Wabash River. The effluent discharged into the river could contain organics, metals, dissolved gases, sulfates, phosphates, and various unknowns; however, the evidence in Table 2.10 suggests that many of these constituents would only be present in trace amounts. The estimated concentrations of the metals at the outfall would comply with primary (40 CFR 141) and secondary (40 CFR 143) federal drinking water standards. [Also, refer to Freeze and Cherry (1979), as well as Fetter (1993) for additional information regarding drinking water standards.]

There are no drinking water standards for calcium or sodium. The concentrations of calcium and sodium at the outfall are below the estimated mean concentrations of these two constituents that occur in the rivers of the world (13.4 to 15 mg/L for calcium, and 5.15 to 6.3 mg/L for sodium) (Hem 1989). Additional dilution would be provided by mixing in the Wabash River after discharge from the outfall had occurred.

The median concentration of titanium in the major rivers of North America is 0.0086 mg/L, while the median for the U.S. public water supplies is 0.0015 mg/L (Hem 1989). The 0.043 1 mg/L titanium concentration at the evaporator/crystallizer outlet (see Table 2.10) exceeds both of these medians. The titanium concentration at the Wabash River outfall is approximately one order of magnitude below the range defined by the two medians. The presence of titanium at these low levels is not a concern.

The NECDF could produce measurable quantities of phosphorous that would discharge into the Wabash River. The mean concentration of total phosphorous near the mouth of the Ohio River (into which the Wabash River flows) has exhibited a value of approximately 0.6 mg/L (Hem 1989). The concentration of phosphorous at the outfall would be approximately 20 times less than this background level. Further dilution after mixing in the Wabash River would reduce any discharged phosphorous to very low levels.

The concentration of total organic carbon (interpreted as being totally dissolved) at the outfall would be approximately 1 mg/L. This value is below the mean dissolved organic carbon concentration [7 mg/L (Thurman 1985)] observed in streams located in warm temperate climates. Additional dilution after mixing in the Wabash River would reduce this concentration even further. The precise composition of the organic compounds that would be discharged into the Wabash River is uncertain because the identities and physio-chemical properties of the organic compounds dissolved in the effluent have not been completely established.

The concentrations of some of the organic compounds listed in Table 2.10 exceed various drinking water standards, either promulgated or issued, for the species at the evaporator/crystallizer outlet. The process distillate concentrations of phenols, benzo(a)anthracene, and hexachlorobenzene at the evaporator/crystallizer outlet are less than 0.01, 0.005, and 0.005 mg/L, respectively, while the recommended drinking water standards are 0.001, 0.0001, and 0.001 mg/L, respectively (Freeze and Cherry 1979, Fetter 1993). After dilution by the NECD sewage treatment plant and pollution control center detention basin flows, the concentrations of these organic compounds comply with the drinking water standards. The enormous sustained flow of the Wabash River further reduces these concentrations to very low levels and ensures that drinking water supplies obtained from the river further downstream would not be compromised.

In summary, none of the estimated concentrations of potential constituents attributable to the NECDF would exceed drinking water standards or naturally occurring values at the point of discharge to the Wabash River. Additional dilution after full mixing in the river would reduce these concentrations to very low levels. No impacts are anticipated to the public water supplies at Terre Haute, Ind., and Mount Cannel, Ill., located 43.5 km (27 miles) and 151 km (94 miles), respectively, downstream from NECD.

4.1.2.2 Air quality and noise impacts

Air **quality impacts.** Potential effects of emissions to the atmosphere were evaluated by estimating maximum increases in ground level concentrations of pollutants resulting from the proposed action, adding these estimates to measures or estimates of background concentrations, and comparing the totals to ambient air quality standards or guideline values for maximum concentrations. Air quality impacts of the proposed action are expected to be minor; a summary of the analyses is given below.

Pollutants for which NAAQS exist (criteria pollutants) include SO_2, NO_2, CO, O_3, lead, and two size classes of particulate matter (PM-10 and PM-2.5) were considered in the analysis of construction activities (Sect. 4.1.1.2). Indiana regulations also include total suspended particulate matter (TSP).

No measurable lead emissions are expected from the proposed facility; lead concentrations in recent years have been well below NAAQS, largely due to decreased use of leaded gasoline in automobiles. Concentrations of CO are of primary concern near major intersections in large cities, where many vehicles are idling at one location and air circulation is limited by surrounding high-rise buildings. Therefore, lead and CO emissions were not subjected to further analysis.

Contributions to the production of O_3, a secondary pollutant formed from photochemical reactions involving hydrocarbons and oxides of nitrogen (NO,), cannot be accurately quantified. The reactions involved typically take hours to complete, so the precursor compounds have moved far from their sources, and have become well mixed with precursors from other sources, by the time 0, formation completely occurs. Regulatory control of 0, is attempted by controlling emissions of volatile organic compounds (VOCs) and NO,. Expected emissions of NO, (20 tons per year) and VOCs (less than 2 tons per year) from the proposed facility are small compared to screening levels used by regulators to determine whether further analysis is necessary. For comparison, these emissions are about 0.2% of the amounts of NO, and VOCs emitted per year by existing stationary sources in Vermillion County. Therefore, the proposed action would not be expected to cause concentrations of 0, precursors near NECD to increase by more than a small fraction of a percent of their existing values.

Emissions of SO,, NO,, and particulate matter (TSP, PM-10, and PM-2.5) would occur from utility boilers. Additional pollutants of interest include organic compounds that could be emitted from the SCWO or from the condenser; however, carbon filtration systems would remove most of this material, and only very small quantities would be emitted to the atmosphere.

Other potential sources of air pollution at NECD include plant vehicular traffic and existing stationary sources such as diesel generators, a waste water incinerator, and a degreasing facility. Based on an analysis discussed in Sect. 4.1.1.2, these sources do not contribute appreciably to ambient-air pollutant concentrations outside the site boundary, and therefore were not included in the following analysis.

The EPA-recommended ISCST3 air dispersion model (U.S. EPA 1995) was used to estimate increases in pollutant concentrations resulting from the proposed activity. Effects of downwash, in which parts of the plume are lowered due to aerodynamic effects of buildings near the stack(s), were also included in the modeling. Concentrations were modeled at 100-m (328-foot) intervals along the site boundary closest to the proposed facility; larger intervals were used at greater distances. Meteorological input data were the same as in Sect. 4.1.1.2.

As in the analysis of construction effects in Sect. 4.1.1.2, modeled concentration increases from the proposed action were added to estimates of existing background concentrations to obtain totals for comparison to standards. Estimates of existing concentrations included the nearest monitored value plus the modeled effects of large off-site sources that are likely to contribute more to existing pollutant concentrations near NECD than they would at the monitor. Examples of such sources include PSI power plants at Cayuga and Terre Haute, the Eli Lilly company near Clinton, and the Panhandle Eastern Pipeline Company at Montezuma (for NO,). The highest modeled contributions of such sources to concentrations of each pollutant for each averaging period at any location near NECD were incorporated into the corresponding estimates of existing background concentrations.

Results of this analysis are compared with standards and with background values in Table 4.3. No exceedances of NAAQS or of Indiana primary standards for TSP would be expected at any off-site location.

The nearest Class I PSD area (Mammoth Cave National Park) is located about 305 km (190 miles) south-southeast of the proposed facility. At that distance, the small emissions of SO,, NO,, and particulate matter from the proposed facility would have only negligible effects on ambient-air concentrations of these pollutants.

Some organic pollutants could be released from the SCWO stack and the filter farm stack. Exact emissions estimates are not yet available, however, as noted above, carbon filters would be expected to capture most of the material. Judging by concentration limits for workers given in 29 CFR 1910-1000, the most hazardous carbon compound emitted is likely to be carbon disulfide (CS,) from the SCWO. The upper concentration limit for CS,, given in 29 CFR 1910.1000 to protect healthy workers on their jobs, is 62,000 $\mu g/m^3$. This value applies to an average concentration over an 8-hour work shift; ambient-air concentrations for the general public apply to a 168-hour week, or 4.2 times the amount of time a worker is exposed. Therefore, to derive an upper-limit guideline concentration of CS, for protection of the general public, the limit for workers is first-divided by 4.2. Because workers would presumably experience several hours of relatively fresh air between exposures, and workers are assumed to be healthier than the most sensitive members of the genera1 population, an additional safety factor (typically 100) is applied to protect the most sensitive members of the general population. That is, the 8-hour standards for workers are typically divided by 420 to obtain ambient-air concentration guidelines applicable to the general population. For CS,, the corresponding 8-hour average concentration would be 62,000/420, or about 148 $\mu g/m^3$.

Table 4.3. Maximum predicted off-site pollutant concentrations during routine operations of the proposed pilot plant

Averaging period	Concentrations ($\mu g/m^3$): Maximum modeled increase[a]	Existing background[b]	Total[c]	Applicable standard or guideline value	Total as a percentage of standard or guideline value
			SO_2		
3-hour	27	923	950	1300[d]	73
24-hour	3.9	334	338	365[d]	93
annual	0.2	47	47	80[d]	59
			NO_2		
annual	1.0	44	45	100[d]	45
			PM-10		
24-hour	1.1	89	90	150[d]	60
annual	0.1	27	27	50[d]	54
			PM-2.5[e]		
24-hour	0.6	--	0.6	65[d]	--
annual	0.1	--	0.1	15[d]	--
			TSP[f]		
24-hour	3.7	157	161	260[f]	62
annual	0.2	64	64	75[f,g]	85
			Carbon disulfide (CS_2)[h]		
8-hour	0.064	0.0	0.064	148[h]	0.04
			Agent VX		
8-hour[i]	< 0.001	0.0000	< 0.001	0.01	< 10
72-hour[i]	< 0.0003	0.0000	< 0.0003	0.003	< 10

[a]The maximum modeled concentration increase associated with the proposed action at any location off site or along the site boundary.

[b]This value includes monitoring results from Table 4.1 plus the modeled contributions from large off-site sources as explained in the text. Background values of hazardous materials (CS_2 and agent VX) are assumed to be zero.

[c]The sum of the preceding two columns, for comparison with the applicable ambient-air standard or guideline.

[d]National Ambient Air Quality Standard, listed in Table 4.1.

[e]The NAAQS for PM-2.5 have only recently been enacted; EPA has not yet established a network of monitoring stations for estimating background concentrations.

[f]Indiana primary standard.

[g]Geometric mean.

[h]Hazardous organic compound, assumed to be carbon disulfide (CS_2). The guideline value used as an upper limit is discussed in the text.

[i]Applicable standards are found in the *Fed. Regist.* 53 (Pt.50), March 15, 1988, p. 8506. The 8-hour standards are for workers; the 72-hour standards are for the general population. Average concentrations for 72-hour periods are not easily obtained from the model code. Therefore, the maximum 24-hour average was used as a conservative estimate (i.e., an overestimate).

If all of the estimated emissions of organic compounds from the SCWO and the filter farm were in the form of CS_2, modeled 8-hour ambient-air concentration increases would still be less than 0.1 $\mu g/m^3$, which is less than 0.1% of the guideline value derived above. Existing background concentrations of CS, or other hazardous materials that could be released from the proposed facility are assumed to be zero, or virtually zero. Therefore, hazardous organic emissions from the proposed facility are not expected to result in concentrations that would approach levels of concern.

Emissions from the filter farm and the SCWO would be filtered so that only very small amounts of toxic pollutants could be emitted to the ambient air. Background concentrations of agent VX in the ambient air are assumed to be zero. Even if agent VX were emitted at the recommended-upper-limit rate to prevent adverse human health impacts (DHHS, 1988), modeling results (Table 4.3) indicate that ambient-air concentrations would be well below the recommended upper limits (DHHS, 1988). Because of the extreme toxicity of chemical warfare agent, the recommended concentration limit for healthy workers is not greatly different from that for the general population; both are very low. Because the volatility of agent VX is very low, other pathways to the atmosphere are very limited, and an extensive filtering system would prevent most toxic materials from escaping the filter farm stack, it is extremely unlikely that even a small fraction of the modeled emission rate would occur during routine operation of the proposed pilot plant.

Noise **impacts** Operation of the proposed facility would result in the generation of noise. Noise measurements for the disposal technology are not yet available. However, measured noise levels are seldom more than 65 dB(A) at distances of 100 m (330 ft) from industrial sources (LS. Goodfriend and Associates 1971). Because sound energy decreases by 6 dB(A) with each doubling of distance from the source, corresponding noise levels at the nearest residence, more than 1 km (0.6 miles) from the proposed facility site, are expected to be less than 45 dB(A). This is less than the 55 dB(A) value that EPA has identified as a yearly average which, if not exceeded, would prevent activity interference and annoyance (U.S. EPA 1978).

The proposed facility may operate during nighttime hours, when background noise levels decrease by about 10 dB(A). Therefore, sounds from specific sources that might not be heard during the day could be heard, and could possibly be annoying, at night. A 10 dB(A) "penalty" is therefore added to sound levels from specific sources between the hours of 10 PM and 7 AM (US. EPA, 1978). However, the estimated sound level at the nearest residence was estimated to be less than 45 dB(A), without accounting for sound absorption by structures and vegetation. Therefore, addition of the 10 dB(A) "penalty" would not cause sound levels from the proposed facility to exceed levels recommended by EPA to prevent activity interference and annoyance.

4.1.2.3 Impacts to human health

Routine pilot testing of the proposed NECDF would include the release of gaseous and particulate emissions (Sect. 4.1.2.2) as well as liquid process effluents (Sect. 4.1.2.1) and solid waste. No atmospheric emissions have been identified (Sect. 4.1.2.2) that would be in violation of air quality standards designed to protect human health. The potential human health effects for workers and the general public resulting from potential exposures to agent VX, emissions from neutralization byproducts (hydrolysate), and SCWO effluent are discussed in this section.

The proposed process effluent from the NECDF would be discharged to the existing on-site FOTW and then the Wabash River. It is this aquatic pathway that would be the potential exposure pathway for members of the public to be exposed to any hazards associated with the liquid process effluent from the proposed NECDF.

VX protection levels for public and workers. Protection of workers and the public against harmful exposures to agent VX requires an understanding of the physical, chemical, and toxicological properties of the agent. Table 4.4 contains a description of the special characteristics of VX.

The safety standards or control limits outlined in Table 4.5 would be in effect during pilot testing of the NECDF; no acute or chronic signs of toxicity are expected in individuals exposed to agent concentrations below these limits. The control limits are the result of extrapolation from the results of laboratory experiments with animals and cell lines (tissues), as well as whatever human data are available. This extrapolation process is similar to that used to estimate safe levels of human exposure to food additives, cosmetics, and over-the-counter drugs.

Atmospheric emissions. Gaseous emissions from the neutralization/SCWO process would be almost completely non existent. The small amount of gases that would be emitted to the atmosphere would be greatly dispersed before reaching potential on-site or off-site receptors. Based on the estimated ambient concentrations of gases (see Tables 2.8 and 4.3) and their relative potencies, no adverse off-site human health impacts are anticipated for the proposed NECDF.

Acute effects of neutralization/SCWO liquid process effluent. A major testing/measurement program was undertaken to evaluate the effects of effluent discharge from both the neutralization and SCWO stages of the proposed process (Manthei et al. 1996; Manthei 1997). This program provided a better characterization of the constituents, including their toxicity, that could be discharged to the Wabash River than was possible before the study. The major elements of this program focused on identifying lethal potencies of various fractions of demilitarized VX in comparison with the lethal potency of VX. Several secondary treatment options were evaluated prior to choosing SCWO, (i.e., H_2O_2, UV, SCWO, with and without several alternative neutralization options) as a means to further reduce the toxicity of the liquid product. The biological assays used to evaluate the efficacy of demilitarization processes include tests to determine the LD, values subsequent to intravenous injections into mice (LD,, refers to the dose that wold be lethal to 50% of a population). Results of these biological assays indicate that agent VX was not present in the exposure media in significant concentrations nor were similarly acutely toxic materials. These tests revealed that the LD,, values were between 1,000 and 1 ,000,000 less acutely toxic than VX. The greater reductions in toxicity were found for tests that included a second stage of destruction like SCWO.

Acute exposures under routine pilot testing would only be possible in the waters of the Wabash River during recreational water contact. Such dermal contact is not expected to exceed a few hours per occurrence and, on the basis of available bioassay data, (Manthei et al. 1996; Manthei 1997) no adverse acute responses in humans would be anticipated.

Chronic effects of neutralization/SCWO liquid process effluent. Chronic health effects, such as cancer or reproductive (teratogenic) effects, are the long-term (months to decades) or recurring health effects that may appear after a brief or prolonged period of exposure. Because the proposed full scale test of the NECDF is expected to take place over a period of months, it is appropriate to examine the potential for discharges from this facility to

Table 4.4. Biological/physical characteristics relevant to agent VX toxic effects

Chemical agent	VX
Chemical Abstracts Service (CAS) no.	50782-69-g
Chemical name	0-ethyl-S(2-diisopropyl-aminoethyl)-methyl-phosphonothiolate
Mode of action	Anticholinesterase
Acute toxicity	• Head and neck areas of humans very sensitive to VX penetration . Contaminated vegetation can cause toxicity upon ingestion
Chronic toxicity	• Mutagenicity studies were negative • Teratogenicity studies were negative • Inactive delayed neuropathy induction • No evidence of carcinogenic activity

Source: U.S. Army 1988, p. 4-4.

Table 4.5. U.S. Department of Defense safety standards for agent VX exposure

Exposures’	Concentration of VX in air ($\mu g/m^3$)
Agent worker exposure [8-hr time-weighted average (TWA) in a work shift]	0.01
General population exposure	
72-h TWA[b]	0.003[c]
Ceiling value[d]	0.01[c]
Source emission limit (ceiling value)[d,e]	0.3

“No individual would be intentionally exposed to direct skin or eye contact with any amount of solid or undiluted liquid agent, or to solid materials contaminated with agent.

“Final recommendation by the U.S. Department of Health and Human Services (DHHS) Centers for Disease Control, 53 Fed. Regist. 8504-7 (March 15, 1988).

‘It is recommended that this level of detection be demonstrated and used at all sites where agent VX will be transported and destroyed.

“Ceiling value normally refers to the maximum exposure concentration at any time, for any duration. Practically, it may be an average value over the minimum time to detect the specified concentration.

‘Proposed by the U.S. Department of the Army; accepted by DHHS as not posing a threat to human health.

Source: C. A. Hennies, Brigadier General, Director of Army Safety, “Changes to Department of the Army (DA) Toxic Chemical Agent Safety Policy,” a memorandum, Feb. 2, 1990.

contribute to chronic health risks. Chemicals to which people may be exposed are the final products of demilitarization, beginning with VX and impurities that might be present in the ton containers, and ending with the chemicals that follow the water pathway out of the crystallizer/evaporator. The list of potential chemicals is found in Table 2.10.

Data on the toxicity of agent VX to humans or animals following long-term exposures were not found in the available literature. However, discussions held by the Centers for Disease Control prior to their promulgation of agent control limits (for inhalation) for nerve agents in 1988 (CDC 1988) lead to the conclusions that ". . . carcinogenicity is not relevant for nerve agents, and ". . . nerve agents are not likely to be teratogenic." These conclusions are supported in the review of the literature by Opresko et al (1997) in which an attempt was made to estimate oral reference doses for chemical warfare agents.

If any VX or EA-2192 were to remain below the method detection limit after neutralization, it would be reduced further in the SCWO and then in the crystallization/ distillation stage. These materials then would enter the FOTW which discharges to the Wabash River, with a combined dilution factor of approximately 1: 174,000 (see Table 4.2). Such small amounts of materials considered not to contribute to carcinogenicity or teratogenicity pose an insignificant chronic risk to human health.

After the destruction of VX in the neutralization process, a long list of breakdown products is formed. In order to make estimates of risk for potential human exposures to the breakdown products, there must be some identified pathway for human exposure and a process for evaluating the extent of exposure. At NECD, the only viable pathway for prolonged human exposure to neutralization/SCWO process effluent would be through the ingestion of finfish or drinking water. A list of potential constituents in the effluent from the neutralization/SCWO process are identified and tabulated in Table 2.10. Additional reductions in the concentrations of these constituents will be accomplished by dilutions, on the order of 1:174,000, in the FOTW and the Wabash River.

Contaminants represented in Table 2.10 may be ingested by humans through drinking water or through the eating of fish that live in the water receiving the discharge from NECDF. It is possible that some of the constituents may bioaccumulate in fish leading to an increase in the concentration of the constituents beyond the levels estimated for water. Bioaccumulation factors typically range from 1 (minimal bioaccumulation), to 100. Because no bioaccumulation factors were identified for many of the compounds, a default factor of 100 was assumed. It was further assumed that maximum fish consumption by humans would be 55 g/day based on upper percentile figures for recreational freshwater anglers (U.S. EPA 1995) and that exposure would occur over the 9-month period when the NECDF would be pilot tested with agent VX. Moreover, it is assumed that the same people who eat the fish live in Terre Haute and consume 2 liters of water per day derived from the Wabash River. For chemicals for which it was not possible to identify chronic risk factors, a known potent organic carcinogen was used as a surrogate so that there would be little potential for underestimating risk. In fact, each aspect of the analysis was conducted using assumptions m-choices that were conservative, or overestimating. After combining the risks for the constituents, the risk for contracting a cancer as a result of ingesting water and fish from the Wabash River downstream of the Newport facility is much less than 1×10^{-6}. A risk of this general magnitude is considered to be insignificant.

Although no specific federal standards exist for acceptable lifetime cancer risk from exposure levels associated with a facility permitted under RCRA, guidelines have been established by the EPA for acceptable exposure levels from remediation (i.e., clean-up) actions [such as those complying with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)]. For known or suspected carcinogens, acceptable exposure actions are generally those that would impart an excess upperbound lifetime cancer risk to an individual of between 1×10^{-4} and 1×10^{-6} (a probability of 1 excess lifetime cancer death in a population of 10,000 and 1,000,000 exposed respectively) using information on the relationship between dose and response (40 CFR 300.430). The EPA has expressed a preference for clean-ups achieving the more protective end of the risk range (i.e., 1×10^{-6}). The estimated risk associated with the process effluent is below this more protective level and only a low number of people would be potentially exposed during the g-month period of operations. Also, the analysis serves as an initial, reasonably conservative (i.e., does not underestimate) estimate of potential human health risk.

On the basis of preliminary data, this risk estimate of much less than 1×10^{-6} provides the confidence to proceed with the design and construction of the facility. In deference to the need for substantiation or corroboration of the above estimates of health risk, which are based on a screening methodology, a more detailed health assessment is underway (personal communication, Kathleen Simmers, U.S. Army Center for Health Promotion and Preventive Medicine, to Sam Carnes, ORNL, Feb. 4, 1998).

4.1.2.4 Ecological resources impacts

Aquatic resources. This EIS concludes that the proposed facility poses minimum potential for adverse impact to aquatic resources during normal operations. The analysis and basis supporting this conclusion are explained and discussed in this section.

The proposed stormwater detention basin on the site would permanently alter a total of approximately 170 m (560 ft) of existing, intermittent drainage channels in the headwaters of Little Raccoon Creek. During periods of adequate precipitation, these channels provide aquatic habitat ranging from flowing creek conditions to a series of small pools. This habitat supports an assemblage of aquatic life dominated by aquatic insects and other invertebrates as well as small fish (probably blacknose dace and creek chubs) adapted to low flows and small pool conditions. Construction-related removal of trees and other vegetation as well as direct impacts to the channels themselves would elicit a shift toward an aquatic community more tolerant of direct sunlight, altered substrates and flows, and altered food inputs. Fish movement into these channels would likely be restricted. The total length of stream channel significantly altered by construction of the detention basin would represent less than one percent of the total length of stream channel available in the Little Raccoon Creek drainage.

Under normal operations the only potential pathway for impact to aquatic organisms is from the release of process liquid effluent (see Table 2.10a) into the Wabash River. The transport of liquids produced at intermediate steps during the pilot testing into nearby wetlands or streams via surface runoff is unlikely giventhat (1) the treatment processes will occur indoors, and (2) the minimization of incidental releases or spills has been given a high priority. The potential for any impacts on the nearby aquatic environment via the deposition of airborne contaminants from the project is also expected to be negligible.

Any compounds remaining in solution after the various neutralization/SCWO/ evaporator stages will be discharged into the Wabash River following normal treatment at the existing FOTW. The FOTW outfall is located within the main channel of the Wabash River approximately 4 km east of the proposed facilities. Upon discharge, the combined effluent from the treatment plant would become greatly diluted with water from the Wabash River as described in Sects. 4.1.2.1 and 4.1.2.3.

Ecological receptors which could possibly be affected in the Wabash River include primary producers (e.g., phytoplankton, periphyton, vascular plants), zooplankton and other invertebrates (e.g., crustacea, mollusks, arthropods), amphibians, fish, and reptiles, In this EIS, the analysis of potential impacts resulting from normal (routine) operations of the proposed facility focuses on the likelihood of impacts in the vicinity of and downstream of the FOTW outfall.

Recent bioassay studies have been conducted by the U.S. Army Edgewood Research Development and Engineering Center (ERDEC) (Haley 1997, 1998) and the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM 1998). These studies evaluated the response of standard test organisms-selected for their sensitivity to many contaminants-to actual process effluent from bench-scale tests. The studies investigated the effects of actual evaporator condensate on fathead minnow larvae survival and growth, daphid (water fleas) survival and reproduction, and green algae growth. The results of these bioassay tests are summarized in Table 4.6. Based on these results, the evaporator condensate does not appear to be any more toxic to aquatic organisms than is distilled water.

The conclusion is therefore that it is unlikely this effluent will cause any adverse effects on aquatic biota in the Wabash River for the following reasons:

- The evaporator effluent exhibits-at worst-quite low toxicity to the test organisms;
- There is essentially no difference between the process effluent and distilled water in the aquatic toxicity tests;
- The process effluent will be further diluted by a factor of 62 in the FOTW prior to being discharged into the Wabash River; and
- The Wabash River will further dilute the effluent by at least an additional factor of 2,800 at the boundary of the mixing zone.

The dilution factors, listed above, were applied to the anticipated constituents in the final process effluent (See Table 2.10a) in order to investigate the resulting concentrations in the Wabash River. The results of this analysis indicate that nearly all of the anticipated constituents in the final effluent would be present at considerably less than 1 ppb prior to discharge to the Wabash River. Even prior to full dilution in the river, none of the heavy metals or other listed inorganics (except possibly sulfides) in Table 2.10a would be expected to occur at concentrations sufficiently high to be harmful to any aquatic organisms. Nor do they exceed median background concentrations, where such information exists, for numerous freshwaters, including the Wabash River. Dilution after full mixing in the Wabash River would further reduce the concentrations of the anticipated effluent constituents to insignificant levels.

In summary, the whole effluent bioassays indicate that the effluent from the proposed facility-as discharged through the existing FOTW and into the Wabash River-is unlikely to adversely affect aquatic biota because the toxicity of the effluent is quite low (e.g., no different than that of distilled water). Therefore, no adverse impacts to aquatic resources should occur during normal operations.

Terrestrial resources. For incident-free operations the only significant potential for impacts to terrestrial organisms is via the aquatic pathway from the release of waste byproducts

Table 4.6. Aquatic bioassay results for evaporator condensate/effluent.

Tested Species (Effect Studied)	Exposure Duration	Concentration at which effect was observed, expressed as a volumetric ratio of the effluent to the culture media (in percent; Note: higher percentages equate with lower toxicity)			
		Lowest Observable Effects Concentration (LOEC)		No Observable Effects Concentration (NOEC)	
		Effluent[a]	Distilled Water[a]	Effluent[a]	Distilled Water[a]
Ceriodaphnia dubia, a species of water flea (survival)	7 days	NA[b]	NA[b]	100%	100%
Ceriodaphtria dubia, a species of water flea (reproduction)	7 days	100%	100%	75%	75%
Pimephales promelas, fathead minnow (survival)	7 days	NA[b]	NA[b]	100%	100%
Pimephales promelas, fathead minnow (growth)	7 days	NA[b]	NA[b]	100%	100%
Selenastrum capricornutum, an alga (growth)	96 hr	NA[b]	NA[b]	100%	100%

Sources:

USACHPPM, *National Pollutant Discharge Elitnination System Permit Application for the Department of the Army, Newport Chemical Depot, Newport Chetnical Demilitarization Facility (Draft)*, U.S. Army Center for Health Promotion and Preventive Medicine, Aberdeen Proving Ground, Md., 1998.

Personal communication from M. Haley, Edgewood Research Development and Engineering Center, Aberdeen Proving Ground, Md., to G. K. Eddlemon, Oak Ridge National Laboratory, Oak Ridge, Tenn., March 18, 1998.

Foomotes:

[a]The test media (evaporator condensate or distilled water) was amended with salts (e.g., sodium bicarbonate) to raise its salinity to that of typical freshwaters; without such adjustments, harmful effects may be observed due to the imbalance between the organism and its ionic equilibrium with the test media.

[b]NA means that no effects were observed from exposure of test organisms to 100% evaporator condensate.

of the VX neutralization and SCWO treatment pilot testing (referred to as process distillate) through the FOTW into the Wabash River. The primary potential exposure path would be through drinking water. A recently conducted toxicity study of the process distillate indicates that effects, if any, to terrestrial organisms should be negligible (USACHPPM 1998). Rats that were fed pure process distillate failed to show any toxic signs at any dose; there were no observed differences from the control group receiving deionized/sterile water (USACHPPM 1998).

Any terrestrial organism would be exposed to chemicals from the process distillate only upon emergence of the waste effluent from the outfall beneath the surface of the Wabash River. Dilution of the distillate would take place first when it reached the liquid in the FOTW (by a factor of 62), and again as the combined effluent flowed from the outfall into the Wabash. The final ratio of process distillate when fully mixed in the Wabash would be 1: 174,000 (see Table 4.2). Based on lack of toxic effects from pure process distillate, and subsequent significant dilution before possible exposure, it is not expected that any terrestrial organisms could consume enough of the effluent to cause any toxic effects.

Because of their high potential toxicity, the two hypothetical constituents (both organophosphates) of primary concern in the effluent would be any VX and EA-2192 (a co-product similar in toxicity to VX) which survived both the neutralization and subsequent SCWO processes. None of the possible chemical agent breakdown products are as acutely toxic as the agents from which they would be derived (U.S. Army 1988, Appendix B). Movement of any organophosphate constituents of the effluent, including VX and EA-2192, through the terrestrial food chain is not expected because they do not accumulate or persist. Based on what is known about other organophosphates in agricultural systems, these compounds would not show persistence in meat or milk; the compounds are not accumulated and would not affect food chains beyond herbivores (U.S. Army 1988, Appendix 0). Due to the lower toxicity and generally low concentrations of any non-organophosphate constituents in the effluent, concentration in the food chain to levels sufficient to cause problems is unlikely.

Threatened and endangered species. There are no federally listed threatened or endangered aquatic species in on-site streams or the Wabash River within 20 km of the outfall of the FOTW and probably not within 85 km (see the Biological Assessment, Appendix D). Although unlikely, should individuals of state-listed endangered species (e.g., the blue sucker) reside or pass within the mixing zone immediately downstream of the outfall, they could be adversely affected by the effluent from the proposed NECDF.

Terrestrial species with federal protected status possibly occurring along the potentially impacted reach of the Wabash River are the threatened bald eagle and endangered Indiana bat. Bald eagles have been sighted along the River east of NECD; foraging area of the Indiana bat has been documented to occur within about a kilometer of the outfall location (PRC 1997). As discussed above, it is unlikely that individuals of either species would consume sufficient levels of organophosphate constituents originating from the pilot test plant to cause effects. If bald eagles or Indiana bats are present they would beaffected, if at all, through loss of prey such as fish (for eagles) and insects with an aquatic stage (for bats) due to any organophosphate toxicity to the prey animals. Evidence indicates, however, that these constituents would neither bioaccumulate nor persist in such potential prey (see above). The significance of the impacts would be determined by the extent to which prey animals would be reduced in numbers, if at all, over the g-month operating span of the neutralization pilot test.

4.1.2.5 Waste management

Process wastes including metal scrap, evaporator/crystallizer brines, and spent carbon bed filters would be generated during disposal plant operations, as described in Sect. 2.2.3.4. Metal parts would be decontaminated to 3X levels and shipped to the Army Arsenal at Rock Island, Illinois, where they would be smelted for reuse. Process solid wastes would be transported and disposed of off-site. A commercial hazardous waste landfill would be used for disposal of hazardous solid wastes, and its RCRA permit would specify disposal procedures. Decisions on whether certain wastes are hazardous or nonhazardous would be based on applicable state and/or federal regulations and the results of the monitoring and analysis program for these wastes developed by the Army. Process solid waste characteristics are summarized in Table 2.9. Table 2.7 lists the estimated quantities of waste that would be generated by the proposed disposal operations at the NECDF.

A small amount of off-site land would be used for disposal of process solid wastes. For example, if the total of all process solid wastes (brines, sludge, solids, and scrap metal) produced during the disposal facility's lifetime were disposed in a landfill, the landfill area consumed would be about 0.13 ha (0.32 acres), assuming a 7.6-m (25-ft) cell depth. Some landfills have deeper cells, and the land use would be proportionately smaller. In practice, wastes are deposited in horizontal layers over the entire area of a cell as they are received. Not all NECDF process solid waste would actually be disposed of in landfills. Approximately 390 metric tons (430 tons) of decontaminated scrap metal would be smelted for reuse.

Impacts from transportation of process solid wastes are expected to be minimal. The maximum on-site level of traffic for waste transport is estimated at 60 trips per day by forklifts carrying waste bins and 55-gal drums to the waste holding area. Off-site shipments would occur under contract with a waste disposal/scrap metal vendor, and are expected to take place at regular intervals. Only 5 to 6 off-site trips per day are anticipated on the average to transport the evaporator/crystallizer wastes to an off-site landfill. Use of larger trucks to haul the process wastes could reduce the number of required trips.

4.1.2.6 Socioeconomic impacts

Pilot testing of the chemical neutralization facility would begin in 2002 and end in 2004. Approximately 400 operations workers would be employed during this period, the same as the number of workers required to build the facility. As in the construction period (see Sect. 4.1.1.6), about 200 additional indirect jobs would be created in the five-county impact area. As an upper bound, it can be assumed that 30% of the direct operations workers and 10% of the indirect workers would move to the impact area (U.S. Nuclear Regulatory Commission 1996): It can be further assumed that 60% of these inmoving workers would be accompanied by families and that the average family size would be 3.02 (U.S. Bureau of the Census 1991). Therefore, this impact analysis is based on an upper bound of 309 new residents-including 61 school age children-in 140 households. These numbers are identical to those used in the analysis of construction period impacts (Section 4.1.1.6). The assumptions regarding inmigration and presence of family members are the same for both construction and operations periods because project duration is the same for both. Furthermore, it may be assumed that workers with the skills necessary to fill operations-period jobs and workers trained in the appropriate construction trades will be equally available within commuting distance of the plant site.

Once the chemical neutralization facility is built, it is expected that any inmoving construction workers would leave the impact area to take other jobs. In order for these workers to remain in the local area, new construction jobs would have to be created by the occurrence of new, currently-unplanned, commercial and industrial development. Such development would result in cumulative impacts, which are addressed in Section 4.4.

Population. As is likely to occur during project construction, operations period inmigrants would probably locate throughout the five county region, with the largest concentration in Vermillion and Parke counties, Indiana. The increase in current population represented by 309 new residents is described in Section 4.1.1.6. Growth of this relatively small magnitude would not disrupt the affected communities, even in the unlikely event that all inmigrants would settle in a single county.

Housing. Just as in the construction period, it is expected that the local market could provide housing for all inmoving operations workers, even in the highly improbable event that all inmovers would locate in a single county. Therefore, housing impacts would be minimal.

Education. As explained in Section 4.1.1.6, any impacts caused by the influx of 61 new school age children to the socioeconomic impact area would be minimal.

Utilities. As explained in Section 4.1.1.6, 309 new residents in 140 households are not expected to strain existing water and sewer systems nor would they have a noticeable affect on electricity and gas service in the impact area.

Solid Waste. Existing landfills are expected to easily accommodate the solid waste generated by project operations and 140 new households.

Transportation. As during the construction period, operations workers entering and exiting NECD via SR 63 could experience some delays. This would be especially likely at the end of the work day if all 400 workers end their shift at the same time. In addition, the risk of accidents at the point where vehicles leave NECD and turn onto SR 63 would increase as a result of project-induced traffic, representing a small to moderate impact to the local transportation network. Once again, possible mitigation measures-such as staggered shifts, car and van pooling, a traffic light, and acceleration lanes-should be considered.

Laud Use. As in the construction period, plant operations are not expected to change the nature of on- or off-site land use. However, the completion of pilot plant operations could stimulate increased public discussion of how to use the land within NECD's boundaries after all chemical agent is destroyed.

Economic Structure. At the end of plant construction and the onset of operations, the number of construction workers in Vermillion County, Indiana, would return to pre-project levels. Impacts to the local economy would be negligible, with the creation of 400 new direct operations jobs balanced by the loss of the same number of direct construction jobs.

Community Concerns. Recent expressions of local opinion indicate the likelihood that operation of the pilot neutralization facility would be seen by residents of the impact area as preferable to incineration and would not generate widespread opposition-as long as no accidents or "near misses" occur (see Appendix B). However, if problems with safe operation of the plant occur, substantial public opposition to the facility is likely to develop and to be accompanied by conflict among community members related to continuing plant operations.

4.1.2.7 Impacts to cultural, archaeological, and historic resources

No on-site impacts to cultural resources are anticipated during the operations period because additional disturbances to the land would not occur after construction of the chemical neutralization facility is completed. As during construction, inmigration during the operations period would be relatively small and short-lived and is not expected to adversely affect any off-site historic and archaeological resources within the five-county area.

4.1 .3 Accident Analysis-Proposed Action (Construction and Pilot Testing of the NECDF)

This section describes hypothetical accidents that could occur as a result of the proposed action and evaluates the impacts of these accidents on humans and various natural resources. Accident impacts on human health, land and water use, ecology, socioeconomics, and cultural, archaeological, and historic resources are analyzed (see Sects. 4.1.4.1 to 4.1.4.5). Although there could be acute toxic effects from atmospherically dispersed agent VX, no long-term air quality impacts would result from the accidental release of agent. As discussed in the subsections below, significant adverse impacts could accompany any accidental release of agent VX.

For the purposes of this document, the analysis of accidents is intended to provide only an upper-bound estimate for the zone of potential environmental impact. As such, the accident analysis presented in this EIS should not be considered to be a detailed safety analysis or risk assessment for the proposed action or its alternatives.

The accident analysis focuses on the release of agent VX and involves many conservative (Le., pessimistic) assumptions intended to provide an upper bound on the extent of any environmental impacts. For example, the hypothetical accident releasing the largest quantity of agent, when combined with the most unfavorable meteorological conditions, is used to establish an upper bound on any potential effect of agent VX accidentally released to the environment. Such hypothetical accidents are extraordinary events with extremely low likelihoods of occurrence but with potentially significant environmental impacts. For the "upper bound" purposes of this assessment, it is furthermore assumed that no actions (e.g., fire suppression, evacuation of population) would be taken to control or mitigate the consequences of such an accident. The result of these conservative assumptions is the identification of a hypothetical "zone of potential impact" that represents the area beyond which adverse environmental impacts would not be expected to occur.

Storage accidents that might occur during the proposed pilot testing would be the same as those described in Sect. 4.2.2 for the no action alternative. The analysis of storage accidents has been deliberately separated from the analysis of accidents during pilot testing of the NECDF to facilitate the comparison between the proposed action (construction and pilot testing of the NECDF) and the no action alternative (continued storage of the agent VX stockpile at NECD). However, it should be noted that the proposed action does not introduce any new VX agent hazards beyond what already exists in the storage warehouse at NECD. Furthermore, while the types of accidents that could occur during pilot testing at the NECDF are similar to those that could occur during continued storage, the storage accidents have the potential for more severe consequences due to the larger quantities of VX that could potentially be involved.

In 1996, an analysis was conducted on the risks of the proposed neutralization technology by MITRETEK (MITRETEK 1996). The risk analysis for the proposed action concentrated on several activities associated with disposal operations. Accident initiators included the usual processing plant equipment failures, as well as external events and human error. In regard to the likelihood of accidents during the pilot testing, MITRETEK concludes that the inherent risks of the neutralization technology are not severe. The greatest concern for impacts following a release of chemical agent would be the airborne hazard. In addition, spilled liquid agent could also impact surface areas and/or surface water and groundwater resources.

4.1.3.4 Method of analysis for agent VX accidents

Downwind dispersion of accidentally released agent VX was analyzed with the D2PC atmospheric dispersion model (Whitacre et al. 1986) to estimate impacts on human health, socioeconomics, land and water use, and ecological resources. This model was developed by the U.S. Army Chemical Research, Development and Engineering Center and was used to determine the downwind hazard distances associated with airborne concentrations of agent VX. Two such distances were identified: the no-deaths distance (i.e., the downwind distance beyond which no human fatalities would be expected to occur) and the no-effects distance (i.e., the downwind distance beyond which no human health effects, such as miosis, tremors, airway tightening, nausea, vomiting and diarrhea, would be expected to occur). These distances for an accidental release of agent VX are defined as the straight-line distance from the point of the accident to the point directly downwind from the accident that has a certain inhalation dose. Here, dose is defined as the airborne concentration of agent VX, integrated over the time of plume or cloud passage. For the no-deaths distance, a dose of 1.76 $mg\text{-}min/m^3$ was used (Whitacre et al. 1986). For the no-effects distance, a dose of 0.44 $mg\text{-}min/m^3$ was used (Whitacre et al. 1986).

The D2PC model incorporates extensively documented atmospheric dispersion assumptions that are currently in use in a variety of other atmospheric dispersion models. When used to calculate doses, the D2PC model conservatively estimates (i.e., it overestimates) the extent of the zone potentially impacted by atmospheric dispersion of agent VX because no compensation is made for the potential confinement of an atmospheric plume by terrain effects, and constant (e.g., straight line) dispersion characteristics are assumed to apply.

Maximum impacts were estimated based upon atmospheric dispersion of agent VX under worst case (WC) meteorological conditions that would somewhat inhibit the cross wind dispersion of agent. The WC meteorology represents a credible condition that results in substantial quantities of chemical agent being transported to large distances downwind of the release point. A slightly stable atmosphere (Stability Class E) with a wind speed of 1 m/s (3.3 ft/s) was chosen for the WC meteorological conditions.

Impacts from accidental releases of agent VX under more typical weather conditions were also estimated. Such impacts were based-on atmospheric dispersion under conservative most likely (CML) meteorological conditions. These conditions represent a frequently occurring atmospheric stability (Stability Class D) with a wind speed of 3 m/s (9.8 ft/s). In comparison to WC conditions, CML meteorological conditions would result in a wider plume of chemical agent that does not carry lethal concentrations as far downwind (see Appendix G for additional details and an illustration of plume geometries).

4.1.3.2 Zones of potential impact for accidental releases of agent VX

No detailed or extensive assessment has yet been conducted of the potential accidents that might occur during the proposed pilot testing activities; however, a risk evaluation by MITRETEK has identified a single "worst case" accident associated with the pilot testing of the NECDF (MITRETEK 1996). MITRETEK found that the worst case accident during neutralization at NECD involved an aircrash that would rupture the tanks holding drained agent and would create an ensuing fire. Both of the active 0.9-m^3 (240-gal) holding tanks could be involved. The tanks were assumed to be 75 % full, therefore, the quantity of agent VX involved in such an accident would be 1.3 m^3 (360 gal).

During pilot testing,two ton containers could be simultaneously in the demilitarization building awaiting punch and drain operations. MITRETEK found that there is sufficient separation between the agent-holding tanks and the ton containers awaiting processing that an aircrash would be unable to rupture both the holding tanks and the ton containers in the same accident. If the accident involved only the two ton containers [each containing about 0.7 m^3 (190 gal)] and not the holding tanks, then 1.4 m^3 (380 gal) of agent VX could be involved. This quantity is similar to, but slightly larger than, the quantity involved in the holding tank accident. This accident, involving two ton containers, is not inconsistent with the "planning basis accidents" for NECD (ANL 1997) that are incorporated into CSEPP as discussed in Sect. 1.4.

The aircrash accident involves an ensuing fire that would consume all but 2.5% of the agent VX involved. The surviving agent would be lofted by the heat of the fire to become atmospherically dispersed through the breach in the structure created by the aircrash. An evaluation of the accident involving the two ton containers yields a lethal downwind hazard distance of 8.5 km (5.3 miles) under WC conditions. As discussed in Appendix G, this accident was "categorized" as a 10-km (6-mile) accident for the purposes of analysis in this EIS. The no-effects distance for this accident would be 56 km (35 miles), which is rounded upward to 60 km (37 miles) for analysis in this EIS. Under CML conditions, the lethal downwind hazard distance for this same accident would be about 2 km (1.2 miles), and the no-effects distance would be about 7.5 km (4.7 miles).

4.1.3.3 Accidental spills of hydrolysate

Prior to the treatment of the process effluent (also called hydrolysate, composed of constituents as shown in Table 2.10) from the neutralization reactor, accidental spills could occur. The amount of hydrolysate generated by the facility each day would be about 19 m^3 (5,000 gal); however, the neutralization process would be conducted in batches that would create about 4 m^3 (1,000 gal) of hydrolysate per batch.

After neutralization of agent VX and the TCC effluent, the hydrolysate would be moved by pipeline to the SCWO area for further-processing. For the purpose of this assessment, it is assumed that the 4 m^3 (1,000 gal) of hydrolysate represents the maximum credible spill. The greatest concern for impacts following a spill of hydrolysate would be for the spill to impact surface areas (including vegetation) and/or surface water and groundwater resources. Any impacts incurred as a result of spills would be localized to the spill area. The main impacts anticipated would be associated with remediation of the contaminated soil. Since only 1,000 gallons of hydrolysate are at risk at any given time, the effort should be rather small. Occupational precautions, standard for a toxic cleanup, will afford adequate protection. Because the spilled liquid constituents would be adequately contained by properly designed berms, dikes, and sumps, any hydrolysate spilled at NECD should pose no adverse impacts.

4.1.4 Impacts From Accidents

4.1.4.1 Human health impacts

Human health impacts from exposure to accidentally released agent VX can be categorized as either lethal effects or sublethal effects. Sublethal effects are not quantified in this EIS because of their great variation depending on exposure concentrations, the duration of exposure, the exposure pathway, and the number and health status of people potentially exposed; however, a quantitative evaluation of the lethal effects has been conducted for this EIS. Estimates of potential human fatalities are based on the downwind no-deaths distance as determined from the D2PC model (see the more detailed discussion in Appendix G). The fatality estimates presented here are those that would result if the wind were to blow in the most unfavorable direction (usually toward the largest concentration of population). The assumed WC meteorological conditions are those that would disperse chemical agent in a manner that would produce a lethal concentration of agent VX at the greatest downwind distance.

As described above, the worst-case accident during pilot testing at the NECDF would be an aircrash into the Chemical Demilitarization Building. The airborne, lethal concentration of agent VX in such an accident is categorized as extending about 10 km (6 miles) downwind. There are about 4,000 residents within this distance of the proposed NECDF. Among this population, such an accident could cause an estimated 50 fatalities under the WC meteorological conditions. Under the more likely CML conditions, the same accident might cause only a single fatality.

All of the above fatality estimates are based on residential population statistics and thus are more closely associated with nighttime distributions of population than with daytime distributions; however, WC meteorological conditions can also be associated almost exclusively with nighttime hours at NECD. CML conditions are likewise associated with daylight hours.

The downwind no-effects distance for this accident (under WC meteorological conditions) would be about 60 km (37 miles). There are about 300,000 residents within this distance of the proposed NECDF site.

4.1.4.2 Impacts on land and water resources

Accidental releases of agent VX. An accidental release of agent VX into the atmosphere could potentially affect a large land area downwind from the site of the release. Mortality and injury to wildlife and livestock could occur within the dispersing plume, while vegetation and soils could be contaminated with-chemical agent. Impacts on the growth of on-site and off-site vegetation in the vicinity of NECD would be minimal because plants are relatively insensitive (i.e., have a relatively high tolerance) to agent VX. However, contaminated vegetation could be harmful to livestock and wildlife for an extended period of time (U.S. Army 1988, Vol. 3, Appendix 0, Sect. 0.3.2.2). Therefore, the pasturing of livestock in the vicinity of NECD would be precluded until the contamination declined to levels at which the animals could graze safely and produce meat or milk products that would be safe for human consumption. The use of land for growing agricultural crops for human or animal consumption could also be temporarily precluded within contaminated areas.

The length of time during which grazing and crop growing would be precluded would depend on the chemical agent's persistence. Available evidence indicates that the effects of soil contamination on vegetation and animals would be negligible after one year in the case of agent VX (U.S. Army 1988, Vol. 3, Appendix 0).

Water resources also could be impacted by the airborne dispersion of VX after an accident associated with the proposed action. The impact zone includes all of NECD and portions of Vermillion, Park, and Fountain counties in Indiana and extends into Vermilion and Edgar Counties in Illinois. The impact zone is drained by Dry Branch (at the extreme northern edge and possibly outside of the impact zone); Jonathan, Little Vermillion, Buck, Little Raccoon, and Sugar creeks; and the Little Vermilion and Wabash rivers. The Wabash River ultimately receives all runoff that flows overland from within the 10 km (6 miles) impact zone. Numerous farm ponds used to water livestock are scattered throughout the impact zone. The persistence of VX and VX reaction products would be longer lasting on land, in soil, and in stagnant bodies of water than in flowing bodies of water where turbulence would accelerate hydrolysis.

Accidents associated with the proposed action could involve a spill of agent VX directly onto land surfaces. Lands outside the depot would not be impacted by a direct accidental spill of VX because only a small area would be affected within the NECDF/Building 144 fence line. Soils in the immediate neighborhood of the spill would be highly contaminated with VX. Rapid response and decontamination at the spill site in accordance with the NECD spill prevention, control, and countermeasures plan would minimize as well as localize environmental impacts (U.S. Army 1990; 1996).

Spills that occurred in handling areas inside the NECDF would be contained by an engineered system of curbs, berms, and sumps designed to contain, control, and collect accidental spills. The neutralization reactors, SCWO reactors, and evaporators/crystallizers would rest on curbed concrete slabs such that accidental spills would not impact the surface water or groundwater.

Spills occurring outside of the NECDF, during loading, transportation, or unloading of the ton containers would be more likely to impact land, surface water, and groundwater. The severity of the impact on land and water resources would depend on the details of the accident, how much VX was involved in the spill, and the rapidity with which containment procedures and decontamination measures would be implemented after the spill had taken place. Containment and decontamination after an accidental spill would minimize runoff and seepage of VX. The caustic solution used in the decontamination process would adversely impact on-site vegetation in the immediate vicinity of the spill, but vegetation would be expected to grow back shortly thereafter (U.S. Army 1988).

Seepage of VX agent and caustic solution into sand and gravel lenses within the glacial till is not expected since timely cleanup is planned (U.S. Army 1990). If cleanup were not timely, monitoring of wells tapping the lenses would be required and alternate water supplies would have to be obtained for consumers of groundwater whose wells were impacted. More than 50% of the 49 wells located within 3.2 km (2 miles) of NECD tap sand and gravel lenses within the glacial till (see Sect. 3.3.2.4).

Accidental spills of hydrolysate during treatment. The engineered system of curbs, berms, and sumps would contain, control, and collect any accidental spills of hydrolysate that occurred within the proposed NECDF. Accidental spills would be decontaminated and cleaned up in a timely manner in accordance with NECD spill prevention, control, and countermeasures plans (U.S. Army 1990; 1996).

4.1.4.3 Ecological impacts

Accidental releases of agent **VX**. Because certain animal species are more sensitive than humans to chemical agent, animal fatalities and other effects could occur at greater distances than those for humans, potentially up to the human no-effects distance (U.S. Army 1988, Appendix 0). Locations of sensitive ecological resources are shown in Fig. 3.7. The no-effects distance from the pilot test facility includes 18 counties or parts of counties in Illinois and Indiana. Sensitive ecological resources in this no-effects zone and downwind of an accidental VX release could be affected.

*Aquatic resources***.** Under the proposed pilot testing of neutralization/supercritical water oxidation of agent VX, the "worst case" accident scenario involves the failure of two of the 910 L (240-gal) holding tanks containing the drained agent awaiting neutralization [total of 1360 L (360 gal), assuming each tank to be 75 % full]. Because containment structures and sumps within the proposed facilities are expected to adequately contain the entire contents of the holding tanks, direct contamination of surface waters and consequent harrn to aquatic life by overland flow are highly unlikely.

If the VX holding tanks were damaged by direct impact by an aircraft and a subsequent fire, however, an atmospheric plume containing as much as 36 kg (80 lb) of potentially lethal aerosolized agent and combustion products could be blown many kilometers downwind. Such a plume could drift over the Wabash River as well as many smaller streams, lakes, and ponds, depending on wind velocity and direction (prevailing winds are from the south). Aquatic species within water bodies could be exposed to agent VX following deposition of the agent directly onto surface waters and by entry of runoff from contaminated land. The following analysis of potential impacts of the plume of VX agent generated by the postulated accident under conditions prevailing during the proposed action is based on several additional assumptions:

- The affected areas under the VX plume and the cumulative percent VX depletion (deposition) from the plume at (1) the 1% human lethality distance contour, (2) the no human deaths distance contour, and (3) the no human effects contour, are as estimated by the D2PC atmospheric dispersion model (see Sect. 4.1.3 and Appendix G for a discussion of the application of this model).
- Plume passage over a given point lasts between 30 and 60 minutes. Table 4.7 presents the post-accident mean area1 deposition of VX in mg/m' for two wind speeds (1 m/s and 3 m/s) at varying distances from the accident source.
- Mean area1 deposition of VX on flowing-streams in the path of the plume is equivalent to deposition on land (this is a conservative assumption for receiving streams as opposed to still waters such as ponds and lakes because, barring unusual meteorological conditions, an aliquot of flowing water within a stream crossed by the plume would probably be subject to VX deposition for a shorter time than land).
- The receiving water body is a pool or stream either 10 cm deep or 1 m deep.

Table 4.7. Predicted post-accident deposition of VX on land and water surfaces after accidental release of 36.4 kg (80 lb) of VX into the atmosphere

(based on application of the D2PC dispersion model discussed in Sect. 4.1.3.1)

Distance (km)	Plume Area[d] (km^2)	Cumulative Percent VX Deposition"	A VX Deposition[f] (kg)	Mean Areal Deposition (mg/m^2)
		CASE I: Mean Wind Speed = 1 m/s		
1.6"	0.087	50	18	210
2.1[b]	0.15	51	0.36	5.4
7.6	2.0	58	2.6	1.4
		CASE 2: Mean Wind Speed = 3 m/s		
6.3"	2.8	28	10	3.6
8.5[b]	5.1	30	0.73	0.32
57"	230	47	6.2	0.028

"Distance from site of accident (proposed facility) to plume contour for 1% human lethality.
'Distance from site of accident to plume contour at which no human lethality occurs.
Distance from site of accident to plume contour at which no human health effects occur.
'Cumulative plume area from source to selected distance from source.
'Cumulative fraction of total released VX that deposits on surfaces within given plume distance contour.
'Total VX deposited within successive distance contours. In Case 1, for example, 0.36 kg is deposited from the plume between 1.6 and 2.1 km from the source of the release.

- Deposited VX is rapidly and completed mixed in the receiving water body (generally, in still waters mixing would be much slower than in streams). Table 4.8 shows calculated VX concentrations in surface waters at various distances from the NECD site of release.

There are few data available concerning the aquatic toxicity of VX. Using very limited data on VX toxicity to striped bass from a study by Weimer et al. (1979), a mathematical expression for estimating the LT_{50}s for a given concentration of agent was developed for the U.S. Army's (1988) Final Programmatic Environmental Impact Statement for the Chemical Stockpile Disposal Program. This analysis used that mathematical expression to calculate the LT_{50}s for fish at various concentrations estimated for different combinations of distance from the release point and receiving water depth:

$$\log(LT_{50}) = a - b \log(C)$$

where LT_{50} = median lethal exposure time in hours; C = VX concentration in ppm (mg/L) in water; and a and b are constants (a = 1.52; b = 0.63).

Moreover, for the purpose of comparing exposure concentrations to a generally recognized benchmark of acute toxicity, the 96-hr LC,, (concentration lethal to 50% of the test

Table 4.8. Predicted post-accident deposition and post-dilution concentrations of VX in receiving waters compared to aquatic toxicological benchmarks after accidental release of 36.4 kg (80 lb) of VX into the atmosphere

Distance (km)	Mean Areal Deposition (mg/m')	Concentration 10-cm deep" pool or stream (μg/L)	Concentration l-m deep" pool or stream (μg/L)	Fish LT_{50} [b] IO-cm deep" pool or stream	Fish LT_{50} [b] l-m deep" pool or stream	Haz Quotient' (IO-cm deep) Conc / LC,, (0.28 μg/L)	Haz Quotient' (I-m deep) Conc / LC,, (0.28 μg/L)
CASE I: Mean Wind Speed = I m/s							
1.6"	210	2100	210	19 min	1.5 hr	7600	760
2.1'	5.4	54	5.4	3.5 hr	15 hr	190	19
7.6'	1.4	14	1.4	8 hr	35 hr	50	5.0
CASE 2: Mean Wind Speed = 3 m/s							
6.3"	3.6	36	3.6	4.5 hr	19 hr	130	13
8.5"	0.32	3.2	0.32	21 hr	3.7 d	11	1.1
SP	0.028	0.28	0.028	4 d	17 d	1.0	0.10

"Rapid and complete dilution of deposited VX in (a) IO-cm deep pool or stream, and (b) l-m deep pool or stream, is assumed.

[b] LT_{50} = median lethal time = time required to kill half the fish exposed to a given concentration of agent. LT_{50} values are calculated from mathematical expression relating concentration and median lethal time for striped bass provided in Appendix 0 in U.S. Army 1988.

[c] Hazard quotient = ratio of the post-dilution concentration of VX in the receiving water body to the calculated 96-hr LC,, for striped bass using the mathematical expression relating concentration and median lethal time for striped bass provided in Appendix 0 in U.S. Army 1988.

[d] Distance from site of accident (proposed facility) to plume contour for 1% human lethality.

[e] Distance from site of accident to plume contour at which no human lethality occurs.

[f] Distance from site of accident to plume contour at which no human health effects occur.

organisms after 96 hrs exposure), a LT_{50} value of 96-hrs exposure time was used in the above expression to back-calculate to a 96-hr LC,, of 0.28 μg/L. It is important to note the uncertainty surrounding these values accruing from the fact that not only is the above expression derived from very limited data, but the lowest concentration tested (20 μg/L) was considerably higher than the extrapolated 96-hr LC,, of 0.28 μg/L.

Because so little is known concerning the aquatic toxicity of VX, a water quality criterion for the protection of aquatic life has not been developed. Therefore, although recognizing the uncertainty involved, the published chronic water quality criterion (U.S. EPA 1986) for another highly toxic organophosphorus compound, the pesticide Guthion (azinphos-methyl) was selected for comparative purposes. It is reasonable to expect, however, that VX aquatic toxicity is considerably greater than Guthion toxicity if for no other reason than that the more plentiful data on mammalian toxicity of VX indicates that acute oral toxicity of VX ranges from about 50 to 200 times that of Guthion, and acute dermal toxicity up to 2200 times that of Guthion (Manthei 1997; Smith 1987; Sax and Lewis 1989).

Tables 4.8 and 4.9 show the results of this comparative analysis. The fish LT_{50} of 19 minutes (compared to a plume passage time of at least 30 minutes) for a 10-cm deep body of

Table 4.9. Predicted post-accident deposition and post-dilution concentrations of VX in receiving waters compared to the EPA chronic water quality criterion (CWQC) for the protection of aquatic life [a] for the organophosphorus pesticide, Guthion (Azinphos-methyl)[b]

[The postulated accident (under the proposed action) involves the release of 36.4 kg (80 lb) of VX into the atmosphere during a period of 30 minutes]

Distance (km)	Mean Area1 Deposition (mg/m^2)	Concentration IO-cm deep pool or stream ($\mu g/L$)	Concentration l-m deep pool or stream ($\mu g/L$)	Haz Quotient (IO-cm deep) Conc *f* CWQC (0.01 $\mu g/L$)	Haz Quotient (l-m deep) Conc / CWQC *(0.01* $\mu g/L$)
		CASE 1: Mean Wind Speed = I m/s			
1.6[c]	210	2100	210	210,000	21,000
2.1[d]	5.4	54	5.4	5,400	540
7.6'	1.4.	14	1.4	1,400	140
		CASE 2: Mean Wind Speed = 3 m/s			
6.3"	3.6	36	3.6	3,600	360
8.5[d]	0.32	3.2	0.3 2	320	32
57'	0.028	0.28	0.028	28	2.8

[a]EPA 1986.

[b]In the absence of a water quality criterion for VX. VX, however, may be considerably more toxic than Guthion to aquatic life.

'Distance from site of accident (proposed facility) to plume contour for 1% human lethality.

'Distance from site of accident to plume contour at which no human lethality occurs.

"Distance from site of accident to plume contour at which no human health effects occur.

water less than 2 km from the site of the release suggest that shallow ponds and creeks such as Little Raccoon Creek and Little Vet-million Creek lying in the path of the plume could sustain VX concentrations high enough to kill many if not most of the organisms residing there. Nearer the source, VX concentrations would likely be even higher. Flowing streams of 1 m depth beyond a distance of about 1.6 km (1 mi) would incur concentrations yielding fish LT_{50}s of 1.5 hrs or more (perhaps three times the time for plume passage), and therefore, given the assumptions and limitations of this analysis, somewhat less than 50% of the resident fish may suffer injury or death. The most important large stream near the site of the accident, the Wabash River, approaches to within approximately 3.5 km (2.2 mi) of the site. At this distance, the LT_{50} for fish is greater than 15 hrs (under l-m/s wind conditions; the LT,, may be lower than 15 hrs under 3-m wind conditions) and most resident fish would therefore be expected to survive the relatively brief passage of contaminated water resulting from fallout from the atmospheric plume.

Pond and lake dwellers inhabiting surface waters in the path of the plume, however, would be subject to far longer exposure times, limited primarily by relatively slow hydrolysis and other physico-chemical mechanisms contributing to destruction of the agent. For these "captive" aquatic organisms, even the relatively long LT_{50}s at 57 km (35 mi) and beyond (from the source of the release) of 4 and 17 days for 10-cm deep and l-m deep surface waters, respectively, could still mean serious injury or death to many if not most aquatic organisms residing there.

The additional comparisons of VX concentrations with the calculated 96-hr LC,, (Table 4.8; note that, because it was back-calculated using the LT_{50} and its corresponding VX concentration, the LC,, is not truly independent of the LT_{50}s in Table 4.7), and the chronic water quality criterion for Guthion (Table 4.9) tend to support the conclusions that an accidental release of VX into the atmosphere would adversely affect aquatic populations of lentic surface waters (e.g., ponds and lakes) as far away as 57 km (35 mi) and quite possibly at considerably further distances. Further harm might be incurred when the first post-accident rainfall and runoff transports VX deposited on land onto adjacent surface waters. Table 3.4 lists major water bodies within 100 km (62 mi) of the NECD. Serious impacts to aquatic populations in flowing waters (creeks and rivers), however, would probably be limited to the small creeks such as Little Raccoon Creek within 2 to 3 km (1.2 to 1.8 miles) of the release because the time of exposure would be relatively short. Given the uncertainties inherent in this analysis, however, the proximity of the Wabash River suggests that aquatic life in this river could be harmed to a greater degree than indicated by this analysis if the model or limited toxicity information are not fairly representative of site-specific conditions and local fauna and flora.

Terrestrial resources. Wildlife downwind of an accidental release within the 60-km (37-mile) no-effects distance could die from direct inhalation or contact with aerosolized and volatilized VX. Birds and insects may be particularly susceptible (U.S. Army 1988, Appendix 0). Herbivores such as deer and rabbits not affected by direct contact or inhalation of agent would be most likely affected by ingestion of agent deposited on the surface of vegetation. Due to the relatively low sensitivity (i.e., high tolerance) of plants to VX, it is expected that impacts of deposition on the growth of vegetation off of the pilot test facility site would generally not be significant. However, evidence that plants absorb VX and its breakdown products indicates that vegetation contaminated with chemical agent would be harmful to grazing livestock and wildlife over an extended period of time (U.S. Army 1988, Appendix 0). In the no-effects zone, ingestion of contaminated vegetation could be lethal to some grazing animals. Soil contamination by VX could last for up to a year, after which available evidence indicates that its effects on vegetation and animals would be negligible (U.S. Army 1988, Appendix 0). Based on what is known about other organophosphate chemicals in agricultural systems, VX and its breakdown products would not persist in meat or milk. Accumulation in food chains beyond herbivores would not be expected (U.S. Army 1988, Appendix 0).

Threatened and Endangered Species. Six federally designated endangered aquatic species have been reported within 100 km (62 miles) of the Newport site (D. Hudak, FWS, personal communication to H. Quarles, ORNL, Oct. 28, 1997; D. Hudak, FWS, personal communication to L. L. Sigal, ORNL, June 17, 1986; Nelson personal communication to L. L. Sigal, ORNL, June 17, 1986): the fanshell (*Cyprogenia stegaria*), clubshell (*Pleurobema clava*), and white wartyback (*Plethobasus cicatricosus*) mussels, and the fat pocketbook (*Potamilus capax*), pink mucket (*Lampsilis orbiculata*), and tubercled-blossom (*Epioblasma torulosa torulosa*) pearly mussel. Recent information on the distribution of these mussels indicates, however, that only two species (fanshell and clubshell) probably occur within 100 km of the site (see the Biological Assessment, Appendix D). The nearest reported occurrence of the fanshell and clubshell mussels is in Tippecanoe County, Indiana, 85 km (53 mi) or more away from the site. The others apparently no longer occur within 100 km (62 mi) the site. Three additional species, the orange-footed pimpleback (*Plethobasus cooperianus*) and rough pigtoe (*Pleurobema plenum*) mussels, and the white cats paw pearly mussel (*Epioblasma obliquata perobliqua*) may occur within the State of Indiana, but have not been collected in recent years (D, Hudak, FWS, personal communication to L. L. Sigal, ORNL, Jul. 11, 1986). A total of five endangered mussels have been collected from the Wabash River, but none from the reach nearest the NECD nor from the smaller streams such as Little Raccoon Creek which drain the NECD property (Miller 1984). Based on the above analysis, these occupants of flowing streams would probably not be seriously harmed should the VX plume pass their way. An important uncertainty, however, concerns the fact that the limited toxicity data available is for fish, not freshwater invertebrates. It is not unusual for freshwater invertebrates to be more sensitive to contaminants than fish. The potential effects of accidental releases of VX on these endangered species will be addressed in more detail in the Biological Assessment (see Appendix D).

Both Indiana bat colonies at NECD are within 3.2 km (2 miles) of the proposed pilot test facility and are therefore well within the human no-deaths distance. Some or all individuals of this federally listed endangered species could be killed from inhalation or contact with aerosolized and volatilized VX if downwind from an accidental release. Similarly, if bald eagles (federally listed threatened species) were present along the Wabash adjacent to NECD during an accidental release of VX, they could be adversely affected or killed if the plume moved to this area. Any bald eagles present along the Wabash further from NECD in Parke, Fountain, and Warren Counties would be within the no-effects distance, and could also be affected if the plume spread to these areas. The bald eagle wintering areas in Moultrie and Jasper counties, Illinois, are well beyond the no-effects distance and impacts to individuals are less likely. The locations of both of the federally threatened plant species are well beyond the no-effects distance. Because of the great distance, and the low sensitivity of plants to VX, it is extremely unlikely that individuals of either Mead's milkweed or eastern prairie fringed orchid would be affected.

In accordance with the Endangered Species Act, the U.S. Fish and Wildlife Service (FWS) has been contacted for identification of and information about listed threatened or endangered species or species proposed for listing that could occur within a 100-km (62-mile) radius of NECD. A biological assessment for threatened and endangered species is being prepared and will be submitted to the FWS for review (see Appendix D).

Accidental spills of hydrolysate during treatment. A spill of untreated hydrolysate or other liquids involved in the process within the processing **area** should be adequately contained by the curbs, dikes, berms, and sumps planned for the project, and would therefore be unlikely to enter area surface waters and adversely affect aquatic life.

4.1.4.4 *Socioeconomic impacts*

Accidental release of agent VX. The "worst case" accident associated with pilot testing of the NECDF could cause deaths as far as 8.5 km (5.3 miles) from the facility and could have sublethal effects to a distance of 56 km (35 miles); these distances have been rounded up to 10 km (6 miles) and 60 km (37 miles) respectively. The town of Newport is located within the 10-km zone, as are four other municipalities having populations of at least 500 each. In addition, six much smaller communities-ranging in population from 50 to 150—are located within this area of potential lethality. Almost all of the five county socioeconomic impact area is located within the 60 km region that could experience some effect from an accidental release of agent.

In addition to fatalities, an accident could result in a temporary decline in population as some residents evacuate the area. This decline in population could be longer lasting if buildings require decontamination or if current residents choose to relocate permanently as a result of their experience. If a large number of residents are affected or the dislocations caused by the need to decontaminate structures are long-lasting, the impacts would be significant. Housing values also could decline to some extent, because the attractiveness of the affected area to potential buyers could be diminished. Local traffic patterns could be disrupted if roads are contaminated and require temporary closure, Other public services also could experience temporary disruptions if key facilities (e.g., water or sewage treatment plants; schools) are contaminated. These impacts would be significant if important services to local residents are suspended for more than few days. The local economy-and consequently the local tax base-could be adversely impacted if local businesses, industries, and agricultural land are rendered temporarily unusable as a result of contamination. If a large number of enterprises is affected or if the effects are long-lasting, these impacts would be significant. The exact costs of an accidental release of agent VX are unknown, but the costs of a catastrophic accident at a nuclear power plant have been estimated at between $1 billion and $10 billion (US GAO 1997). The psychological impacts of an accident also could be significant, with the magnitude of adverse effects experienced by local residents varying with the number of fatalities and the extent to which inhabitants are displaced. It is likely that active community opposition to disposal operations would increase dramatically after an accident, and conflicts among community members related to NECD activities also could arise.

Accidental spill of hydrolysate during treatment. Any spill of hydrolysate occurring in the processing area would be contained within the boundaries of NECD. Accordingly, there would be no impacts to the socioeconomic resources of the surrounding communities.

4.1.4.5 Impacts to cultural, archaeological, and historic resources

Accidental release of agent VX. As explained in Section 4.1.3, the "worst case" accident associated with pilot testing of the NECDF could cause deaths as far as 10 km (6.2 miles) from the facility and could have sublethal effects to a distance of 60 km (37.2 miles). A number of sites that are listed in the National Register of Historic Places, including several covered bridges, are located within the IO-km area, and all but one of the historic and archaeological sites identified in Section 3.7 are within the 60 km zone. Access to affected sites would be restricted until they could be decontaminated. As noted in the Final Programmatic Environmental Impact Statement (1988), if a structure could not be decontaminated it might have to be destroyed. Such a loss would constitute a significant impact to cultural resources.

Accidental spill of hydrolysate during treatment. As explained in section 4.1.3, any spill of hydrolysate occurring in the processing area would be contained on site. Therefore, archaeological and historical resources located in the surrounding area would be unaffected. No additional impacts to on-site resources are anticipated beyond what could occur during project construction (see Section 4.1.1.6).

4.1.5 Environmental Justice

In compliance with Executive Order 12898, the Army has taken further steps to determine if human health or environmental impacts would be "disproportionately high and adverse . . . on minority populations and low income populations." There is no evidence that minority groups exist in significantly large numbers in the vicinity of NECD, especially when compared to other counties in the vicinity and to the states of Indiana and Illinois (see Table 3.20). Therefore, there could be no disproportionate or adverse impacts to minority populations from the proposed action.

Low-income residents in the area may supplement a fraction of their diets through fishing or other food collection activities, and therefore, potentially consume greater quantities of local fish or game than higher-income groups. Low-income groups could therefore experience a greater degree of exposure from eating potentially contaminated fish or game. Although the number of people that might be exposed to the effluent is expected to be small, lower income groups may represent a disproportionately large fraction of those potentially exposed; as shown in Table 3.20, the low-income proportion of the population of several jurisdictions in the area, including the communities of Rockville, Clinton, and Newport in Indiana as well as Edgar and Vermilion counties in Illinois, is substantially larger than the low-income proportion of the population in their states. It should be noted, however, that the liquid effluents and gaseous emissions from the proposed facility are not expected to adversely affect drinking water or constituents of the food chain, including fish and wildlife, thus eliminating the potential for adverse impacts to any population groups, including low-income groups. There is no evidence at this time that consumption of fish, shellfish, or game from or near the Wabash River should be restricted or limited.

With regard to potential accidental releases of agent VX, there is no evidence that minority groups, including the largest group identified (Blacks), exist in significantly large numbers in the vicinity of NECD, especially when compared to other nearby counties and to the states of Indiana and Illinois (See Table 3.20). Therefore, there could be no disproportionate adverse impact to minority populations from the proposed action associated with potential accidental releases of agent VX. Given their greater proportion of the population, there could be a disproportionate impact to low-income populations in the event of an accidental release. Procedures are in place under CSEPP to ensure that low-income populations are adequately protected in the event of an accidental release. It should also be noted that emergency response planning under CSEPP prohibits the consumption of potentially contaminated food and water for all population groups, including low-income groups, thus eliminating disproportionate adverse impacts to any population groups, including minority and low-income populations.

4.2 THE NO-ACTION ALTERNATIVE—CONTINUED STORAGE

Activities during continued storage include all current storage and maintenance operations as described in Sects. 2.1.4 and 2.1.5. These operations are defmed as those which occur without any accidental release of chemical agent into the enviromnent. Analysis of this alternative assumes that "business as usual" would occur during continued storage activities. Sect. 4.2.2 discusses the impacts associated with accidental releases of chemical agent during continued storage.

4.2.1 impacts from Routine Continued Storage Activities

Continued storage activities consist of the actions required to either modify the inventory in storage to a higher or lower level of ready-to-issue status, or to systematically inspect and repair the stocks as necessary so that safe storage can continue. Normal maintenance activities are characterized by extensive preparation prior to actual operation.

4.2.1.1 Impacts on land and water use

There are no land or water use impacts associated with maintenance activities under the incident-free, continued storage alternative.

4.2.1.2 Air quality and noise impacts

Air quality impacts of current maintenance activities at NECD are negligible. Principle sources of air pollutants associated with these activities are vehicle emissions and dust generated by vehicle movements. These sources are small in absolute terms and in comparison to other sources in the area around Newport.

Noise levels associated with maintenance activities arise primarily from vehicle use. A firing range used to qualify plant security personnel in small arms use is remotely located, and has minimal, if any, off-site noise impacts.

4.2.1.3 Human health impacts

Small, but well understood, risks to workers are associated with maintenance of the stockpile. Army procedures, however, are designed to ensure the safety of the stockpile workers; there no significant adverse impacts to human health are likely during continued storage.

4.2.1.4 Ecological impacts

During incident-free storage, no releases from the storage area would occur. Therefore, there would be no adverse effects on aquatic or terrestrial ecological resources in the vicinity of the NECD.

4.2.1.5 Socioeconomic impacts

Routine continued storage represents no change from current activities at NECD. Accordingly, there would be no additional socioeconomic impacts.

4.2.1.6 Impacts to cultural, archaeological, and historic resources

Cultural resources would not be affected by routine continued storage, which represents a continuation of current activities.

4.2.2 Accident Analysis — No Action Alternative (Continued Storage)

This section describes hypothetical accidents that could occur as a result of the continued storage of VX-filled ton containers at NECD and evaluates the impacts of these accidents on humans and various natural resources. Accident impacts on human health, land and water use, ecology and socioeconomics are analyzed (see Sects. 4.2.2.1 to 4.2.2.5). Although there could be acute toxic effects from atmospherically dispersed agent VX, no long-term air quality impacts would result from accidental release of agent.

A discussion of the approach to the assessment of impacts from accidental releases of agent VX at NECD is contained in Sect. 4.1.3 and Appendix G. Those sections also contain a description of the overall method of analysis (see Sect. 4.1.3. 1), as well as definitions of the zones of potential impact (see Sect. 4.1.3.2) and the meteorological conditions (see Sect. 4.1.3.1) used in the analysis.

A risk assessment conducted in 1987 for the eight U.S. chemical weapons storage sites (GA Technologies, Inc. 1987; U.S. Army 1988, Vol. 3, Appendix J), found that the "worst case" accident during the storage of ton containers at NECD would involve an earthquake or an aircrash, with each of these events having an ensuing fire. The entire inventory of the storage warehouse could be involved in such an accident. The lethal downwind hazard distance associated with such an accident under the WC meteorological conditions could be greater than 100 km (62 miles). As discussed in Appendix E, this accident was "categorized" as a 100-km (62-mile) accident for the purposes of analysis in this EIS. Under CML conditions, the lethal downwind hazard distance for this accident would be categorized as 50 km (32 miles). This zone of impact is considerably larger that the zone associated with accidental releases of agent VX during the proposed pilot testing activities; hence, any impacts to human health or enviromnental resources from accidents during storage would be significantly larger and more widespread than for accidents during pilot testing.

422.1 Human health impacts

Estimates of potential fatalities were based on the no-deaths distance as determined by the D2PC atmospheric dispersion model. The fatality estimates presented here are those that would result from the least favorable wind direction-usually toward the largest concentration of population. The assumed WC meteorological conditions are those that would disperse chemical agent in a manner that would produce a lethal concentration of agent VX at the greatest downwind distance.

As described above, the worst-case accident during continued storage at NECD would be an earthquake or aircrash into the storage warehouse housing the ton containers of agent VX. The airborne, lethal concentration of agent VX in such an accident could extend about 100 km (62 miles) downwind.

There are about 1,150,000 residents within 100 km (62 miles) of the storage warehouse at NECD. Among this population, an aircrash into the storage warehouse could cause au estimated 18,500 fatalities under the WC meteorological conditions. Under the more likely CML conditions, the same accident might cause 5,000 fatalities.

All of the above fatality estimates are based on residential population statistics and thus are more closely associated with nighttime distributions of population than with daytime distributions; however, WC meteorological conditions can also be associated almost exclusively with nighttime hours at NECD. CML conditions are likewise associated with daylight hours.

4.2.2.2 impacts on land and water resources

The impacts from an accident associated with continued storage could produce a downwind hazard up to 100 km (62 miles) from NECD. Table 3.4 lists water resources within 100 km (62 miles) that could be impacted for a time period ranging from 1 to 6 years after being contaminated by a cloud, puff, or plume of agent VX accidentally injected into and dispersed by the atmospheric winds.

4.2.2.3 Ecological impacts

Because of the differences in the type of accident and the much greater amount of agent that would be released, impacts from continued storage accidents could exceed those associated with the proposed action. The downwind no-deaths distance associated with the largest accidental release of VX under worst-case meteorological conditions at NECD is greater than 100 km (62 miles) for continued storage. The 100-km (62-mile) zone considered for evaluation of potential impacts to ecological resources (see Fig. 3.7) includes 38 counties or parts of counties in Indiana and Illinois. Any of the sensitive ecological resources in this zone and downwind of an accidental release of VX could be seriously affected. Because of the uncertainty associated with the D2PC meteorological model beyond 100 km, the no-deaths and no-effects distances for continued storage are not considered beyond this distance even though impacts beyond this area could occur.

Aquatic resources. Under continued storage, the "'worst case" accident would release about 34,000 kg (75,000 lb) of VX into the atmosphere. This is approximately 940 times the release assumed in Sect. 4.1.3.3 under the proposed action to pilot test neutralization/supercritical water oxidation of VX and its hydrolysis products. Uncertainties in the D2PC dispersion model allow little confidence in extrapolation beyond 100 km. It is nevertheless evident from the analysis in Sect. 4.1.3.3 for accidents that could result from pilot testing and the nearly 1000-fold increase in the quantity of VX that would probably deposit on the land and water beneath the plume that aquatic populations in both still, and quite possibly flowing waters, would be harmed or destroyed both within and well beyond 100 km (62 mi) from the site of the accident.

Terrestrial resources. The conclusions of the accident impact analysis discussed for pilot test neutralization in Sect. 4.1.3.3 are qualitatively correct but understated with respect to accidents for continued storage. Animals downwind of a release of VX throughout the 100-km (62-mile) zone could be negatively impacted or killed. The possibility of significant damage to vegetation is greater than for the pilot test plant accident, but is still unlikely.

Threatened and Endangered Species. Two federally designated endangered freshwater mussels (see discussion in Sect. 4.1.3.3) have been reported within 100 km of the Newport site. Four other endangered aquatic species may occur between 100 and 200 km (124 mi) from the outfall. Given the magnitude of the release under the "worst case" storage accident scenario, it is possible these endangered mussels could be harmed or killed should the VX plume pass over their habitat. The bald eagle wintering areas in Moultrie and Jasper Counties, Illinois, are within this zone. If winds from the northeast spread plumes to these areas when bald eagles were present they could be affected.

4.2.2.4 Socioeconomic impacts

The "worst case" accident associated with continued on-site storage of agent VX could cause deaths as far as 100 km (62 miles) from NECD. All five counties of the socioeconomic impact area — plus all or part of 30 other counties-are located within the 100-km region. Qualitatively, the socioeconomic impacts resulting from a continued storage accident would be similar to those described for an accident during pilot testing of NECDF (Section 4.1.3.4). However, the impacts associated with a continued storage accident would be of a much greater magnitude than those described in Section 4.1.3.4, because the area that would be exposed to agent VX and the number of people affected would be many times larger.

4.2.2.5 Impacts to cultural, archaeological, and historic resources

As explained in Section 4.22, an accident occurring during continued storage of agent VX could cause deaths up to 100 km (62 miles) from NECD. All of the historic and archaeological sites identified in Section 3.65 — plus many others — are located within the 100 km zone. In the event of an accident, access to affected sites would be restricted until they could be decontaminated. As noted previously, structures that could not be decontaminated might have to be destroyed and this would constitute a significant impact. Because the area affected during a continued storage accident would be so much larger than during an accident at the pilot facility, the impact to cultural resources would likewise be much more extensive.

4.3 UNAVOIDABLE ADVERSE IMPACTS

The unavoidable adverse impacts of pilot testing of the NECDF involve consideration of the effects of construction, incident-free operation, and the risk of serious accidental releases of agent VX as discussed below.

4.3.1 Construction and Routine Pilot Testing of the NECDF

Implementation of the proposed NECDF would result in disturbance of existing land use and the loss of habitat for wildlife. The amount of land area disturbed on the NECD would equal approximately 20 - 28 ha (50 - 80 acres) for the physical plant structure and support facilities and for roads and utilities.

Impacts on employment, housing, business, enterprises, and municipal infrastructure would be minimal. The size of the work forces required for construction and operation are small in comparison with the population in communities in the impact region.

4.3.2 Hazard/Risk of an Accident

Risks of an accident involving chemical agent will exist for a period of time ranging from a few months for pilot testing to many years for continued storage. The potential consequences of accidents and the number of people at risk for these two alternatives differ considerably. The risk of an accident is very small but cannot be completely eliminated under any conceivable alternative. The Army will implement mitigating measures to reduce the probability and potential consequences of an accident through application of the proper administrative procedures [e.g., standing operating procedures (SOPs)], limiting conditions of operations (LCOs), and protective design (e.g., fail-safe devices, human factors engineering) and safety features (e.g., automatic monitoring and alarming of unsafe/unhealthy conditions) of plant operations.

Environmental impacts could occur as a result of an accident. Fish, wildlife, public water supplies, threatened and endangered species, agriculture, and other land uses, and the local economy could be impacted.

4.4 CUMULATIVE IMPACTS

The combination of impacts from the proposed action with those of other past, present, or reasonably foreseeable activities at NECD and in the surrounding area may result in cumulative impacts. These impacts are discussed in this section according to subject category (land and water use, air quality, human health, ecology, waste management, and socioeconomics).

4.4.1 Land and Water Use

The site for the proposed pilot testing facility was selected to minimize conflicts with land use within NECD and also outside the NECD boundaries. About 16 ha (40 acres) would be affected directly by NECDF construction, and 4 to 12 ha (10 to 30 acres) would be affected by roads and utilities construction. Off-site land disturbance would be minimal and may not be required at all; off-site construction would be limited to utilities upgrades. No adverse cumulative land use impacts would be anticipated from construction or operation of the pilot testing facility.

Continual recharge is provided to the glaciofluvial aquifer by the Wabash River. The instantaneous minimum discharge (during natural flow conditions) of the Wabash River recorded upstream from NECD at Lafayette, Ind., was 648,000 m^3/day [265 cfs (171 Mgd)] on January 12, 1954 (COE 1966, Table 9, sheet 4 of 6). This minimum flow is more than ten times the recommended withdrawal rate from the glaciofluvial aquifer for NECD, and more than a thousand times larger than the continuous water demand of the pilot testing facility (see Sect. 3.3.2.5). Sufficient water would be available to recharge the glaciofluvial aquifer and to supply the pilot testing facility even during a prolonged drought.

Operation of the pilot testing facility would increase the quantity of treated sanitary sewage discharged into the Wabash River. The Wabash River already is stressed by both industrial pollution and agricultural runoff. Incremental water quality degradation in the Wabash River would be minimal because the sewage discharge increase would be relatively small, and because the effluent would be treated prior to release. The slight impact to the Wabash River attributable to pilot testing probably would not be measurable, and would be negligible when compared to water quality impacts that could occur after an accident during continued storage (see Sect. 4.2.2.2).

Table 4.10 compares the concentrations of constituents in the NECDF distillate with those already present in the Wabash River. No credit is taken for removal and dilution that would occur in the sewage treatment plant and by the pollution control center detention basin. For all constituents in Table 4.10 (except titanium), the NECDF effluent is cleaner than the water of the Wabash River. Hence, the downstream concentration is less than the upstream value. In the case of titanium, the mass flux entering the river is so small that the increase in the concentrations of titanium is approximately 0.2 parts per trillion (10^{12}). This increase would not be perceptible if the calculated result was rounded off to two significant figures. The analysis presented in Table 4.10 clearly demonstrates that the NECDF would not impose adverse cumulative impacts on the Wabash River.

Table 4.10. Constituent concentrations in Wabash River water upstream and downstream from the proposed NECDF

Constituent	Background[a] concentration (mg/L)	NECDF[b] distillate concentration (mg/L)	Ratio of NECDF distillate to background
Barium	0.01	0.00043	0.043
Calcium	15	0.218	0.015
Chromium	0.01	0.0012	0.120
Copper	0.0055	0.001	0.182
Iron	1.7	0.0193	0.011
Lead	0.0064	0.0019	0.297
Magnesium	4	< 0.015	< 0.004
Mercury	0.00019	< 0.00011	< 0.579
Sodium	10	0.147	0.015
Zinc	0.014	0.0108	0.771
Titanium	0.005	0.0431	8.62
Total phosphorus	0.29	0.03	0.103
Arsenic	0.0018	< 0.00012	< 0.067
Selenium	0.00073	0.00052	0.712
Nitrate	0.23	< 0.05	< 0.217
Total organic carbon	7	< 1	co.143

[a]The median concentrations for barium, calcium, magnesium, and titanium in freshwater were obtained from Bowen (1979). The remaining background concentrations (except total organic carbon) were measured in Wabash River water samples obtained at Lafayette, Indiana, during the period of 1989-1993, and retrieved from the EPA STORET data base on October 17, 1994. The median titanium concentration is in excellent agreement with similar values reported by Hem (1989) and discussed in Sect. 4.1.2.1. The total organic carbon concentration is a mean value reported by Thurman (1985) for streams located in warm temperature climates.

[b]Obtained from Table 2.10. These are effluent concentrations that would *occur* at the evaporator/crystallizer outlet.

The NECD sewage treatment plant has experienced occasional problems complying with existing NPDES permit limits. The numbers of workers on-site has been insufficient to maintain the biological activity near its design point. The proposed action and concomitant sanitary sewage increase could partially improve this situation. The NECDF sanitary sewage generation rate exceeds the process effluent rate (from the evaporator/crystallizer) by approximately one order of magnitude (a factor of ten). Both streams would be piped to the sewage treatment plant. Dilution of the sanitary wastewater flow by the process effluent would be insufficient to reduce the increased biological activity available from the NECDF and which would move the sewage treatment plant operating point closer to its design value.

4.4.2 Air Quality

No significant adverse cumulative air quality impacts are anticipated as a result of the proposed action. Existing air quality in the region is good; the area around NECD is in attainment of all National Ambient Air Quality Standards (NAAQS) and Indiana standards for total suspended particulate matter (TSP).

To obtain upper-bound estimates of cumulative impacts, maximum modeled increases in particulate matter concentrations were added to the highest concentrations currently expected to occur in the vicinity of NECD. No monitoring stations for particulate matter are located in the immediate vicinity of NECD. Effects of some large sources near NECD are not fully represented in the nearest monitoring data from Blanford, about 21 km (13 mi) south of NECD. Such sources include the Public Service Indiana (PSI) plants at Cayuga and Terre Haute, the Illinois Power Company plant in Oakwood, Illinois, and the Lauhoff Grain Company (which operates a cogeneration plant in addition to the soybean oil mill) in Danville, Illinois.

A separate modeling analysis was performed to estimate effects of these large off-site sources on existing atmospheric concentrations at several locations near NECD. The greatest of these modeled concentrations was added to the corresponding monitoring data to obtain an upper-bound estimate of existing background concentrations near NECD. This procedure is conservative because it double counts any effects of the modeled sources that are included in the monitoring data.

Air-dispersion modeling was used to estimate maximum increases in pollutant concentrations that would occur due to construction and operation of the proposed facility; the results were added to upper-bound estimates of existing background concentrations near NECD to obtain cumulative pollutant concentrations for comparison with air-quality standards. Although conservative procedures were used to model concentration increases, and also to estimate existing background concentrations, no exceedances of NAAQS or Indiana TSP standards were predicted to occur outside the site boundary as a result of the proposed action.

Air dispersion modeling was also used to evaluate effects of agent VX that could be emitted in small quantities from the proposed facility. Existing background concentration of agent was assumed to be zero. Although assumptions pertaining to the amount and nature of the emissions were extremely pessimistic, results indicated no ambient-air concentrations approaching any standard or guideline set to protect human health.

4.4.3 Human Health

Cumulative effects on human health may be considered for persons working on-site as well as for persons in the general public off-site. Both of these groups of people can be exposed to noise and chemical contaminants as a result of the proposed action. The proposed action would do little to affect the noise environment for off-site persons because the proposed site at the NECD is adequately remote from nearby residents that no off-site noise would be noticeable. With respect to exposures to on-site workers at the proposed facility and workers at other locations at the NECD, noise impacts are expected to be very small to none. Noise would be indistinguishable from standard industrial noise for a location employing a similar number of people.

Airborne exposures to chemical contaminants of the proposed action is essentially precluded by the extremely small airborne releases; thus no cumulative impacts are expected from this pathway. The remaining pathway is the water pathway, via the ingestion of fish and drinking water. People could be exposed via this pathway regardless of where they live. It is the eating of fish caught in the Wabash River near the effluent source and drinking water downstream that could contribute to cumulative effects. At present, the human health analysis that evaluated potential impacts on people from eating such fish and drinking water, has resulted in a range of possible impacts, all of which are quite small. These range from a potential cancer risk of about one in a million to much less for a person eating about 5.5 grams of fish per day and drinking 2 liters of water. Significant uncertainty surrounds this range of estimates. Until this uncertainty is resolved, it may be said that exposure to chemical hazards via the food chain pathway will probably not contribute to cumulative impacts on the health of people on-site or off-site of the NECD.

4.4.4 Ecological Resources

Construction of the site proper and support facilities, including the access road and utilities, would remove or modify approximately 20-28 ha (50-80 acres) of terrestrial habitat with minimal effect on terrestrial species, and negligible loss (if any) of wetland area. There is minimal potential for cumulative impacts to aquatic resources from construction of the proposed facility so long as standard engineering practices are employed to prevent erosion and the subsequent introduction of suspended solids and minor construction-related spills into the streams nearest the site.

Routine, incident-free operation of the proposed disposal facility has limited potential to impact ecological resources primarily through release of waste byproducts of the VX neutralization and SCWO treatment into the Wabash River. Based on whole effluent bioassay testing of the process effluent discussed in Sect. 4.1.2.4, any adverse effects of process effluent on aquatic biota of the Wabash River would be limited to a small area within the mixing zone immediately downstream of the effluent outfall. The proposed action, therefore, would contribute only negligibly to cumulative impacts on terrestrial and aquatic resources.

4.4.5 Waste Management

Solid and sludge wastes from the construction and proposed pilot testing of the proposed NECDF, when added to wastes from other NECD activities and wastes from activities outside of NECD would not create appreciable cumulative impacts at waste disposal sites or facilities in the area around NECD. As discussed in Sect. 4.4.1, unrecycled liquid wastes would be treated and discharged to the Wabash River.

4.4.6 Socioeconomics

Construction period. During the period proposed for construction of the chemical neutralization pilot facility (see Sect. 2.2.5), two other projects are expected to take place at the NECD site. One is the Installation Restoration Program, which will employ an average of six people per year with a peak work force of 15 to perform remedial actions in selected areas. The other on-site project expected to coincide with NECDF construction is the demolition of nonstockpile facilities, which will employ 18 workers. The demolition work will be performed by the Tennessee Valley Authority (TVA) with a work force that is likely to come from outside the local area. In addition to these on-site projects, two Vermillion County industries will have expanded their current facilities by the time NECDF construction begins, adding approximately 30 to 50 new jobs. However, this increase in employment will be largely offset by the recent closure of a nearby manufacturing plant. The future could bring additional changes, as local economic development officials continue to try to recruit new industry (S. Treaster, Vermillion Co., Ind., Economic Development Council, personal communication to M. Schweitzer, ORNL, Sept. 19 and Oct. 22, 1997; C. Green, Parke County, Indiana, Economic Development Council, personal communication to M. Schweitzer, ORNL, Oct. 14, 1997).

Because the net increase in off-site employment created by currently-planned industrial expansions is minimal, these activities are not expected to add appreciably to the inmigration of workers that would occur as a result of pilot facility construction. As for on-site employment, even if all of the demolition workers are TVA employees who move to the impact area from elsewhere and 30% of the workers employed by the Installation Restoration Program are inmovers (as is assumed for the NECDF construction work force), this would add only slightly to the number of workers that would inmigrate as a result of NECDF construction. As explained in Section 4.1.1, the project- related workers expected to move to the local area during the construction period are expected to have only minimal impacts on local socioeconomic resources. The relatively small addition of new residents added by the other projects discussed above would cause no cumulative impacts to local housing, public services, land use, or the local economic structure. The only exception is that the delays likely to be experienced by NECDF workers attempting to leave the depot could be slightly exacerbated if the other on-site workers end their work day at the same time. If new commerce and industry comes to this area during the NECDF construction period and substantial numbers of workers move in to take the jobs created, additional socioeconomic impacts could occur.

Operations period. The Installation Restoration Program and the demolition of nonstockpile facilities are scheduled to continue throughout the period that the pilot plant would operate (see Sect. 2.2.5), employing the same number of workers as during the construction period. Currently, no new off-site industrial additions or expansions are planned for the operations period, but new commercial and industrial enterprises could be developed in the future. Because inmigrating NECDF operations workers are expected to have only minimal effects on the local area (see Section 4.1.2), the relatively small number of new residents likely to move in as a result of the additional projects identified above would cause no cumulative socioeconomic impacts except for a possible slight increase in the delays experienced by workers leaving the site at the end of the work day. However, this could change if substantial numbers of new workers move to the area — or if construction workers who move to the area to build the chemical neutralization facility do not leave after the project is completed — as a result of new, currently-unplanned commercial and industrial development.

4.4.7 Cultural, Archaeological, and Historic Resources

Construction period. The on-site remediation and demolition projects planned for the construction period (see Sect. 4.4.6) would take place on previously-disturbed land and are not expected to affect any historical or archaeological properties. Construction-related inmigration of workers is not expected to have any adverse effect on historical and archaeological resources in the socioeconomic impact area (see Section 4.1. 1), and the few new residents likely to come to the area as a result of planned projects and expansions (Section 4.4.6) would not result in any cumulative adverse effect. However, if substantial new development occurs in this area and undeveloped land is converted to industrial, commercial, and residential uses, archaeological resources could be disturbed.

Operations period. On-site remediation and demolition projects undertaken during the operations period would be continuations of those taking place during project construction and would only affect previously-disturbed land. Operations-related inmigration of workers is not expected to have any adverse effect on historical and archaeological resources in the socioeconomic impact area (see Section 4.1.2), and no cumulative adverse effect would be caused by the small number of new residents likely to move to the area due to planned projects and expansions. However, if substantial new commercial and industrial development takes place, archaeological resources could be disturbed.

4.5 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

For the proposed action, some of the resource commitments would be irreversible and irretrievable; that is, the resources would be neither renewable or recoverable for future use. Generally, resources that may be irreversibly and irretrievably committed by construction and pilot test operations include: biota destroyed in the vicinity of the site, construction materials that could not be recovered or recycled, and energy sources or materials consumed or reduced to unrecoverable forms of waste.

Resources used during the construction and operation of the proposed pilot plant would include cement, gravel, ore used for steel, natural gas, diesel fuel, gasoline, and water. Water used and not recycled as process water during the proposed pilot testing would be discharged to the Wabash River or evaporated and recycled to the atmosphere for distribution elsewhere.

Construction activities also require a commitment of human and financial resources. Such commitments could threaten or jeopardize the uses of these resources for alternative projects or Federal activities. Commitments of machinery, vehicles, and fossil fuels would be required to complete the project; however, none of these resources is in short supply relative to the size and location of the proposed action.

4.6 THE RELATIONSHIP BETWEEN SHORT-TERM USES OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY

The proposed action would involve a short-term use of land and resources, as well as minor, short-term increases in suspended particulates, emissions (both gaseous and liquid), and solid wastes associated with construction and pilot testing. Among the benefits to be gained from allowing such impacts to occur would be the development and demonstration of a technology that could be used to possibly destroy the entire stockpile of agent VX currently stored at NECD.

The Army plans to recycle approximately 390 metric tons (430 tons) of scrap metal that would be generated during the proposed pilot testing. This material — the empty steel one-ton containers — would be smelted for reuse or sale into the scrap metal market. This recycling activity could offset the potentially adverse environmental effects — and would likely reduce the energy requirements — of mining and smelting virgin ore.

4.7 MITIGATION MEASURES

4.7.1 Safety Enhancements

A preliminary risk assessment of the proposed pilot test facility was recently conducted by MITRETEK (MITRETEK 1996). The results of that preliminary evaluation have resulted in improvements to the conceptual design of the proposed facilities. Such evaluations and safety assessments will continue throughout the development of the design through its eventual construction and operation. The planned operational verification testing prior to actual facility operation will be an important mitigation measure for reducing risk from pilot test operations.

4.72 Human Factors

Good hiring practices, training programs and oversight of workers' performance during the proposed pilot tests are necessary to mitigate accidents that could result from human error. Planned screening procedures, hiring practices, and training procedures for the CSDP are outlined below.

4.7.2.1 Hiring practices and screening of employees

Operations and maintenance personnel expected to have access to agent VX would be required to enter the Army's Chemical Personnel Reliability Program (CPRP). This controlled access program provides a means of assessing the reliability and acceptability of individuals being considered for and assigned to chemicalduties. Qualifying factors include competence, dependability, emotional stability, and positive attitude towards assigned duties and the objectives of the CPRP program. Disqualifying factors include alcohol abuse, drug abuse, negligence or delinquency in performance of duty, conviction by a military or civil court of a serious offense, any significant physical or mental condition which compromises the performance of an assigned duty, poor attitude, or inability to wear required protective clothing. Personnel security investigations which may involve investigations or checks by the

Federal Bureau of Investigation could be conducted as part of this program. This process may also involve written inquiries to listed references. The individuals would be interviewed by the certifying official, and all medical records would be reviewed by qualified medical personnel. The operating and maintenance contractor would be required to establish a random drug testing program. Employees may be subject to verification by functional test, urine screening, search, or other action following guidelines of the Food and Drug Administration.

4.7.2.2 Training program

An integrated work force training program has been designed to ensure that all facilities related to stockpile disposal are operated in a uniform and consistent manner that provides protection to human health and the environment, both on and off the facility site, and to minimize factors that degrade human performance or increase the likelihood of human error. The Chemical Demilitarization Training Facility (CDTF) located at Aberdeen Proving Ground, Md., is used to provide initial and refresher training to operating and maintenance personnel for all such disposal facilities. The CDTF consists of classrooms; a non-agent laboratory for sampling, analytical, and monitoring activities; an equipment area with major pieces of munition/bulk disassembly equipment; and a fully equipped Demilitarization Protective Ensemble Support Area, where personnel will undergo rigorous training that includes classroom instruction and actual hands-on experience with simulated chemical agent. Personnel will be evaluated and graded for their response to simulated failures and emergencies. After training is completed at the CDTF, the operators will undergo additional hands-on training at the NECDF facility. The Army will encourage use of the CDTF to the maximum extent possible, although training for some activities unique to the proposed NECDF may involve training at other locations, including the NECDF. Prior to the start of pilot testing, operators will be required to demonstrate competence in performing their assigned duties through written and oral exams and by performing exercises (under normal and emergency situations) while observed by a certifying official.

4.8 MONITORING

4.8.1 Agent Monitoring

Monitoring procedures for the chemical agent VX are summarized in this section.

4.8.1.1 Standards for agent exposure

DOD airborne exposure limits for agent VX are presented in Table 4.5. These safety standards have been established by DOD—and in some cases DHHS-and serve as guidelines for monitoring within the proposed facility, within the storage areas, during transport activities, and on the perimeter of the installation. The airborne exposure limits are set conservatively to provide an adequate safety margin to protect workers and public health. The exposure limits are defined as follows:

- *Time Weighted* Average *(TWA)*. The TWA is the allowable unmasked worker exposure limit established by the Army and approved by DHHS for an 8-h/day exposure averaged throughout a maximum of five consecutive work periods for an indefinite time.
- *General Population Limit (GPL)*. The GPL is the allowable TWA agent exposure limit established for the general public for a 72-h time period.
- *Immediately Dangerous to Life and Health (IDLH)*. The maximum concentration from which, in the event of respirator failure, one could escape within 30 min without a respirator and without experiencing any escape impairing (e.g., severe eye irritation) or irreversible health effects. These values were determined during the Standards Completion Program only for the purpose of respirator selection (i.e., the requirement for wearing of self-contained breathing apparatus or supplied air respirator protective devices).
- *Maximum Permissible Limit (MPL) for demilitarization protective ensemble*. An engineering control level based on the maximum concentration in which personnel in DPE may work for two or less hours per entry in agent contaminated areas. The agent concentration and time limit on DPE entries at this engineering control level was based on the maximum agent concentration used in DPE penetration testing.

4.8.1.2 instrumentation

Air monitors currently in use and available for the facility include rapid-response detectors and delayed-response samplers for both high and low levels (concentrations) of agents. Air monitors for agent VX are well-developed and have been subjected to extensive precision and accuracy testing in actual monitoring environments. Monitoring systems would include an miniature chemical agent monitoring system (MINICAMS™) and a depot area air monitoring system (DAAMS), each of which can detect low and high levels of agent. MINICAMS™ primarily produces audible alarms in the presence of high or low levels of agent, whereas DAAMS provides a continuous record of low as well as high agent levels. Both systems would use gas chromatography.

The MINICAMS™ is an automated gas chromatograph that can be configured to detect agent VX. The chromatogram is recorded on a strip chart, and an alarm is provided that would be wired to a remote control center. The DAAMS has a sampler consisting of a solid sorbent tube through which air is aspirated for a predetermined period of time. Samplers are used to obtain time-dependent average concentrations at low detection levels for historical documentation. Gas chromatography is employed because it is the only method with the sensitivity to detect low levels represented by the GPL. Sampling times are about 2 and 12 h for the TWA and GPL respectively; the analysis time is about 1 h.

Sampling for the presence of high levels of agent VX during routine surveillance activities can be performed with chemical agent field detector kits. These kits can include a hand-operated aspirator bulb, detector tickets, detector tubes, detector paper, and reagents. Air is drawn through a detector ticket or tube, and-when the ticket or tube has been treated with reagent solution, an immediate color change is observed if agent vapor is present. For liquid sampling, the detector paper is put in direct contact with the unknown liquid. A specific and immediate color change is used to confirm the presence of agent.

4.8.1.3 Storage monitoring

Monitoring is performed to detect chemical agent leakage from ton containers. Most leaks would be vapor leaks from pin-sized holes around plugs and valves, although liquid leaks from weld cracks or serious corrosion penetrations would also be detected. Management of leaking ton containers is discussed in Sect. 2.1.4. Monitoring results are used to define the level of protective equipment needed and to verify the safety of workers performing surveillance and maintenance. Procedures to monitor storage areas have been implemented and validated during the past several decades.

4.8. 1.4 Handling and on-site transport monitoring

Workers would remove ton containers from the storage area and transport them to the CDB. Because of the short transport distance, monitoring would not be conducted during this movement.

At the CDB, low- and high-level monitors and samplers would be placed to detect and document the presence of any agent vapor. The CDB would be equipped with agent monitors, detector tubes, and detector paper. These items would be employed in response to an accidental spill during handling or transport and in verifying cleanup.

4.8.1.5 Disposal plant monitoring

A network of chemical agent alarms and samplers would be located within the proposed facility:

- to verify compliance with applicable work area standards (Table 4.5),
- to detect process upsets so that corrective actions could be taken before a hazardous situation could develop, and
- to verify the safety of the operation.

The instruments that would be used include high- and low-level MINICAMS™ and DAAMS. The MINICAMS™ would serve as the chemical agent alarm, providing warning of process upsets, as well as potentially hazardous conditions. The DAAMS would be used to provide a historical record of agent concentrations and to confirm MINICAMS™ alarms.

If agent were detected, MINICAMS™ would provide a local alarm, and a signal would be transmitted to activate a visible and audible alarm in the control room. The local alarm would alert outside operators to wear their protective masks and take proper action as outlined in preapproved standard operating procedures. A permanent record of the date, time, and location of any alarm would be recorded automatically on a computer.

The building ventilation exhaust stacks-would be the main sources for agent emission to the atmosphere. The stacks would therefore be monitored to verify that the and filters were performing as designed and to provide information if agent were emitted.

4.8.2 Perimeter Monitoring

Perimeter monitoring stations would be located around the disposal plant to provide a record of any major agent release. In contrast to ventilation monitoring, perimeter monitoring is intended neither to control disposal activities nor to provide an early warning of an accidental release. This kind of monitoring has been used in the past to prove the historical safety of agent storage operations. The perimeter monitoring stations may also be required to collect meteorological data for modeling the dispersion of any accidental agent release.

Current plans are to install the perimeter monitoring stations before the commencement of pilot test operations such that some baseline monitoring can be completed. The number and location of these stations have not yet been determined. The perimeter monitoring plan will be coordinated with DHHS before finalization.

4.9 PERMITS, APPROVALS, FINDINGS, AND CONSULTATIONS REQUIRED

Before implementing the proposed action, the Army would be required to coordinate its actions with various federal, state of Indiana, and local legal and regulatory authorities. This section summarizes the permits, approvals, and consultations required by these authorities. Regulatory compliance is supervised by the authorities listed in Table 4.11.

Table 4.11. Authority responsible for administering environmental protection programs for the proposed Newport Chemical Agent Disposal Facility

Program	Authority
Air quality	
Prevention of significant deterioration	State of Indiana
National emission standards for hazardous air pollutants	State of Indiana
New source performance standards	State of Indiana
Water quality	
National pollutant discharge elimination system	State of Indiana
Water pollution regulations	State of Indiana
Hazardous/solid waste’	State of Indiana
Wetlands	
Clean water act - -	State of Indiana and U.S. Army Corps of Engineers

“The 1984 amendments to the Resource Conservation and Recovery Act are administered by the U.S. Environmental Protection Agency.

4.9.1 Permits and Approvals Required for Construction

Certain reviews, permits, and approvals must be obtained before construction. According to Public Law 91-121, *Armed Forces Appropriations Act* of 1970, and Public Law 91-441, *Armed Forces Appropriations Act of 1971*, any disposal plan that the Army prepares must be reviewed by DHHS, whose supervisory responsibility and authority are normally thought of in terms of its public health and safety functions; DHHS also looks critically at the potential impacts of proposed projects.

Executive Order 12088, *Federal Compliance with Pollution Control Standards*, requires that all federal agencies comply with all applicable federal, state, and local pollution control standards. Compliance with applicable pollution control standards generally requires that the Army secure environmental permits in the same manner as do private project sponsors. RCRA and Clean Air Act permits are required before construction, and the CWA/NPDES permit application is required before operations.

The processes for acquiring these three permits are very similar (see Fig. 4. 1), but their technical contents are quite different. The RCRA permit application prepared by the Army and NECD and submitted to the Indiana Department of Environmental Management (IDEM) and the U.S. Environmental Protection Agency (EPA) provides detailed information regarding the neutralization process followed by SCWO, how the agents will be handled, what monitoring capabilities the proposed facility will have, the chemical and physical properties of the hazardous waste, and a plan to safely manage the waste throughout the treatment process. The permit application details all aspects of the operation, maintenance, and closure of the proposed facility. This information gives IDEM and EPA enough information to verify that the facility would be in compliance with regulations and to develop a facility-specific permit. The permit process is estimated to last approximately two years from application submission to final approval.

The Army and NECD are required to obtain an Air Quality Permit to Construct the proposed facility to ensure that any air emissions from the proposed facility remain within regulatory limits for air emissions and are safe for the surrounding community. In order to obtain the Clean Air Act (CAA) permit, the Army and NECD must prepare the permit application which contains information on anticipated air emissions during the facility's construction and operation, and a plan to minimize the effects of these emissions on air quality. This information will provide data to demonstrate that the emissions from the proposed facility meet minimum requirements set by EPA and IDEM. The permitting process is estimated to take approximately two years and must be completed before construction of the proposed facility can begin.

In order to obtain the National Pollutant Discharge Elimination System (NPDES) permit, the Army must illustrate that any liquid discharge from the neutralization/SCWO process meets minimum requirements for pollution levels. The NPDES permit is scheduled to be issued to NECD for release of wastewater, treated by the neutralization/SCWO process, into the installation's wastewater treatment system. IDEM will verify that any discharge from the wastewater treatment system will not adversely affect aquatic life or human health if discharged into the environment. The NPDES permit is required before the systemization of the proposed facility begins.

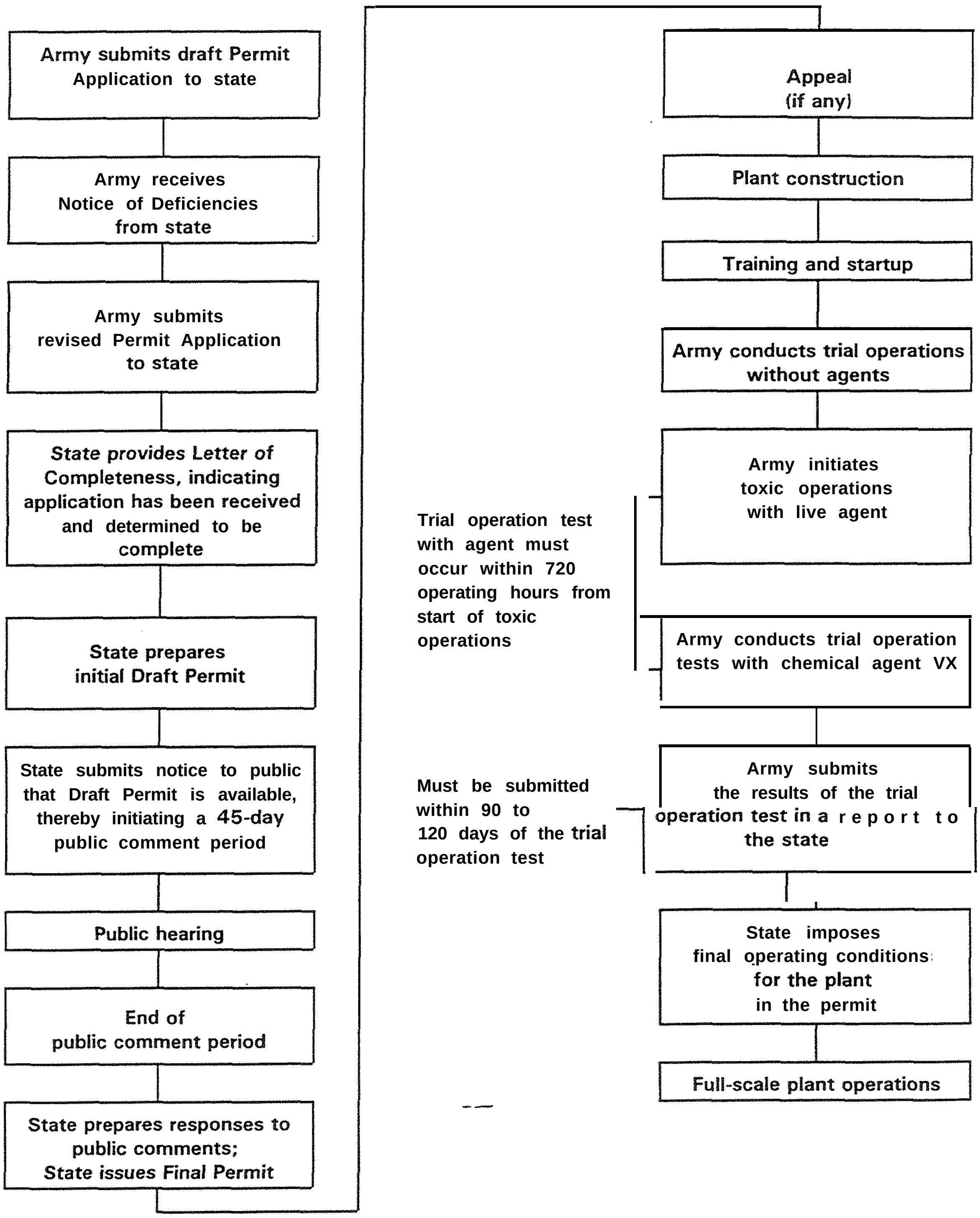

Fig. 4.1. **Schematic diagram of the permit processes for the Resource Conservation and Recovery Act, National Pollutant Discharge Elimination System, and the Clean Air** Act.

The Army will respond to regulatory authorities' reviews of all permit applications. The state and the EPA will then propose specific permit terms. At that point, the permits are made available for public review and comment. After reviewing public comments, the state and EPA issue the final permits, and construction may begin. Permit applications will include information stipulating that the Army will monitor facility air and water emissions and ensure that facility air and water emissions meet requirements and are protective of the environment.

Contact with the FWS has been initiated in regard to potential impacts to threatened and endangered species (see Appendix D). Biological assessments for endangered species will be submitted to the FWS and are shown in Appendix D. Also, informal consultation with the Indiana State Historic Preservation Office has been initiated in regard to potential impacts to historic or archaeological resources (see Appendix F). A reconnaissance-level archaeological survey of the area of the proposed pilot plan is currently underway and will be submitted to the Indiana State Historic Preservation Office when completed.

4.92 Permits and Approvals Required for Operation

After the completion of construction, the Army would test the facility prior to the start of actual operations with agent VX. The state of Indiana will impose final RCRA operating conditions as necessary. As long as operation of the facility continued, the Army would be subject to a variety of reporting, inspection, notification, and other permit requirements of EPA and the state of Indiana. RCRA requires submittal of annual and biannual reports to the state of Indiana and the EPA.

RCRA and NPDES permit applications for the proposed facility will be submitted to the state of Indiana. Applications for air emissions source permits have been submitted in accordance with the requirements of the Clean Air Act and state of Indiana. Prior to toxic operations (i.e., operating with chemical agent), the Army would have to obtain the permits described from the state of Indiana and EPA. Additionally, DHHS would continue its supervisory role, reviewing data and making appropriate recommendations concerning public health and safety before toxic operations began.

The current NPDES permit for the existing NECD sewage treatment plant is in the process of being modified to include the acceptance of effluent from the NECDF.

The Army would conduct simulated operations for operator training and facility systemization before toxic operations were begun. The Army would have to demonstrate comprehensive monitoring capabilities, equipment systemization, and preoperational inspections before toxic operations began.

4.9.3 Citizen Advisory Commissions

The establishment of Citizen Advisory Commissions was authorized in the 1993 Defense Authorization Act (Public Law 102-484). According to the law, the Secretary of the Army must establish a Chemical Demilitarization Citizens' Advisory Commission for each State with a low-volume chemical stockpile site (that is, Aberdeen Proving Ground, Blue Grass Chemical Activity, and NECD).

The Department of the Army will provide a representative to meet with each commission to hear citizen and State concerns regarding stockpile disposal activities and plans. Each commission will be composed of nine members appointed by the governor. Seven of these individuals must be from areas within an 805-km (500-mile) radius of the stockpile site, and the other two members must be from a State agency with direct responsibilities related to the program.

Each commission will have a designated chairman and consist of unpaid volunteers. The commissions will meet with the Army representative at least twice a year and will disband after the chemical weapons stockpile in their respective state is destroyed.

The Governor of Indiana has established an Indiana Chemical Citizens Advisory Commission. Regional coordination meetings are held once per quarter to facilitate exchange of information and concerns between government jurisdictions.

4. 10 REFERENCES

ANL (Argonne National Laboratory) 1997. *Emergency Response Concept Plan for the Chemical Stockpile Emergency Preparedness Program, Rev. 1, Vol. 5: Emergency Planning Guide for the Newport Chemical Depot CSEPP Site,* ANL/DIS/TM-42, Argonne National Laboratory, Argonne, Ill., September.

Bowen, H. J. M. 1979. Environmental Chemistry of the Elements. 330 pp. Academic Press, New York, NY.

Centers for Disease Control (CDC) 1988. Transcripts of discussions held by CDC prior to Federal Register promulgation of agent control limits, as described in Opresko et al, 1997.

Code of Federal Regulations (40 CFR Part 141). 1996. Title 40: *Environmental Protection Agency*; Part 141: *National Primary Drinking Water Regulations*, U.S. Government Printing Office, Washington, D.C., July 1, pp. 288429.

Code of Federal Regulations (40 CFR Part 143). 1996. Title 40: *Environmental Protection Agency*; Part 143: *National Secondary Drinking Water Regulations*, U.S. Government Printing Office, Washington, D.C., July 1, pp. 470-473.

Code of Federal Regulations (7 CFR Part 658). 1997. Title 7: *Agriculture*; Part 658: *Farmland Protection Policy Act*, U.S. Government Printing Office, Washington, D.C., January 1, pp. 558-565.

COE (U.S. Army Corps of Engineers) 1966. "Hydrology of the Ohio River Basin," Appendix C, *Ohio River Basin Comprehensive Study*, Vol. IV, U.S. Army Engineer Division, Ohio River Corps of Engineers, Cincinnati, Ohio, August.

DHHS (U.S. Department of Health and Human Services) 1988. Final Recommendations for Protecting the Health and Safety Against Potential Adverse Effects of Long-Term Exposure to Low Doses of Agents GA, GB, VX, Mustard Agent (H, HD, T), and Lewisite (L), *Federal Register* 53:50, 8504-8507.

Fetter, C. W. 1993. *Contaminant Hydrogeology*, Macmillan Publishing Co., New York,

Fischer, H. B., List, E. J., Koh, R. C. Y., Imberger, J., Brooks, N. H., 1979. *Mixing in Inland and Coastal Waters*, Academic Press, Inc., New York.

Freeze, R. A., and Cherry, J. A. 1979. *Groundwater,* Prentice-Hall, Inc., Englewood Cliffs, N.J.

GA Technologies, Inc. 1987. *Risk Analysis of the Continued Storage of Chemical Munitions*, reports GAC-18562 and SAPEO-CDE-IS-87009, prepared for Program Executive Officer-Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., by GA Technologies, Ja Jolla, Calif.

Garner, J.D., and J.E. Gardner. 1992. Determination and summer distribution and habitat utilization of the Indiana bat (Myotis sodalis) in Illinois. Illinois Department of Conservation. Final Project Report No. E-3. Springfield, IL.

L.S. Goodfriend and Associates 1971. *Noise From Industrial Plants*. NTID 300.2, Prepared for the U.S. Environmental Protection Agency, Office of Noise Abatement and Control, Washington, D.C.

Haley, Mark. 1997. The Aquatic Toxicity of SCWO Evaporator Effluent. Report No. P499-2-1 0/24/97. Program Manager for Chemical Demilitarization, U.S . Army Edgewood Research Development and Engineering Center, Aberdeen Proving Ground, MD.

Hem, J. D. 1989. *Study and Interpretation of the Chemical Characteristics of Natural Water*, Third Edition, U.S. Geological Survey Water-Supply Paper 2254, U.S. Government Printing Office, Washington, D.C.

HUD (U.S. Department of Housing and Urban Development 1978. *Flood Hazard Boundary Map, Vermillion County, Indiana, Unincorporated Areas*, Federal Insurance Administration, Community-Panel Number 180449 0003 A, p. 3 of 4, effective date, November 24.

IDEM (Indiana Department of Environmental Management) 1997. *National Pollutant Discharge Elimination System (NPDES) Permit No. IN 0003506, U.S. Army Newport Chemical Depot, Mason & Hanger Corp.*, Indianapolis, Indiana, cover letter, 24 pp. to permit, and briefing memo (May 1).

Johnson, R. O. 1996. *The Development of an Aquatic Spill Model for the White Oak Creek Watershed, Oak Ridge National Laboratory, Oak Ridge, Tennessee*, Report No.

ORNL/TM-l3 18 1, Lockheed Martin Energy Research Corp., Oak Ridge National Laboratory, Oak Ridge, Tenn. (May).

Kinsey, J. C. and C. Cowherd, Jr., 1992. "Fugitive Dust," *Air Pollution Engineering Manual*, A. J. Buonicore and W. T. Davis (eds.), Van Nostrand Reinhold, New York.

Manthei, J. H. 1997. Alternate Technology's VX Program Review for the State of Indiana. U.S. Army ERDEC/SCBRD-RTL. October 29, 1997.

Manthei, J. H., R.A. Way, D.M. Bona, K.P. Cameron and B. I. Gaviola, 1997. Intravenous Toxicity of VX/NaOH, Super Critical Water Oxidation (SCWO), and VX/Water By-Products in Mice, Alternate Technology Program Interim Report: 97-3 16-05-o l-97.

Manthei, J. H., D. H. Heitkamp, R.A. Way, D.M. Mona, and C.B. Lee, 1996.Intravenous Toxicological Evaluation of Fourteen VX Decontamination By-Products in Institute of Cancer Research (ICR) Mice, ERDEC-TR. ERDEC, APG, MD.

Mantbei, J.H., et al. 1996. *Intravenous Toxicological Evaluation of Fourteen VX Decontamination By-products in Institute of Cancer Research (ICR) Mice*, Report No. ERDEC-TR, Research and Technology Directorate, U.S. Army Edgewood Research Development and Engineering Center, Aberdeen Proving Ground, MD.

Miller, A.C. 1984. A Mollusc Evaluation at the Newport Army Ammunition Plant, Newport, Indiana. Nov. 29, 1984 Report, U.S. Army Waterways Experiment Station, Corps of Engineers, Vicksburg, MS.

MITRETEK 1996. *Preliminary Risk Assessment of Alternative Technologies for Chemical Demilitarization*, MTR-96W0000023 (Rev. 1), prepared for Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., by MITRETEK, McLean, Va., October.

O.M. Opresko, R.A. Young, R.A. Faust, S.S. Talmage, A.P. Watson, R.H. Ross, K.A. Davidson, and J. King 1997. "Chemical Warfare Agents: Estimating Oral Reference Doses" submitted to *Reviews in Environmental Contamination and Toxicology*.

PRC Environmental Management, Inc. (PRC) 1997. *Biological Survey of Federal Endangered Bats at Newport Chemical Depot,* Army Material Command Contract No. DAAA08-94-D-007, Delivery Order 0022.

Sax, N. I., and R. J. Lewis, Sr. 1989. Dangerous Properties of Industrial Materials. Seventh Ed. Van Nostrand Reinhold, New York.

Smith, G. J. 1987. Pesticide Use and Toxicology in Relation to Wildlife: Organophosphorus and Carbamate Compounds. U.S. Fish and Wildlife Service Resource Pub. 170. Washington, D.C.

Thomann, R. V., and Mueller, J. A. 1987. *Principles of Surface Water Quality Modeling and Control*, Harper & Row, Publishers, Inc., New York.

Thurman, E. M. 1985. *Organic Geochemistry of Natural Waters*, Martinus Nijhoff/Dr W. Junk Publishers, Dordrecht, The Netherlands.

U.S . Army 1997. *Evaluation of Confirmatory Testing of Supercritical Water Oxidation for Treating VX/NaOH Hydrolysate*, prepared for the U.S. Army Program Manager for Alternative Technology and Approaches, Aberdeen Proving Ground, Maryland, by Stone & Webster Engineering Corp., Boston, Mass. (May 30).

U.S. Army 1997a. *Information Package for the NRC Technical Assessment of the SWCO Post Treatment Units for the Newport VX Chemical Agent Disposal Facility at Newport Chemical Depot, Newport, Indiana*, Vol. I, "Introduction, Response to Post Treatment Technology Questions, and Project Information," and Vol. II, "Referenced Documents," Program Manager, Alternative Technology and Approaches, Aberdeen Proving Ground, Maryland (September 17).

U.S. Army 1997b. *Government Review Issue Civil Drawings Package No. 1, Alternative Chemical Stockpile Disposal Program, Aberdeen Proving Ground, Newport, Indiana*, Contract No. 15-960030-51, prepared by Stone & Webster Engineering Corporation, Boston, MA, September 30, 24 drawings plus index.

U.S. Army 1996. *Chemical Accident/Incident Response and Assistance (CAIRA) Plan*, prepared by Mason & Hanger Corporation, Operating Contractor, Newport Chemical Depot, Newport, Ind. (October 1).

U.S. Army 1996a. ***Draft Final** Newport Chemical Activity Facility-Wide RCRA Facility Investigation: Sampling and Analysis Plan*, Delivery Order 0002, Contract No. DAAA15-93-D-0011, prepared by ENTECH, Inc., McLean, Virginia, and Science Applications International Corp., McLean, Virginia, for the U.S. Army Environmental Center, Aberdeen Proving Ground, Md. (June).

U.S. Army 1990. *Spill Prevention, Control & Countermeasures (SPCC) Plan for Newport Army Ammunition Plant, Newport, Indiana*, prepared by Mason & Hanger-Silas Mason Co., Inc., Operating Contractor.

U.S. Army. 1988. Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement. Aberdeen Proving Ground, MD.

USACHPPM 1998. Interim Rat Oral LD_{50} of Process Distillate, Slide prepared by the U.S. Army Center for Health Promotion and Preventive Medicine, Aberdeen Proving Ground, Md.

USACHPPM 1998. Interim Chronic Aquatic Toxicity: Slides prepared by the U.S. Army Center for Health Promotion and Preventive Medicine, Aberdeen Proving Ground, Md.

USACHPPM 1998. *National Pollutant Discharge Elimination System Permit Application for the Department of the Army, Newport Chemical Depot, Newport Chemical Demilitarization Facility (Draft)*, .U.S. Army Center for Health Promotion and Preventive Medicine, Aberdeen Proving Ground, Md.

USAEHA (U.S. Army Environmental Hygiene Agency) 1975. *Water Quality Study, Newport Army Ammunition Plant, Newport, Indiana 47966, 15 April — 3 May 1973, 29 January — 8 February* 1974, written by J. T. Watson and J. W. Bauer, Water Quality Engineering Special Study No. 24-026-73/75, Aberdeen Proving Ground, Maryland.

USATHAMA (U.S. Army Toxic and Hazardous Materials Agency) 1991. *Draft Site Investigation Report for the Night Soils Pits, TNT Manufacturing Area, Chemical Plant, Decontaminated Waste Burial Ground, and Little Raccoon Creek*, Volume 1 of 2: Text, Appendices A-B, Contract No. DAAA15-88-D-0008, Task No. 0010, prepared by Dames & Moore, Bethesda, Maryland, for USATHAMA, Aberdeen Proving Ground, Maryland(October).

U.S . EPA (U.S. Environmental Protection Agency) 1995. *User's Guide for the Industrial Source Complex (ISC3) Dispersion Models*, EPA-454/B-95-003, U.S . Environmental Protection Agency, Research Triangle Park, North Carolina.

U.S. EPA 1995. *Exposure Factors Handbook*, EPA/600/P-95/002A, June 1995 External Review Draft, U.S. Environmental Protection Agency, Washington, DC.

U.S. EPA (U.S. Environmental Protection Agency) 1988. *Screening Procedures for Estimating the Air Quality Impact of Stationary Sources,* Publication EPA-45014-88-0 10, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.

U.S. EPA (Environmental Protection Agency). 1986. Quality Criteria for Water. EPA 440/5-86-001. Office of Water Regulations and Standards, Washington, D.C.

U.S. EPA (U.S. Environmental Protection Agency) 1985. *Compilation of Air Pollutant Emission Factors,* Publication AP-42, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.

U.S. EPA (U.S. Environmental Protection Agency) 1978. *Protective Noise Levels: Condensed Version of the EPA Levels Document*, EPA-550/9-79-100, U.S. Environmental Protection Agency, Office of Noise Abatement and Control, Washington, D.C.

U.S. Nuclear Regulatory Commission 1996, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, NUREG-1437, Vol. 2, Appendix C, Washington D.C.

Weimer, J. T., et al. 1970. Toxicity of VX and GD in Aquatic Animals Indigenous to the Carrol Island Test Area Water, Edgewood Arsenal Technical Report 4441. U.S. Department of the Army, Edgewood Arsenal, MD.

Whitacre, G. C., et al. 1986. *Personal Computer Program for Chemical Hazard Prediction (D2PC)*, U.S. Army Chemical Research and Development Centers, Aberdeen Proving Ground, Md.

Whitaker, J.O., J. Veilleux, and E. Vincent. 1998. Progress Report Status of Myotis sodalis and other bat species at Newport Chemical Depot. Report issued to Philip Cox, 28 July 1998.

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6. DISTRIBUTION LIST

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APPENDIX A

EVALUATION OF ALTERNATIVE CHEMICAL DEMILITARIZATION TECHNOLOGIES

This appendix provides the history and background of the U.S. Army's chemical demilitarization Alternative Technology Program (ATP) and provides the history and rationale for the selection of neutralization followed by supercritical water oxidation as an alternative disposal technology proposed to be pilot tested for destroying the bulk VX agent stored at the Newport Chemical Depot (NECD) in Indiana.

A series of studies and recommendations-initiated by the ATP and the U.S. Army's Program Manager for Chemical Demilitarization (PMCD)-has supported moving toward pilot demonstration and further evaluation of neutralization processes and post-treatment technologies. These studies and recommendations (as described below) focused on potential disposal technologies for chemical warfare agent stockpile sites that store only bulk containers (i.e., non-explosively configured stockpiles). These stockpiles include the bulk mustard agent (i.e., agent HD) stored at the Aberdeen Proving Ground (APG) in Maryland and the bulk VX agent stored at NECD.

Based on the aforementioned studies, the Under Secretary of Defense for Acquisitions and Technology (see Exhibit A.l) and the Assistant Secretary of the Army for Research, Development and Acquisition (see Exhibit A.2) authorized the PMCD to prepare environmental impact analyses-in accordance with the National Environmental Policy Act and Army Regulation 200-2—to evaluate the proposal to construct and operate pilot test facilities to demonstrate the neutralization processes followed by either on-site or off-site post treatment for the APG and NECD stockpiles.

The remainder of this appendix provides historical background to the development of technologies for demilitarizing chemical agents and munitions in the U.S. stockpile, including alternative technologies for bulk-only sites; summarizes statutory requirements imposed by Congress for the development and evaluation of alternative technologies; describes the principal findings and recommendations of various studies and investigations of alternative technologies, including those of the National Research Council (NRC); presents a chronology-based characterization of the selection of neutralization and post-treatment technologies for the bulk-only sites; describes how SCWO was selected as the post-treatment technology proposed to be pilot-tested at NECD for that site's bulk VX agent; summarizes the principal findings and recommendations of a recent NRC study regarding SCWO as a post-treatment technology for neutralized agent VX; and summarizes the current status and ongoing research and development related to SCWO. For the purpose of completeness, this appendix includes some information relevant to alternative technologies for destroying mustard agent, although attention is focused on technologies for destroying agent VX.

A.1 HISTORY AND BACKGROUND

The U.S. stockpile of unitary chemical warfare agents and munitions has been maintained primarily as a deterrent to other countries' use of chemical weapons against our military personnel. As components of the chemical weapons stockpile became obsolete or unserviceable, they were disposed of by a number of methods. The Army has placed emphasis on developing and deploying the safest, most environmentally responsible disposal methods supported by available technology. The Army's chemical weapons demilitarization program has been heavily influenced by legislative direction, evolving federal and state regulatory requirements, international treaty considerations, and public input.

The Army first requested the National Academy of Sciences (NAS) to review chemical agent and munition demilitarization alternatives in 1969. The academy initiated a study of the issue, and prepared a report, Letter, Office of the President, National Academy of Science, 25 June 1969 (Transmittal of the NAS Ad Hoc Advisory Committee Report on Disposal of Obsolete and Surplus Chemical Warfare Agents and Munitions). In 1972 a NAS Senior Advisory Panel concluded that the original NAS recommendations of the dual approach consisting of chemical neutralization of the nerve agent GB, incineration of HD, and continued evaluation of incineration for destruction of both GB and the nerve agent VX should be followed (Report of the Senior Advisory Panel on the Demilitarization of Chemical Munitions/Agents, 27 July 1972). Because incineration was already successfully in use for destruction of H, HD, and other agents at the Rocky Mountain Arsenal in Colorado, the Army's initial efforts in response to the 1972 NAS report focused on chemical neutralization of the inventory of bulk GB. Although technical difficulties were encountered, nearly 4,200 tons of GB were destroyed by chemical neutralization at Rocky Mountain Arsenal between 1973 and 1976. Research into neutralization methods for destroying H, HD, and VX met with limited success.

In the fall of 1979, the Army began testing at the Chemical Agent Munitions Disposal System (CAMDS) at Tooele, Utah, employing neutralization, incineration, thermal deactivation, and thermal decontamination of munitions and agent storage containers. The mission of CAMDS is to test and evaluate equipment and processes proposed for chemical agent and munitions demilitarization. From 1981 to 1986, approximately 38 tons of bulk agent, munitions, and contaminated metal parts were treated using thermal processes with extremely high agent destruction efficiencies.

The Army approached the NAS in 1982 to independently review demilitarization plans and to evaluate the safety of continued storage. A 1984 report from the National Research Council (NRC) reviewed a considerable number of alternative demilitarization technologies and endorsed the Army's choice of munitions disassembly, incineration of agent, and thermal treatment of energetic and metal parts (NRC 1984). The NRC determined that the Army should continue to maintain the storage of the majority of munitions and agents, proceed with destruction of M55 rockets, and analyze incineration and thermal treatment as the primary means for destroying the remainder of the stockpile. During this period, tests at CAMDS demonstrated the capability of incineration to destroy VX and GB.

Construction of the Johnston Atoll Chemical Agent Disposal System (JACADS) was begun in the mid-1980s. JACADS serves the dual purpose of being a demonstration plant for incineration and thermal treatment technology while providing the means to destroy agent and munitions stockpiled on Johnston Atoll. In November 1985, Congress enacted Public Law 99-195 which required the Army to develop a program for the disposal of all stockpiled chemical agents and munitions. This plan was submitted to Congress in 1986, selecting incineration and thermal treatment as the baseline technology. Congress then directed that siting studies be performed. A Final Programmatic Environmental Impact Statement (FPEIS) for the

CSDP, published in January 1988, documented the selection of on-site disposal as the least-risk alternative. The FPEIS compared alternative technologies to baseline incineration but concluded that none of these technologies presented a viable alternative demilitarization process (U.S. Army 1988, vol. 1, pp. 2-84 to 2-86).

Congress enacted Public Law 100-456 in 1988 requiring that operational verification tests (OVT) be used to demonstrate the efficiency and safety of JACADS before full-scale operations could begin and before any destruction facility could be systemized and operated in the United States. A series of four OVT campaigns was successfully completed in March 1993. The NRC reviewed the results of the OVT campaigns and concluded that the baseline process, which employs a number of preparation steps followed by four incineration process streams, was the only demonstrated safe and effective single demilitarization process capable of handling both agent and munitions (NRC 1994a). Experience gained in operating JACADS has resulted in refinements in the design of the similar chemical agent disposal facilities at Tooele, Utah, Anniston, Alabama, Pine Bluff, Arkansas, and Umatilla, Oregon. These refmements will also be implemented in future chemical agent stockpile disposal facilities utilizing the baseline incineration technology.

A.2 SPECIFIC REQUIREMENTS OF PUBLIC LAW 102-484

As a result of interest in alternatives to the baseline technology (high-temperature incineration), Congress passed Public Law 102-484, which instructed the Army to re-examine alternative technologies for potential use at low-volume sites. Section 173 of the Act required the Secretary of the Army to submit to the Congress a report on the potential alternatives to the use of the Army's baseline disassembly and incineration process for disposal of chemical agents and munitions. The report was to include:

- an analysis of the report of the Committee on Alternative Chemical Demilitarization Technologies of the NRC of the NAS;
- any recommendations that the NAS made to the Army regarding the report of that committee, together with the Secretary's evaluation of those recommendations;
- a comparison of the baseline disassembly and incineration process with each alternative technology evaluated in the report for use in the Army Chemical Stockpile Disposal Program, taking into consideration each of the following factors: (a) safety, (b) environmental protection, (c) cost effectiveness;
- for each alternative technology recommended by NAS, the date by which the Army could reasonably be expected to systemize, construct, and test the technology, obtain all environmental and other permits necessary for using that technology for the disposal of chemical agents and munitions, and have the technology available for full-scale chemical weapons destruction and demilitarization operations;
- a description of alternatives to incineration that were being developed by Russia for use in its chemical demilitarization program and an assessment of the extent to which such alternatives could be used to destroy chemical weapons in the U.S. inventory of such weapons;
- consideration of appropriate concerns arising from meetings of the Chemical Demilitarization Citizens' Advisory Commissions established pursuant to Section 172; and

- in any case in which the criteria specified in Section 174 were met, notification that the Secretary intended to implement an alternative technology disposal process at a low-volume site.

Section 174 further specified that if the date by which chemical weapons destruction and demilitarization operations could be completed at a low-volume site using an alternative technology process evaluated by the Secretary of the Army was no later than December 31, 2004, and the Secretary determined that the use of that alternative technology process for the destruction of chemical weapons at the site was significantly safer and equally or more cost-effective than the use of baseline disassembly and incineration process, then the Secretary of the Army should carry out the disposal of chemical weapons at that site using such alternative technology process.

The reports required by Section 173 are the two reports by the NRC (NRC 1993; NRC 1994b), which formed the basis for the Army's report to Congress (U.S. Army 1994) as required by the Act. Section A.3 below highlights the alternative technologies reviewed by the NRC and the specific recommendations and findings of the stockpile committee, as well as the Army's evaluation of the recommendations of the NRC's stockpile committee.

A.3 RESPONSE TO PUBLIC LAW 102-484

The Army, with assistance from the NRC, initiated a response to the requirements specified by Congress through a series of studies, evaluations, and reviews of alternative technologies. These efforts and the conclusions and recommendations resulting from these efforts are discussed below.

A.3.1 Summary of 1993 Alternative Technologies Review

The Committee on Alternative Chemical Demilitarization Technologies of the NRC, meeting in 1992 and early 1993, collected and studied information on alternative and supplemental technologies and reported their findings in June 1993 (NRC 1993). The NRC identified technologies as alternatives to the baseline technology that they considered appropriate for further evaluation by the Committee on Review and Evaluation of the Army CSDP (known as the "Stockpile Committee"). These alternative technologies are summarized in Table A. 1.

The NRC grouped the alternative technologies considered into six categories based on process operating conditions and types of reactions involved. The operating conditions span the ranges of low, medium, and high temperatures and low and high pressures. Reaction types include hydrolysis, oxidation, hydrogenation, pyrolysis, and reaction with sulfur. These categories represent a broad spectrum of processes, some of which have been studied only in the laboratory and some of which are in commercial use for destruction of hazardous and other wastes. Although some technologies have been developed for specific applications, in all cases, research, development, testing, and evaluation (RDT&E) of the application to chemical agent and other elements of the chemical weapons stockpile would be necessary. The NRC determined that no alternative technology was sufficiently mature so that it could be implemented to meet the Congressionally mandated disposal deadline of December 31, 2004.

Table A.l. Alternative technologies considered appropriate for further evaluation

Technology	Process description
	Low-temperature, low-pressure neutralization
Chemical neutralization	Agents are converted to products of reduced toxicity by chemical reaction with added reagents. The reactions are carried out at atmospheric pressures in the temperature range 68” to 212°F (20” to 100°C). Candidate reactions include hydrolysis in strong aqueous base, acid-catalyzed hydrolysis, reaction with ethanolamine, acid chlorinolysis, and reaction with chemical reducing agents.
Neutralization with ionizing radiation	Involves the use of penetrating ionizing radiation to chemically change agent to products of reduced toxicity. Material to be irradiated is in aqueous solution and pumped in a pipe past an electron beam or gamma ray source. The initial conditions are ambient temperature and pressure: however, the irradiated material will be heated and pressure may increase as a result of the production of gases.
	Low-temperature, low-pressure oxidation
Chemical oxidation	Strong chemical oxidizing agents react with agent at low temperatures in liquid-phase solution. Candidate oxidizers, including peroxydisulfate salts, OXONE® (a patented oxidizing agent), organic peroxides, chlorine dioxide, hydrogen peroxide, chlorine (in acid solution), and ozone have completely oxidized chemical warfare agents at or near ambient temperatures.
Electrochemical oxidation	Generates reactive metal ions that react with organic compounds in water to produce carbon dioxide and inorganic acids.
Oxidation with oxidizing agents and ultraviolet light	Ultraviolet radiation decomposes ozone or hydrogen peroxide in water to form hydroxyl radicals that oxidize most organic compounds. Processes have been developed to treat very dilute solutions (1 to 10 ppm of organics in water).
Biodegradation	Cellular systems (or enzymes) degrade agents (or products resulting from chemical pretreatment of agents) in dilute aqueous solutions.

Table A.1 (Continued)

Technology	Process Description
	Moderate-temperature, high-pressure oxidation
Wet air oxidation	Involves the oxidation of chemical substances in dilute aqueous medium at 392” to 635°F (200” to 335°C) and 20 to 136 atm (294 to 2,000 psi). Air is the source of the oxidizing agent.
Supercritical water oxidation	Reacts combustible materials using air or oxygen in water at temperatures and pressures above the critical point of water [705°F (374°C) and 218 atm (3,205 psi)]. Oxidation is accomplished under supercritical conditions to obtain excellent dense-phase mixing and high rates of heat transfer.
	High-temperatare, low-pressure pyrolysis
Molten metal pyrolysis	Molecules are thermally decomposed in the presence of molten metal at 2,912” to 3,092°F (1,600” to 1,700°C) to small molecules or atoms. Wastes from this process are primarily a gas stream of nitrogen (N_2), hydrogen (H_2), and carbon monoxide (CO), and a solid slag.
Plasma arc processes	Ionized gas, reaching temperatures of 21,632°F (12,000°C), can be shaped to form a torch or an arc in a carbon electrode furnace. Waste streams can be either pyrolyzed or oxidized by the heat from the plasma. Bulk temperature gradients in the reactor are controlled to accomplish specific objectives: fuel gas production, complete oxidation of organic waste, or production and control of vitrified slag. Reactor temperatures are 2,552” to 3,182°F (1 ,400” to 1,750°C).
Gasification processes	Involves the partial oxidation of agent in the presence of steam and air or oxygen to produce a fuel gas, primarily CO, Gasification units are often vertical shaft reactors operating at pressures from 1 to 30 atm and temperatures from 356” to 3,002°F (180” to 1,650°C). Commercial and pilot-scale plants are operational.
Synthetica detoxifier	A two-step process in which liquid agent is first evaporated by high-temperature [1,292°F (700°C)] steam in the presence of a moving reactive alkaline bed and then pyrolyzed at higher temperatures [2,372°F (1,300°C)]. Gasification is rapid and the products contain mostly CO and H_2 with trace quantities of light hydrocarbons, such as methane (CH,). The combustible by-products enter a catalytic converter for oxidation and are polished by a carbon filter.

Table A. 1. (Continued)

Technology	Process Description
	High-temperature, low-pressure oxidation
Catalytic fluidized-bed oxidation	A combustion process in which a fluidized granular solid provides thermal inertia and high heat transfer rates for the rapid oxidation of feed material. Combines two thoroughly tested technologies and has achieved commercial status for the destruction of hazardous waste.
Molten salt oxidation	Molten salt oxidation at 1,652” to 1,832°F (900° to 1,000°C) is used with air as a medium in which to oxidize mixtures of combustible materials. Acidic products form salts that dissolve in the molten salt bath. The molten salt is typically a mixture of sodium carbonate and sodium sulfate.
Catalytic oxidation	Halogenated volatile organic compound catalytic oxidation units typically consist of a preheater, gas or electric, to elevate the gas stream temperature to the catalyst working temperature of about 932°F (500°C). Usually used to achieve final oxidation and cleanup of dilute gas streams.
	Other technologies
Hydrogenation process	Carbon bonds with heteroatoms are broken, and the heteroatoms are replaced with hydrogen. Widely used in oil refining processes to reshape hydrocarbon chains into useful products. Generally operates in the 797” to 896°F (425” to 480°C) temperature range and wide ranges of pressure from 10 to 100 atm (147 to 1,470 psi), with large excesses of hydrogen. Requires suitable catalyst.
Reaction with sulfur (Adams process)	Organic compounds react with elemental sulfur, either in the vapor phase from 932” to 2,732°F (500” to 1500°C) or in the liquid phase from 275° to 842°F (135° to 450°C). A polymeric carbon-sulfur residue is produced along with gaseous and liquid by-products.

Source: derived from NRC (1993).

The NRC found that few low-temperature, low-pressure technologies have the capability to provide for complete chemical agent destruction in a single-step process. Even fewer technologies could be applied successfully to other elements of the chemical weapons stockpile. In most cases, application would require a two-step process, combining technologies in series, to achieve the level of destruction required. An emphasis was placed on the ability of several of these technologies to detoxify chemical agent, producing products of reduced toxicity suitable for storage and/or subsequent destruction. Moderate-temperature, high-pressure oxidation technologies were found to show some potential for chemical agent destruction; however, the high-pressure environment and corrosive nature of the reactants and products create confinement and materials selection challenges that would require a substantial investment in research and pilot plant development. High-temperature and low-pressure oxidation technology (i.e., incineration) has demonstrated the capability to destroy chemical agent in a single-step process and broad versatility in dealing with other chemical weapons stockpile components.

After the commencement of the ATP in August 1994, Science Applications International Corporation (SAIC) performed an update for the Army on the NRC alternatives report (SAIC 1995). Table A.2 summarizes SAIC's assessment at the start of the ATP.

A.3.2 Summary of Recommendations of the NRC Stockpile Committee

In March 1994, the NRC Stockpile Committee released its report on recommendations for alternative technologies (NRC 1994b). In deriving its recommendations, the Stockpile Committee was concerned primarily with the technical aspects of safe disposal operations. However, the committee recognized that other issues will influence the selection of disposal technologies, not the least of which are the concerns of citizens who might be affected by these operations. To learn more of these concerns, the Stockpile Committee and the NRC's Alternatives Committee held a public forum in June 1993 to discuss the committee's criteria for evaluating alternative technologies, and receive public comments. The major NRC findings and recommendations were as follows:

- The baseline system has been demonstrated as a safe and effective disposal process for the stockpile.
- The development of a successful alternative technology for agent destruction may produce some reduction in the risks associated with that portion of disposal operations. However, delays in disposal operations can only increase the already much larger cumulative risk of accidental release from storage.
- The committee recommends further study of an enhanced baseline system and of four alternative technology combinations for agent destruction, all based upon neutralization (chemical hydrolysis) of the agent as a first step. The four alternatives are (a) neutralization, followed by incineration-of the hydrolysis products, either on-site or transported to another liquid incinerator-equipped site; (b) neutralization, followed by wet air oxidation, followed by biological oxidation; (c) neutralization, followed by supercritical water oxidation; and (d) neutralization followed by biological treatment.

Table A.2. Applicability of alternate technologies to the disposal of chemical agents (VX, GB and mustard) in the U.S. Chemical Weapons Stockpile and level of development maturity

Alternative technology	Capable of destroying”				Development status[b]				Subject of survey update
	Agent	Energetic	Metal parts	Dunnage	Lab	Pilot plant	Demo plant	Operating plant	
Low-temperature, low-pressure liquid phase detoxification									
Base hydrolysis	Y	N	U	N	A	A		C	✓
Acid hydrolysis	Y	N	U	N	A	A		c	✓
Low-temperature, low-pressure liquid phase oxidation									
Ionizing radiation	U	U	U	N	C				
Chemical oxidation	Y	N	U	N	C				✓
Ultraviolet light plus ozone	U	N	N	N	C				
Electrochemical oxidation	Y	N	U	N	A	A			✓
Biodegradation	U	N	N	N	A			C	✓
Moderate temperature, high-pressure oxidation									
Wet air oxidation	U	U	N	N				C	✓
Supercritical water oxidation	Y	U	N	N	A	A	C		✓
High-temperature, low-pressure pyrolysis									
Molten metal	Y	U	Y	Y			c		✓
Plasma arc	Y	U	Y	N				C	✓
Steam reforming	Y	U	N	N				C	✓
High-temperature, low-pressure oxidation									
Catalytic, fixed bed	Y	N	N	N				C	✓
Catalytic, fluidized bed	Y	Y	U	U				C	
Molten salt	Y	U	N	N	A		C		✓
Combustion	Y	Y	Y	Y			A	A	
Other technologies									
Hydrogenation	Y	N	N	N				C	✓
Reactions with sulfur	Y	U	U	U			C		✓

“Key: Y = Yes; N = No; U = Uncertain.

[b]A = Operation with agent; C = Commercial operation for non agent substances

Source: U.S. Army 199.5.

- The committee found no feasible alternatives to incineration for energetic or for high-temperature detoxification of metal parts. Thus, even a successful alternative technology would affect only agent disposal operations and the associated potential release of either agent or other pollutants.

In addition, there were specific NRC recommendations pertinent to alternative technologies:

Recommendation 1. The Chemical Stockpile Disposal Program should proceed expeditiously and with technology that will minimize total risk to the public at each site.
Recommendation 10. Dispose of energetic materials by incineration.
Recommendation 14A. Neutralization research should be substantially accelerated and expanded to include field-grade and gelled material as appropriate and the neutralization of drained containers.
Recommendation 14B. Neutralization research should be accompanied by preliminary analyses of integrated systems capable of reducing agents all the way to materials acceptable for transport or disposal.
Recommendation 14C. These analyses and research should be conducted in parallel to lead to the selection of a single system for further development.
Recommendation 15. The Army should continue to monitor research developments in pertinent areas.
Recommendation 16. Neutralization followed by transport for final treatment should be examined as an alternative at the Aberdeen and Newport sites. This examination should include location of acceptable receiver sites and transport routes, and a comparison of costs and schedules relative to on-site baseline treatment. If favorable results are indicated, the examination should be expanded as an option to eliminate the liquid incinerator at other sites. At those locations, on-site incineration of energetic and associated metal parts is still recommended.
Recommendation 17. Proven alternative technologies, if available without increasing-risk, should be considered for application on the basis of site-specific assessments.
Recommendation 19. Application of an alternative technology at any site should be preceded by demonstration of safe, pilot operation. These operations should not be carried out on a trial basis at storage sites.

A.3.3 Army's Evaluation of the NRC Recommendations

In April 1994, the Army reported to Congress on its evaluation (U.S. Army 1994) of the recommendations by the NRC Stockpile Committee. The Army reviewed and considered each of the recommendations offered by the NRC in their 1994 report. The principal conclusions reached in that evaluation are discussed in the following paragraphs.

The NRC clearly indicated that all proposed changes in the demilitarization program should be assessed primarily in terms of the impact on total risk. This assessment of risk should be performed on a site-specific basis to account for the individual features of each site. The Army is in full agreement with this principle.

The NRC reviewed possible alternatives for the "reverse assembly" portion of the baseline process and found no acceptable alternative. Similarly, the Stockpile Committee concluded that incineration should be utilized for treatment of three of the four major process streams. The Army's review of alternatives is consistent with that of the NRC. The Army agrees with the NRC's recommendations in this area.

As noted in Sect. A.3.2, the NRC identified several technologies as alternatives to the incineration technology and made recommendations to the Army for further evaluation (NRC 1994b). Among the NRC's findings was the recommendation for further study of four alternative technology combinations for agent destruction, all based upon neutralization (chemical hydrolysis) of the agent as a first step. The four alternatives were (a) neutralization, followed by incineration of the hydrolysis products, either on-site or transported off-site to another liquid incinerator-equipped location; (b) neutralization, followed by wet air oxidation, followed by biological oxidation; (c) neutralization, followed by supercritical water oxidation; and (d) neutralization followed by biological treatment.

For the alternative technologies applicable to the stockpile of agent VX at NECD, the Army has concluded that there is no advantage to the neutralization/ incineration recommendation of the NRC [see item (a) in the preceding paragraph] and has inserted neutralization followed by solidification/stabilization into the research and development program instead. Testing determined that 40-50% of the stabilized material leached from the matrix. As discussed in Section AS, further evaluation of the technical, cost, and schedule implications of other post-treatment technologies led the Army to the conclusion that the third alternative identified by the NRC, namely chemical neutralization followed by supercritical water oxidation, should be pursued for the NECD stockpile.

Based on the Army's analysis and evaluation of the NRC technology recommendations, a two-technology RDT&E program to develop stand-alone neutralization for the VX agent at Newport (subsequently determined to be followed by supercritical water oxidation as a post-neutralization treatment technology) and neutralization followed by biotreatment for the mustard agent at Aberdeen was recommended for implementation.

A.4 THE ALTERNATIVE TECHNOLOGY PROGRAM

The ATP was initiated in August 1994 to evaluate the neutralization based technologies, neutralization and neutralization followed by biodegradation, as well as to continue monitoring commercial developments in alternative technologies. According to the mandate in Public Law 102-484, the ATP has focused on the evaluation of alternative technologies capable of demilitarizing the agents stored in bulk liquid form inside ton containers located at the Aberdeen Proving Ground (APG), Maryland, (agent HD) and at the Newport Chemical Depot (NECD), Indiana (agent VX). The ATP is an aggressive RDT&E effort being implemented by the Office of the Product Manager, Alternative Technologies and Approaches (PMAT&A) with support from the U.S. Army Edgewood Research, Development and Engineering Center (ERDEC), other government agencies, and support contractors.

Army-sponsored laboratory and bench-scale testing has been performed with munitions-grade VX at ERDEC and at contractor facilities. Based on these results, PMAT&A selected neutralization of VX with hot caustic (i.e., sodium hydroxide) followed by post-treatment for NECD (as discussed in Section AS, the post-treatment for the proposed pilot plant at NECD is SCWO). The R&D that led to this decision is summarized in this section.

A.4.1 Alternative Technologies Submitted by Commercial Vendors

In order to ensure that the U.S. Army captured the latest technological developments, the Army expanded its search for alternative technologies beyond neutralization-based technologies. The Army published an announcement in August 1995 in the Commerce *Business Daily* (CBD) soliciting concept designs from commercial vendors. The Army also sponsored a major conference on alternative technologies in Reston, Virginia (U.S. Army 1995).

The CBD announcement requested that industry provide concept design packages for technologies that are capable of safely demilitarizing the agents and meeting the chemical demilitarization disposal schedule for the bulk-only sites. The Army received 23 conceptual design packages in October 1995 in response to the CBD announcement. Eleven packages received detailed evaluations and twelve packages were eliminated from consideration based on screening criteria that had been published in the CBD announcement.

A.4.1.1 Screening criteria

Screening criteria were established by the Office of the Program Manager for Chemical Demilitarization (PMCD) with advice and guidance from other government agencies, contractors and oversight organizations to ensure alternative technology submissions were different than the baseline system, met congressional requirements, and had been adequately tested. The CBD screening criteria specified that a proposed alternative technology:

1. should not resemble incineration (refer to 40 CFR 260.10 where applicable);
2. must meet the requirements of the Chemical Weapons Convention (CWC) in the development of a process or equipment;
3. must have completed laboratory-scale testing with agent or surrogates;
4. should have data available on performance and destruction efficiency.

A.4.1.2 Evaluation of twelve alternative technology submissions that were rejected from consideration for failing to meet the screening criteria

Eleven commercial vendors submitted twelve packages for evaluation. Table A.3 identifies the vendors, as well as the criteria against which their submissions were found to be deficient.

A-4.1.3 Detailed evaluation of eleven alternative technology submissions

The Army considered and evaluated in detail eleven of the designs submitted by private vendors that did meet the screening criteria. The feasibility and maturity of the designs were measured according to standards developed by the Army to encompass considerations of the NRC and Public Law 102-484. A brief summary of the detailed evaluations is presented in Table A.4, as extracted from SAIC (1995).

Table A.3. Evaluation of twelve alternative technology submissions that were rejected for failing to meet the screening criteria

Company/Submission	Rationale for Rejection[a]
Howorka Environmental Technology, Howorka B & C, DMI-Project; Two Packages: a Stand-Alone Neutralization and Separation Process	Failure to Meet Criteria 2, 3, and 4
Global Environmental Solutions, Inc.	Failure to Meet Criteria 1, 2, and 3
RPF Enterprises, Inc.	Failure to Meet Criteria 2, 3, and 4
Howorka Environmental Products	Failure to Meet Criterion 1
Neway, Inc.	Failure to Meet Criteria 2, 3, and 4
ToxCo, Inc.	Failure to Meet Criteria 1, 2, and 3
Foster Wheeler Environmental Corp.	Failure to Meet Criteria 3 and 4
Foster Wheeler Development Corp.	Failure to Meet Criteria 2 and 3
EO Systems, Inc.	Failure to Meet Criteria 2, 3, and 4
High Voltage Environmental Applications, Inc.	Failure to Meet Criterion 2: *Referred to the Army Technology Program for possible use as an Effluent Treatment Technology*
Solarchem Environmental Systems	Failure to Meet Criterion 2; *Referred to the Army Technology Program for possible use as an Effluent Treatment Technology*

[a]Screening Criteria:

(1) Should not resemble incineration (refer to 40 CFR 260.10 where applicable).
(2) Development of process or equipment must meet the requirements of the Chemical Weapons Convention.
(3) Laboratory-scale testing completed with agent or surrogates.
(4) Data must be available on performance and destruction efficiency.

Source: derived from PMCD 1996a.

Table A.4. Detailed evaluation of eleven alternative technology submissions that did meet screening criteria

Company and *Proposal/Process Submitted*	Results of Detailed Evaluation of Proposal
Allied Research Corporation, *Adams Process*	Does not meet required engineering maturity; does not meet requirements of the Chemical Weapons Convention
Burns and Roe, *STARTECH Process*	Provides insufficient technical description; no commercial-scale equipment exists
Commodore Laboratories, Inc., *Neutralization Process*	Does not provide minimum process information; small-scale testing does not confirm required levels of agent destruction; inadequately addresses safety issues
Eco Logic, *High Temperature Gas Phase Reduction Process*	Presents a demonstrated history of commercial application; adequately addresses concerns in the areas of agent destruction, worker exposure and safety, completeness of the process, and pilot-scale demonstration; selected as among three best concepts presented for consideration
Neutralization Followed by General Atomics *Supercritical Water Oxidation (SCWO) (Hydrothermal Oxidation) Process*	Was determined to have a high probability of meeting the Army's requirements and schedule; SCWO warrants consideration as a post-treatment method of the product stream from a neutralization process
M4 Environmental Management, Inc., *Molten Metal Process*	Adequately and more completely met the major criteria than competing and comparable technologies; process does not produce a large volume of flue gas; gaseous product is suitable for use as a fuel or chemical feedstock; solid waste should be acceptable for sale or disposal at a waste site; selected as among three best concepts presented for consideration
Plasma Energy Applied Technology, Inc., *(PEAT) Process*	Process concept was not as fully developed as competing technologies; application to chemical warfare agents is the very early developmental stage; provides insufficient technological detail
Rust Federal Services, Inc., *(Rust) Molten Salt Oxidation (MSO) Process*	Produces effluents that may have the characteristics of incineration off-gas; no actual bench- or pilot-scale data available;
AEA Technologies, *Electrochemical Oxidation Process*	One of the most promising and advanced processes for mineralizing HD and VX agents; experience and operations at the pilot- and commercial-scale level; product effluents should create no problems with facility permitting;, selected as among three best concepts presented for consideration
Thermatrix, Inc., *Thermal Oxidation Process*	Has present commercial applications for destruction of fumes and process wastes; inadequate detail provided on how process will handle organophosphate compounds, the reliability of the scrubber system, and process control; inadequately addresses safety issues
Roy F. Weston, Inc., *Plasma Arc Process*	Produces stack effluents with volumes considerably smaller than incineration processes; process is not sufficiently differentiable from incineration; level of agent destruction is unproven, even in laboratory-scale tests; state of development is not sufficiently advanced

Source: derived from SAIC (1995).

A.4.1.4 Technologies selected for consideration by NRC

Three of the 11 technology designs submitted by private vendors received strong recommendations from a knowledgeable panel of reviewers, including professional staff from PMCD (see Table A.4). The Army concurred with these recommendations and forwarded three conceptual design packages to the NRC: (a) electrochemical oxidation (AEA Technologies), (b) high temperature gas phase reduction (ELI Eco Logic International, Inc.), and (c) molten metal (M4 Environmental L.P.).

Other recommendations were made by the panel. The conceptual design package submitted by General Atomics (SCWO) was specifically recommended for consideration as au effluent treatment process following the Army's stand-alone neutralization or neutralization followed by biodegradation processes. Two other effluent treatment technologies were also referred to the neutralization/biodegradation program-W oxidation (Solarchem) and electron beam (High Voltage Environmental Applications).

A.4.2 Alternative Technologies Subjected to Detailed Consideration and Evaluation

The Army ATP evaluated the viability of two neutralization processes and the three alternative technologies submitted by commercial vendors (Eco Logic, AEA Technologies, and M4 Environmental) that were recommended for further testing and review (see Sect. A.4.1.4). Each of the three commercial vendors was required to prepare concept design packages and supply agent test data at their own expense as part of the evaluation. Each firm has completed tests using actual chemical agents. M4 Environmental, Inc. used 0.34 L of agent, Eco Logic used 3 L, and AEA Technology at Porton Down in the United Kingdom used 30 L. Each vendor was also required to submit a schedule for completion of the demilitarization at NECD.

The NRC and U.S. Army Materiel Systems Analysis Activity (AMSAA) have also assessed these technologies (see Sects. A.4.3 and A.4.4, respectively). The subsections that follow describe the alternative technologies that were under consideration for demilitarization of chemical agents at NECD at this stage of the ATP.

A.4.2.1 Baseline incineration (U.S. Army)

In this process, the chemical agent is destroyed in a liquid incinerator. The exhaust from the incinerator flows to an afterburner to ensure complete destruction of the agent. The exhaust gases are then scrubbed by a pollution abatement system prior to the release to the atmosphere.

A.4.2.2 Neutralization followed by treatment and disposal (U.S. Army)

Neutralization is accomplished by a hydrolysis reaction of the nerve agent VX with sodium hydroxide followed by further post-treatment. This neutralized mixture would either be treated on-site or shipped off-site for commercial post-treatment at a treatment, storage and disposal facility.

A.4.2.3 Electrochemical oxidation (AEA Technologies)

In this process, agent is introduced into a continuous batch reactor using an electrochemical cell of nitric acid and silver to attack the agent, resulting in oxidized species. This technology uses recovery operations to recycle process chemicals, thus leaving a Iiquid waste stream.

A.4.2.4 High temperature gas phase reduction (Eco Logic)

In this process, steam and hydrogen break carbon bonds and the excess hydrogen bonds with heteratoms and replaces the heteratoms with hydrogen, thereby destroying the agent. This basic process is widely used in commercial oil refinement processes to reshape hydrocarbon chains into useful products.

A.4.2.5 Molten metal catalytic extraction process (M4 Environmental)

This process is based on the high-temperature pyrolysis of both organic and inorganic elements. The VX molecules are thermally decomposed in the presence of molten metal at 1600” to 1700°C to small molecules or atoms. Wastes are primarily a gas stream of nitrogen, hydrogen, and carbon monoxide and a solid slag.

A.4.3 Evaluation of Alternative Technologies by the NRC

The NRC’s committee on Alternative Chemical Demilitarization Technologies has evaluated the processes identified in Sect. A.4.2 and has issued a report on its findings (NRC 1996). The report specifically focuses on destruction of the site-specific inventories of APG and NECD. The NRC was not asked to compare the alternative technologies to the baseline incineration process, nor was it asked to consider the applicability of the technologies to stockpile inventories at sites other than APG and NECD.

The NRC’s study was comprehensive. The committee received a detailed briefing from the Army and the commercial vendors who had proposed alternative disposal technologies. The NRC committee also met with members of the public near APG and NECD. The results of the preliminary accident hazard assessment of each technology were made available to the committee, as well as the technical results on small-scale testing of the vendor’s technologies using actual chemical agents.

The NRC committee developed a set of evaluation criteria to focus on characteristics that differentiate among the alternative technologies with respect to: process performance and engineering; concerns about safety, health, and the environment; and the implications of the preceding factors in regard to the time required to complete the destruction of the stockpiles.

The NRC study concluded that members of the communities near APG and NECD do not want treaty deadlines or legislative schedules to drive decisions on technology options; however, those people do want the site-specific stockpiles to be destroyed as quickly as possible. The NRC study recognized public opposition to incineration and the desire for an acceptable alternative.

The NRC observed that all of the alternative technologies are of moderate to high complexity. While components of each of the alternative processes were considered standard and proven, none of the alternatives was considered to be an off-the-shelf solution for use as an agent destruction process. Nevertheless, all of the alternative technologies appear to be viable in regard to obtaining RCRA permits.

For the agent VX at NECD, the NRC committee concluded that chemical neutralization followed by off-site treatment and disposal has the following advantages:

- Among the alternatives reviewed by the NRC, neutralization has the largest-scale successful demonstration with actual agent.
- The required equipment has been proven through extensive use in industrial processes similar to those proposed for use in agent destruction.
- The principal unit operations are independent batch processes that do not require elaborate safety interlocks.
- Because the process involves batch processing of liquids, "hold-and-test" analyses to determine batch composition can be readily preformed at several points in the process.
- The process is performed at low temperature and near-atmospheric pressure; the hazard inventory in general is low.
- The selection of materials of construction (for the neutralization reactor) appears to be straightforward.
- No step in the process involves combustion; therefore, no combustion products are emitted.

However, one uncertainty was noted in regard to the appropriate disposal method for VX hydrolysate (i.e., the end product of the chemical neutralization of agent VX) due to its potential toxicity.

The NRC recommended pilot-scale testing of VX neutralization and additional investigation into the appropriate treatment and disposal of VX hydroiysate from chemical neutralization. If successful off-site treatment of VX hydrolysate could not be confirmed by appropriate treatability studies, and if successful on-site treatment of VX hydrolysate with existing commercial processes could not be demonstrated, then the NRC study recommended pilot-scale testing of the AEA electrochemical oxidation process for agent VX at NECD.

A.4.4 Evaluation of Alternative Technologies by the AMSAA

The AMSAA evaluated the processes identified in Sect. A.4.2 and issued a report on its findings (AMSAA 1996). The areas addressed in the study include process operability (technical characteristics), process capability and throughput, safety (worker and public), environmental permitting, cost, and schedule.

The AMSAA study concluded that while none of the alternative technologies are as technically mature as the baseline incineration process, all have the potential to destroy the NECD (and APG) inventories with comparable safety and with costs and schedules comparable to or better than the baseline process.

The AMSAA identified no technical impediments to prevent any of the technologies from achieving an acceptable level of safety. The AMSAA concluded that all of the alternative technologies have less risk in obtaining the necessary permits than baseline incineration, primarily due to the demonstrated negative public opinion about incineration. When the AMSAA adjusted the projected schedules to account for potential risk-induced delays in design, operability, and permitting, none of the alternative technologies were predicted to meet the

December 2004 stockpile destruction deadline. However, no technical impediments were identified that would prevent any of the alternative technologies from potentially destroying the NECD (and APG) stockpiles by December 2004.

The AMSAA study recommended consideration of the M4 Molten Metal process as the preferred disposal process for the agent VX at NECD based primarily on cost. However, in a subsequent evaluation, AMSAA reported that SCWO was a viable post-treatment technology (AMSAA 1997).

A.4.5 Evaluation of Alternative Technologies by the PMCD

The PMCD evaluated the processes identified in Sect. A.4.2 and issued a report on its findings (PMCD 1996b). The evaluation was conducted by a team of subject matter experts (SMEs) selected from Army organizations and outside contractors. The evaluation followed a structured approach, developed by a team of decision analysts, based on commonly used decision analysis techniques. This structured approach provided a framework by which the SMEs could consider the multiple, and often interrelated, criteria involved in the decision. The evaluation was designed to focus the effort on those criteria that were the most important, as well as to minimize subjectivity and bias.

Overall, the SMEs ranked the baseline incineration process highly in all areas except environmental impact. This finding reflects the relatively high maturity of the incineration process as a technology for destruction of chemical agent, the safe operating experience with chemical weapons destruction at pilot- and full-scale facilities, and the extensive level of safety review to which the baseline process has been subjected.

The SMEs noted that the principal weakness of the baseline process is the relatively high level of public opposition to incineration. Because public opposition may delay the permitting process or effectively prevent the required permits from being issued, the SMEs concluded that incineration may not be a viable option at either APG or NECD.

In regard to the alternative chemical disposal processes for destruction of agent VX at NECD, the SMEs recommended neutralization followed by off-site shipment for treatment and disposal. Both the Eco Logic process and the M4 Molten Metal process were noted as having advantages in some areas over the recommended neutralization technologies.

A.4.6 Preliminary Risk Assessment for Alternative Technologies

Mitretek performed a Preliminary Risk Assessment of the options under consideration in 1996 by developing failure modes and effect analyses for each alternative technology (Mitretek 1996). The baseline incineration process was not part of their assessment. Few serious safety risks were identified for any option, and none was identified that could not be mitigated to acceptable levels through design modification. Therefore, the safety issue relates primarily to potential cost and schedule impacts of safety-related design modifications. The potential for design modifications is related to the level of chemical demilitarization design maturity and related commercial or chemical demilitarization experience. The MITRETEK assessment is qualitative in nature because of the design immaturity of the alternatives. The MITRETEK assessment can be summarized as follows:

- Few serious worker safety risks were associated with process failure modes. All identified risks could be mitigated through design modification.
- Public health risk resulting from process failure modes was negligible.
- Risk to public health as a result of external events, such as earthquakes or airplane crashes, is similar for all alternative technologies. Under the worst-case scenario, there could be as many as 48 fatalities in the vicinity of NECD.
- These results were driven by the amount of agent involved in the process. All alternative technologies (and the baseline) propose to have no more than 500 gal of agent in holding tanks at any one time.
- There was a varying level of uncertainty relative to the level of design and understanding of the CSDP safety design requirements.
- The Army's neutralization with off-site shipment has the most mature process and facility design (60% design level) and has incorporated CSDP safety requirements to the greatest extent, followed by the M4 catalytic extraction process (35 % design).
- The Eco Logic and AEA processes were less mature (20% design), and limited information regarding facility design had been developed.
- More detailed process and design information was needed for all the alternative technologies to assess long-term risk to human health and the environment. Successful operation and functioning of the containment and mitigation features of each alternative technology would preclude the release of chemicals into the environment outside of the facilities.
- The chemical and process condition hazards for the Eco Logic and M4 catalytic extraction process were generally greater than for the other options. Specifically referenced was the risk of a fire/explosion because of the presence of flammable gases in the process. Mitretek recommended a fire hazard analysis be conducted when their designs are more mature to determine the probability and consequences of fires and explosions.

A.5 SELECTION OF A POST-TREATMENT TECHNOLOGY FOR BULK VX AGENT

As noted above, the ATP developed and obtained data supporting the destruction of agent VX from the neutralization process and the three vendors. The data were evaluated by three independent groups and two customers (Indiana Citizen's Advisory Committee and the Project Manager for Chemical Stockpile Disposal). All of the independent groups reported that none of the technologies evaluated were unable to safely destroy the agent. As described in section A.4.3, the National Research Council recommended neutralization followed by off-site treatment as its preferred option. Failing the ability to treat hydrolysate off-site, the NRC recommended using the AEA technology as theprimary agent destruction process. AMSAA, as described in section 4.4.4, recommended the M4 process to destroy the agent on the basis of cost. The Core Evaluation Team recommended neutralization followed by either on- or off-site treatment. The Indiana CAC stated a preference for neutralization followed by on-site disposal and M4. The PM CSD recommended neutralization followed by off-site treatment with on-site treatment as a back-up.

Essentially, all of the evaluators and customers recommended or expressed confidence in neutralization. The low pressure/low temperature, batch operations addresses most of the issues expressed by the public and evaluators regarding safety, health, and the environment. However, none of the evaluators were asked to consider an on-site post-treatment technology for the VX neutralization process.

A.5.1. Selection of SCWO

A.5.1.1 History

Water and caustic chemistry VX neutralization process options were pursued from the laboratory testing in late 1994 through the Mettler and chamber testing in 1995. In late November 199.5, offsetting advantages and disadvantages were identified for both VX water and VX caustic neutralization reactions. On-site biodegradation was not being considered due to consistently poor test results. Stabilization of a solidified hydrolysate stream was an on-site post treatment option. Shipping hydrolysate to an unspecified Treatment, Storage, and Disposal Facility (TSDF) was an off-site post treatment option. During this period, the VX/water hydrolysate could not be shipped to other locations for treatability testing which severely restricted investigation of post treatment options for the VX/water reaction products.

A.5.1.2 Additional technologies

As discussed in Sect. A-4.1.4, in August 1995, the U.S. Army advertised in the Commerce Business Daily for technologies that were sufficiently developed to be alternatives to incineration for destruction of HD stockpiles at Aberdeen, Maryland and VX stockpiles at Newport, Indiana. The U.S. Army evaluated and selected several technologies for further consideration from those submitted in response to their advertisement.

The technologies selected as potentially effective for both agent and hydrolysate treatment were:

- Catalytic Extraction Process (CEP)/M4 Environmental Management, Inc. (M4 Environmental)
- Gas-Phase Hydrogen Reduction /Eco Logic International, Inc.
- Silver (II) Electrochemical Oxidation/AEA Technology plc (AEA)

The technologies selected as potentially effective for hydrolysate treatment were:

- Supercritical Water Oxidation (SCWO)/General Atomics (GA)
- UV Oxidation/Solarchem Environmental Systems (Solarchem)
- Electron Beam Treatment.

The following discussion provides the Army's rationale for rejecting all post-treatment technology options except SCWO.

A.5.1.3 UV oxidation and stabilization

The treatability tests by Solarchem in January 1996 utilizing UV Oxidation for the hydrolysate required extensive dilution and a large number of units to achieve destruction. The stabilization testing of hydrolysate conducted through March 1996 at Southwest Research Institute (SwRI) was not successful because 40 to 50% of the organophosphate constituents leached out of the solidified hydrolysate.

A-5.1.4 Off site wastewater treatment

In April 1996, it was decided to investigate and adopt, if appropriate, off site treatment of the hydrolysate. This procedure added calcium hypochlorite (bleach) followed by shipment to the DuPont Chambers Works industrial wastewater treatment facility. A series of experiments investigated the effects of this bleach addition and the ability of the DuPont facility to treat hydrolysate quantities representative of full-scale plant operations. The results of these experiments were discouraging, and treatability studies using other technologies were renewed.

A.5.1.5 Renewed hydrolysate treatability testing

The technologies selected for renewed tests were based on ratings by the blue ribbon technology selection committee in late 1996 (NRC 1996). Electron beam technology was eliminated based on immaturity and UV/Oxidation was eliminated due to its poor destruction in earlier tests.

The four treatment technologies selected for testing were:

- Catalytic Extraction Process (CEP)/M4 Environmental Management, Inc.
- Gas-Phase Hydrogen Reduction/Eco Logic International, Inc.
- Silver (II) Electrochemical Oxidation/AEA Technology plc
- Supercritical Water Oxidation/General Atomics

The treatability studies included tests to demonstrate destruction of sample quantities of VX/NaOH hydrolysate provided by the Program Manager for Applied Technologies and Approaches (PMAT&A), sampling and analysis to quantitatively determine the effectiveness of the process, and preparing a mass balance for the test results. These data were used to prepare a mass balance, simplified process flow diagram (PFD) and an order of magnitude cost estimate for a full-scale facility to treat 30,560 pounds of VX/NaOH hydrolysate per day which results from processing 10,000 pounds of agent VX per day.

General Atomics (GA) was selected as the SCWO vendor because its concept design had been favorably reviewed by the blue ribbon technology selection committee in late 1996. Additionally, GA offered an existing facility capable of processing the quantity of hydrolysate necessary to demonstrate handling of the salt formed in the SCWO reactor when the organics are destroyed to the required level.

A treatability study for the Silver (II) Electrochemical Oxidation was not performed with hydrolysate but included tests to evaluate effects of salt on the electro-chemical cells. These results were considered along with the results from other Silver (II) tests involving treatment of VX agent at Porton Down.

Finally, the Army's ATP conducted a treatability study which evaluated five technologies consisting of those submitted by the three vendors, electrochemical oxidation and SCWO. The principal conclusions from the evaluation (SWEC 1996) of the above treatability studies performed between June and August 1996 were that each technology was capable of reducing the thiols and organic compounds containing the carbon phosphorus bond in the VX/NaOH hydrolysate by at least 99% and that SCWO was the most suitable of the technologies for destroying hydrolysate. The evaluation also identified challenges facing each post-treatment technology if selected for further research, development, and demonstration. The challenges facing SCWO, including the need for confirmatory testing performed at the operating conditions proposed for full-scale operation and integration of solids handling and demonstration of long term corrosion resistance under operating conditions, were considered substantially less than those facing the other alternative post-treatment technologies (SWEC 1996). The study concluded that SCWO was the most suitable for destroying VX hydrolysate (SWEC 1996). The ATP, then requested the NRC and AMSAA to evaluate neutralization followed by SCWO. Both organizations stated that the process was viable.

Other factors supporting the selection of SCWO were:

- the existence of multiple potential SCWO vendors,
- the research base at national laboratories and academic institutions,
- the completeness of the destruction,
- the suitability of the process to the aqueous stream.

Therefore, SCWO was selected for further testing.

A.5.2. NRC Evaluation of SCWO

The Army asked the National Research Council (NRC) to evaluate whether supercritical water oxidation (SCWO) is an effective and appropriate means of eliminating hazardous or toxic organic constituents in VX hydrolysate for ultimate disposition. The report outlines the elements of the proposed neutralization/SCWO technology, evaluates the results of ongoing SCWO tests, and makes recommendations concerning aspects of the technology that require further development (NRC 1998). The scope of the evaluation did not include evaluations of other potential technologies or management options for the VX hydrolysate. Summary findings of the NRC study included:

- criteria for process destruction efficiency and final disposal standards have not been established
- additional development and pilot-scale testing of SCWO technology will be necessary to ensure sustained, reliable operation of a full-scale integrated treatment system
- despite some factors that may create difficulties in sustaining system performance (e.g., large quantities of insoluble salts; unexpected fluctuations in temperature, pressure, and salt expulsion from the SCWO reactor; high levels of corrosion and erosion of materials of construction in the reactor liner and pressure let-down valves; and lack of sustained performance and reliability of the pressure let-down system), the NRC believes that a SCWO system for the treatment of VX hydrolysate with sustained performance can be achieved with additional development and testing
- because the understanding of fundamental processes is limited and the process operational data and experience are sparse, empirical design and engineering judgment

will be required for the selection of a prudent scale for development prior to full-scale demonstration
- although preliminary data indicate that certain noble metals, such as platinum and gold, may have acceptable properties, the data currently available are insufficient for the selection of materials of construction
- process monitoring and control strategies for the management of salts within the SCWO reactor and the destruction of the organic constituents of the hydrolysate have not been demonstrated.

In addition to these findings, the NRC study made a number of recommendations, as listed in summary form below:

- a pilot-scale SCWO process facility with the critical characteristics of the full-scale design should be constructed and operated to further define operating characteristics and demonstrate sustained continuous operation of the process
- testing of materials of construction should be carried out as necessary to finalize the selection of materials for critical components, including the SCWO reactor and the pressure let-down system
- flexibility and redundancy of critical components should be incorporated into the design of the full-scale system to allow for uncertainties about the basis for scale-up and operation
- the Army should make provisions for targeted research and development to resolve problems identified during pilot-scale testing and the full-scale implementation of SCWO technology
- requirements for process destruction efficiencies and final disposal standards for all effluent streams from SCWO treatment should be clearly defined to ensure that the final design meets regulatory standards.

As outlined below, many of these findings and recommendations are currently being pursued by the Army.

A.5.3. Status of SCWO Testing

Follow on testing of the SCWO technology was performed in February 1997 by GA to confirm the conclusions reached in the August 1996 tests. The confirmatory testing used apparatus partially modified to address the problems found during the August 1996 tests. Evaluation (SWEC 1997) of the February 1997 tests concluded that SCWO is effective and suitable for the treatment of VX/NaOH hydrolysate confirming earlier conclusions (SWEC 1996).

Tests at a commercial evaporator vendor were performed to verify that the non-organic salts in the SCWO effluent could be removed so that the recovered water could be reused in the process. These tests also determined that the evaporator could produce a salt suitable for disposal.

The confirmatory testing evaluation (SWEC 1997) included a review of the available materials data to support selection and sizing of liner materials for a full-scale facility. This review determined that material corrosion data were needed.

Additional SCWO testing was planned in parallel with the confirmatory testing at GA to:

- determine destruction kinetics in SCWO
- review alternate approaches to SCWO such as catalysts for applicability to VX hydrolysate
- identify potential issues relating to full-scale performance of the NECDF SCWO installation
- perform materials of construction (MOC) testing.

A survey of candidate testing organizations indicated capability from:

- Eco Waste Technology (EWT)/University of Texas (UT)
- Massachusetts Institute of Technology (MIT)
- Sandia National Laboratory (SNL)
- Los Alamos National Laboratory (LANL)
- Idaho National Engineering and Environmental Laboratory (INEEL)
- Stanford Research International (SRI)
- Battelle Pacific Northwest National Lab (PNNL),

A request for proposal (RFP) was issued to all and responses were received from ET/UT, SRI, LANL, INEEL, and SNL. LANL and MIT both declined because of other priorities within their respective organizations. PNNL elected not to respond to the RFP due to conflict of interest concerns as stated in its letter dated January 21, 1997.

EWT/UT responded with a proposal to address the destruction kinetics of SCWO, electing to utilize methyl phosphonic acid (MPA) rather than hydrolysate. EWT stated that neither its commercial unit at Huntsman Chemical nor its pilot unit at the University of Texas could test with hydrolysate. ET was, therefore, awarded a contract to provide surrogate (MPA) destruction data over the temperature range of interest to corroborate the MPA destruction reported in the GA test. The EWT tests have been completed utilizing a bench scale reactor. The data indicate that MPA is the most refractory constituent in hydrolysate, but that it can be destroyed in a defined range of temperature and residence time (University of Texas at Austin 1997).

SRI responded with a proposal to test the benefits of a catalyst with a small batch reactor system, and a contract to do so was placed with SRI. The SRI process offered the potential for hydrolysate of destruction at lower temperatures through the addition of sodium carbonate. Destruction at lower temperatures could reduce design requirements for a full-scale facility and potentially provide an alternative design. The SRI tests have been terminated because the initial results were inconclusive and showed no benefit to be gained from the addition of sodium carbonate (SRI Final Report, October 19, 1997).

Sandia National Laboratory responded with a proposal to test utilizing their transpiring wall reactor scheme. A review was made of a test report (Sandia Report, SAND 96-8255•UC-702, September 1996) of results for the application of the transpiring wall reactor to smokes and dye feeds. This report presented the most up-to-date results using this type of reactor. It indicated that, even with transpiration cooling, some salt deposition occurred on the reactor walls with a feed containing only 5 % dye. This caused concern that corrosion mechanisms similar to those on a solid wall reactor were present and brought into question the benefit of the transpiring wall reactor if the same materials issues would need to be addressed. Hence, it was decided not to pursue testing of the transpiring wall.

PNNL indicated they had the capability to perform tests to treat hydrolysate at a scale similar to tests performed at GA. PNNL declined responding to the RFP due to concerns that testing could jeopardize future business development opportunities. PNNL has recently notified the U.S. Army that they no longer have contractual concerns and are interested in performing tests. Stone and Webster has reviewed the capability of PNNL equipment to perform testing under the conditions required for hydrolysate treatment. It has been determined that the PNNL equipment is not capable of the pressure and temperature operating regime required for application and no testing is planned utilizing that equipment.

A.6 CURRENT PROGRAM STATUS

Numerous technologies have been evaluated in detail to determine their potential viability for demilitarization of chemical agents stored in bulk (ton) containers at APG, Maryland, (agent HD) and NECD, Indiana (agent VX). The review and analysis by the NRC, AMSAA, and the Army's subject matter experts of the acceptability of these technologies is discussed in detail in Sects. A.4.3, A.4.4, and A.4.5, respectively.

The Army evaluated the findings of the NRC report (NRC 1996), the AMSAA report (AMSAA 1996), and the SME report (PMCD 1996b) in conjunction with other independent evaluations of the alternative technologies, the preliminary hazard analysis (Mitretek 1996), and reports prepared by the PMCD Public Affairs Office regarding public opinion. The Army has also obtained input on alternative technologies from the Indiana and Maryland Citizens Advisory Commissions.

The Army's decision process for alternate technologies involves three distinct phases, each of which includes the compilation of studies and experimental evidence to support a specific decision (or "milestone"). These "milestones" are formalized within the Army system by the issuance of letters from the appropriate level of command to the executing officer. For the Alt Tech program, the first "milestone" occurred with the Congressional directive in Public Law 102-484 to study and evaluate technological alternatives to incineration. In January 1995, the Army initiated Technical Feasibility Testing (TFT), which is synonymous with laboratory and bench-scale testing, for the VX neutralization technology. Based on the results of the laboratory and bench-scale tests, a Milestone I/II decision was reached in January 1997 to pursue pilot testing of the neutralization technology. The two letters on display in Appendix A of the EIS represent the Milestone I/II decision.

During the next phase of decision making, Production Prove-out Testing (PPT), which is synonymous with pilot-plant shakedown testing, and Production Qualification Testing (PQT), which is synonymous with pilot-plant demonstration testing, will be conducted. Based on the results of the proposed pilot testing, the Army anticipates that a Milestone III decision can be reached by April 2004, at which time the Newport neutralization facility will either be or not be selected for use in destroying the entire inventory of agent VX currently stored at NECD.

Accompanying any Milestone III decision to use neutralization in place of incineration will be a response to the language in Public Law 102-484 that requires the Secretary of the Army to issue a determination that (1) the alternative technology is capable of completing all necessary destruction and demilitarization operations by the 2004 deadline and (2) significantly safer and equally or more cost-effective than the incineration process.

In early 1997, the Under Secretary of Defense for Acquisitions and Technology (see Exhibit A. 1) and the Assistant Secretary of the Army for Research, Development and Acquisition (see Exhibit A.2) authorized the PMCD to undertake the steps necessary for pilot testing of the neutralization-based alternative technologies at APG and NECD. This authorization included the directive to prepare environmental impact analyses-in accordance with the National Environmental Policy Act and Army Regulation 200-2—to evaluate the proposal to construct and operate pilot test facilities to demonstrate the neutralization processes for the APG and NECD stockpiles, where the post-treatment technologies are biodegradation and SCWO, respectively. The evaluations leading to the selection of SCWO as the post-treatment technology for the bulk VX agent at NECD, the NRC's evaluation of SCWO, and the current status of SCWO testing are discussed in Sect. AS.

A.7 REFERENCES

AMSAA (U.S. Army Materiel Systems Analysis Activity) 1996. *Summary Report: Technical and Economic Analysis Comparing Alternative Chemical Demilitarization Technologies to the Baseline,* Vol. 1; special Publication No. 75, AMSAA, Aberdeen Proving Ground, Md.

AMSAA (U.S. Army Materiel Systems Analysis Activity) 1997. Special Publication No. 81: *Analysis of Army's Chemical Demilitarization Alternative Technology Neutralization Followed by Supercritical Water Oxidation of Nerve Agent (VX) Stored at NECD,* September 1997.

Mitretek 1996. *Preliminary Risk Assessment of Alternative Technologies for Chemical Demilitarization*, 96W0000023, May.

NRC (National Research Council) 1984. *Disposal of Chemical Munitions and Agents*, National Academy Press, Washington, D.C.

NRC (National Research Council) 1993. *Alternate Technologies for the Destruction of Chemical Munitions and Agents*, National Academy Press, Washington, D.C.

NRC (National Research Council) 1994a. *Evaluation of the Johnston Atoll Chemical Agent Disposal System Operational Verification Testing Part II,* National Academy Press, Washington, D.C.

NRC (National Research Council) 1994b. *Recommendations for the Disposal of Chemical Munitions* and *Agents*, National Academy Press, Washington, D.C.

NRC (National Research Council) 1996. *Review and Evaluation of Alternative Chemical Disposal Technologies*, National Academy Press, Washington, D.C.

NRC (National Research Council) 1998. *Using Supercritical Water Oxidation to Treat Hydrolysate from VX Neutralization*, National Academy Press, Washington, D.C.

PMCD (Program Manager for Chemical Demilitarization) 1996a. *Evaluation of Information on Dioxin Emissions, Alternative Technologies, and Baseline Incineration, Chemical Agent and Munitions Disposal Operations at Tooele, Utah*, 12 July 1996, PMCD, Aberdeen Proving Ground, Md.

PMCD (Program Manager for Chemical Demilitarization) 1996b. *Alternative Technology Program Evaluation Report (Draft)*, 9 September 1996, PMCD, Aberdeen Proving Ground. Md.

SNL (Sandia National Laboratory) 1996. *Transpiring Wall Supercritical Water Oxidation Reactor Salt Deposition Studies*, Sandia Report SAND96-8255•UC-702, September 1996.

SAIC (Science Applications International Corp.) 1995. Survey *and Update of Alternative Demilitarization Technologies*, February.

SWEC (Stone & Webster Engineering Corporation) 1996. *Treatability Study for Treatment of VX Hydrolysate Effluent from Neutralization of VX Chemical Nerve Agent*, September 20, 1996.

SWEC (Stone & Webster Engineering Corporation) 1997. *Evaluation of Confirmatory Testing of Supercritical Water Oxidation for Treating VX/NaOH Hydrolysate*, May 30, 1997.

SRI (Stanford Research Institute) 1997. *Testing Assisted Hydrothermal Oxidation to Destroy VX/NaOH Hydrolysate*, SRI Final Report, October 10, 1997.

University of Texas at Austin, 1997. *Supercritical Water Oxidation of Methylphosphonic Acid-Destruction Efficiency and Kinetics*, November 25, 1997

U.S. 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.

U.S. Army 1994. *U.S. Army's Alternative Demilitarization Technology Report for Congress,* Program Executive Officer—Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., April.

U.S. Army 1995. *Proceedings of the Workshop on Advances in Alterative Demilitarization Technologies,* Program Executive Officer-Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., September.

EXHIBIT A.1

THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, O.C. 20301-3010

ACQUISITION AND TECHNOLOGY

JAN 17 1997

MEMORANDUM FOR SECRETARY OF THE ARMY
ATTN: ACQUISITION EXECUTIVE

SUBJECT: Authorization for Further Planning Steps for the Proposed Implementation of Alternative Technology Pilot Plants at Newport, Indiana, and at Aberdeen Proving Ground, Maryland.

I authorize the Army to prepare an environmental impacts analysis of the proposal to construct pilot plants to demonstrate the neutralization (hydrolysis) process alternative technologies followed by either on-site or off-site post treatment for nerve agent at Newport, Indiana and for mustard at Aberdeen Proving Ground, Maryland I request the Army program the necessary funds to construct the pilot plants and to take the necessary steps to obtain construction permits under the Resource Conservation and Recovery Act (RCRA) from the State of Indiana and from the State of Maryland to construct such pilot plants. In addition, I request the Army conduct effluent toxicity tests to assure that the safety of the effluent from the proposed pilot plants after post-treatment will be thoroughly considered in the decision whether to proceed with construction and operation of the proposed pilot plants.

Paul Kaminski
Paul G. Kaminski

EXHIBIT A.2

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
RESEARCH DEVELOPMENT AND ACQUISITION
103 ARMY PENTAGON
WASHINGTON OC 203104103

REPLY TO
ATTENTION OF

29 JAN 1997

MEMORANDUM FOR PROGRAM MANAGER FOR CHEMICAL DEMILITARIZATION, ABERDEEN PROVING GROUND, MD 210105401

SUBJECT: Authorization for Further Planning Steps for the Proposed Implementation of an Alternative Technology Pilot Plant at Newport, Indiana

The Defense Acqusition Executive (DAE) has approved subject Army recommendation (enclosure) as reviewed by the Overarching Integrated Product Team (OIPT). Through the decision process, the OIPT has reviewed the following documents and recommendations:

a. Review and Evaluation of Alternative Chemical Disposal Technologies, National Research Council, September 1996.

b. Analysis of Army's Chemical Demilitarization Alternative Technology, U.S. Army Materiel Systems Analysis Activii, October 1996.

c. Alternative Technology Program Evaluation Report, U.S. Army Program Manager for Chemical Demilitarization (Draft), September 1996.

d. Recommendation on Alternative Technology for Newport, Indiana, U.S. Army Program Manager for Chemical Demilitarization, November 5, 1996.

These Documents and recommendations support pilot demonstration and further evaluation of Neutralization (hydrolysis) Process Alternative Technology followed by either on-site or off-site post treatment, as a potential disposal technology for unitary chemical agent stockpile sites with bulk storage containers only. Based on these documents, OIPT review and DAE approval, I authoriie the Army to:

a. Prepare, in accordance with the National Environmental Policy Act (NEPA) and the Army Regulation 220-2, Environmental Effects of Army Action, an environmental impacts analysis of the proposal to construct a pilot plant to demonstrate the neutralization (hydrolysis) process atternative technology followed by either on-site or off-site post treatment for nerve agent at Newport, Indiana.

EXHIBIT A.2 (continued)

-2-

b. Program the necessary funds to construct a pilot plant to demonstrate the Neutralization (hydrolysis) Process Alternative Technology followed by either on-site or off-site post treatment for nerve agent at Newport, Indiana.

c. Take the necessary steps to obtain a construction permit, under the Resource Conservation and Recovery Act (RCRA) from the State of Indiana to construct the necessary facilities for pilot demonstrating the Neutralization (hydrolysis) Process Alternative Technology followed by either on-site or off-site post treatment for nerve agent at Newport, Indiana.

d. Conduct effluent toxicology testing for neutralization as required by DOD regulations and applicable state requirements. The results of this testing will be incorporated into the environmental impacts analysis prepared in accordance with NEPA for this proposed project. All Army and DOD environmental and safety offices will be given an opportunity to review and comment on the NEPA documentation prior to a final decision on whether to implement pilot demonstration of the Neutralization (hydrolysis) Process Alternative Technology at Newport, Indiana.

Gilbert F. Decker
Assistant Secretary of the Army
(Research, Development and Acqusition)

Enclosure

APPENDIX B

SCOPING FOR THIS ENVIRONMENTAL IMPACT STATEMENT

This appendix summarizes the environmental issues identified by the public during the scoping process for the Newport Chemical Agent Disposal Facility (NECDF) environmnental impact statement (EIS). The comment period was initiated with the publication in the *Federal Register* of a Notice of Intent to prepare the NECDF EIS (62 *Fed. Regist.* 30315), which solicited written comments on the proposed project. In addition, a public scoping meeting was held in Clinton, Indiana (Vermillion County), on June 30, 1997, to provide a forum for individuals and organizations to offer oral comments on the proposed action. The oral and written comments offered by the public during the scoping period assisted in the identification of the important environmental issues and concerns deserving detailed analysis in the EIS.

B. 1 BACKGROUND

In January, 1988, a public hearing was held in Vermillion County, Indiana, to discuss the Army's Final Programmatic Environmental Impact Statement concerning the disposal of agent stored at multiple sites around the country. Four years later, a public scoping meeting was held in Vermillion County concerning the preparation of a site-specific environmental impact statement on disposal of agent stored at NECD. In both meetings, large numbers of community members attended, made statements, and queried Army representatives. The dominant concern expressed at both events had to do with the safety of the disposal process and how it might affect nearby residents. Among the specific issues raised were the proximity of the proposed disposal site to neighboring towns and schools, the possible effects of natural disasters on plant operations, the training of on-site personnel, the adequacy of emergency management procedures, and the feasibility of shipping the agent off-site (Ace-Federal Reporters, Inc. 1988; Ace-Federal Reporters, Inc 1992).

In the spring and summer of 1994, staff from Battelle Pacific Northwest Laboratories conducted interviews and focus group discussions with people living in the area surrounding NECD as part of a larger effort to assess community views at all potential disposal sites. The researchers concluded that, in general, NECD was held in high regard by community members, many of whom were proud of its role in the national defense effort. Many local residents expressed trust and confidence in the Army, although others reported being shocked upon learning that VX had been manufactured at the depot decades earlier. During the late 1980s, there had been a high level of concern in the community over the Army's plans to incinerate VX on-site, but the Battelle researchers reported that community concern appeared to have waned over time. However, some community residents suggested that the lack of apparent concern could reflect the fact that the Army had taken no disposal-related actions for several years and might not indicate a genuine lack of community interest (Battelle Pacific Northwest Laboratories 1994).

Indiana, like several other states, has a Citizens' Advisory Commission (CAC) that was created by the Army to provide input on state and local concerns regarding the proposed chemical stockpile disposal program. The Indiana CAC has nine members, seven from the area surrounding NECD and two state officials. The Indiana CAC has always been very concerned with protecting the safety of Indiana residents and has expressed serious reservations concerning the proposed incineration plan. Recently, the CAC chairman voiced the Commission's support of chemical neutralization pilot testing (Indiana Citizens' Advisory Commission 1997).

B.2 PUBLIC SCOPING MEETING AND ORAL COMMENTS

Twenty-four citizens registered their attendance at the scoping meeting one June 30, 1997, and two attendees offered comments on the proposed facility. One speaker indicated that any proposed uses of the NECDF after destruction of the chemical agent should be presented to the public for consideration and discussion. The other speaker felt that the health and safety of the public and the facility workers should be the first considerations in the design, construction, and operation of the proposed facility.

B.3 WRITTEN COMMENTS

One of the speakers at the public scoping meeting also submitted a written comment. It reiterated the commentor's concern regarding potential future uses of the proposed facility and the proposed site: Any planned future uses of the facility and land should be presented to the public for comment, and comments should be solicited at not only the local level but also the regional and state levels.

B.4 RELATED SCOPING ACTIVITIES

In conjunction with the planning and evaluation stages of chemical agent demilitarization programs at Newport and other installations (e.g., Aberdeen Proving Ground in Maryland), the Army has pursued related activities that are required before the construction of the disposal facilities. These actions include preparation of the permit and permit modification applications required by the Resource Conservation and Recovery Act, the Clean Air Act, and the Clean Water Act. During these activities, the Army has noted any public concerns or comments that were expressed in those forums. Also, public comments on the Chemical Stockpile Disposal Program in general and on incineration in particular were evaluated for their applicability to this EIS. The following outline summarizes the comments received during these public involvement activities that were reviewed for their applicability to the proposed NECDF.

- Risks associated with disposal options compared with continued storage
  - quantity and condition of stockpile
  - failure of the Johnston Atoll Chemical Agent Disposal System facility to achieve a destruction efficiency of 99.9999% in the metal parts incinerator
  - transporting the stockpile as an interim safety measure
  - types and adequacy of monitoring
  - integrity of storage containers
  - types and hazards of nonstockpile chemical materiel onsite (e.g., buried chemical warfare materiel, former production facilities)
  - stockpile risks in the context of other activities and materials onsite
  - existing security measures are inadequate, making the stockpile vulnerable to sabotage or acts of terrorism
- Accidents
  - proximity of public facilities such as airports
  - need for indoor storage of stockpile
  - nearby population
- Socioeconomic impacts and community issues
  - public opposition to hazardous waste incinerators
  - public perception of the adequacy of the institutional structure to protect their safety
  - federal agency and Department of Defense attention to affected communities
  - need to institutionalize active, meaningful public involvement
  - providing assistance to citizens advisory commissions
  - involving the public in the decision making process rather than simply measuring public reaction to selected disposal option
  - employment
  - impacts on local infrastructure, public services, tourism, property values, and quality of life
  - socioeconomic differences among the counties most affected by the facility
  - importance of the installation's role in the social and economic development of the region
  - adequacy of existing emergency planning and preparedness capability in the community
  - cost of the proposed action and alternatives
  - environmental justice (locating the incinerator in an area that may not have the social, political, and financial resources to oppose it effectively)
- Emergency planning and preparedness measures
  - onsite and offsite
  - public notification systems
  - evacuation of the surrounding area-would be impossible

- Ecology
  - nature, extent, and environmental impacts of existing contamination
  - transport and migration pathways for onsite contaminants (for both stockpile and nonstockpile chemicals and for both normal and nonroutine events)
  - environmental impacts of routine base operations
  - impacts on local agriculture
- Water quality
  - deposition of emissions on nearby surface water bodies (e.g., Wabash River)
  - solubility of agent and contaminants
- Noise
  - from existing operations and from construction and operation of the incinerator facility
- Air quality
  - quantity and components of emissions from incinerator
  - existing air quality (poor, would be further degraded by incinerator emissions)
  - nonattainment areas
  - "synergistic effects" of incinerator emissions and existing air pollutants, especially during inversions
- Human health
  - need for site-specific risk and exposure assessment
  - evaluation of the non-lethal health effects of incineration
  - health effects of existing onsite contamination
  - properties and effects of agents
  - regional cancer rates are high and would increase with incinerator emissions
  - health risk studies should include infants and young children
- Alternative demilitarization technologies
  - need for increased research into alternatives
  - reliability of data supporting safety of incineration
  - all alternatives need to be considered (e.g., burial/entombment)
  - more rigorous and extensive research needed on neutralization and biodegradation, possibly resulting in its selection as the preferred option for destruction of chemical agent
  - dependability and reliability of incineration
- Cost of incineration facility
  - unjustifiable cost compared with other alternatives
  - unjustifiable for "temporary" facility

REFERENCES

ACE-Federal Reporters, Inc. 1988. *Transcript of Proceedings: Public Hearing on the Final Environmental Impact Statement (FEIS) by Department of the Army, Clinton, Indiana, Tuesday, January 26, 1988.*

ACE-Federal Reporters, Inc. 1992. *Transcript of Proceedings: Public Scoping Meeting for the Proposed Newport Chemical Agent Disposal Facility, Vermillion Co., Indiana, Friday, April 3, 1992.*

Battelle Pacific Northwest Laboratories 1994. *Community Viewpoints of the Chemical Stockpile Disposal Program, Appendix D: Newport Army Ammunition Plant Site Report,* Washington, D . C . , November.

Indiana Citizens' Advisory Commission 1997. *Indiana Citizen's Advisory Commission,* June

APPENDIX C

SUMMARY OF SUPPORT STUDIES

The analyses in this EIS are supported by numerous studies, including several investigations and evaluations as to the applicability of alternative disposal technologies for the bulk agent VX stored at the Newport Chemical Depot (NECD) in Indiana. These support studies include the following:

1. **NRC (National Research Council) 1993. *Alternate Technologies for the Destruction of Chemical Munitions and Agents,* National Academy Press, Washington, D.C.**

The Committee on Alternative Chemical Demilitarization Technologies of the NRC, meeting in 1992 and early 1993, collected and studied information on alternative and supplemental technologies and reported their findings in June 1993. The NRC identified technologies as alternatives to the baseline (incineration) technology that they considered appropriate for further evaluation by the Committee on Review and Evaluation of the Army's Chemical Stockpile Disposal Program (known as the "Stockpile Committee").

The NRC grouped the alternative technologies considered into six categories based on process operating conditions and types of reactions involved. The operating conditions span the ranges of low, medium, and high temperatures and low and high pressures. Reaction types include hydrolysis, oxidation, hydrogenation, pyrolysis, and reaction with sulfur. These categories represent a broad spectrum of processes, some of which have been studied only in the laboratory and some of which are in commercial use for destruction of hazardous and other wastes. The NRC determined that no alternative technology was sufficiently mature so that it could be implemented to meet the Congressionally mandated disposal deadline of December 31, 2004.

2. **NRC (National Research *Council)* 1994. *Recommendations for the Disposal of Chemical Munitions and Agents,* National Academy Press, Washington, D.C.**

In March 1994, the NRC's Stockpile Committee released its report on recommendations for alternative technologies. In deriving its recommendations, the Stockpile Committee was concerned primarily with the technical aspects of safe disposal operations. However, the committee recognized that other issues will influence the selection of disposal technologies, not the least of which are the concerns of citizens who might be affected by these operations. To learn more of these concerns, the-Stockpile Committee and the NRC's Alternatives Committee held a public forum in June 1993 to discuss the committee's criteria for evaluating alternative technologies, and receive public comments. Based on the resulting criteria, the NRC evaluated the alternative technologies. The major NRC fmdings and recommendations were as follows:

- The baseline (incineration) system has been demonstrated as a safe and effective disposal process for the stockpile.
- The development of a successful alternative technology for agent destruction may produce some reduction in the risks associated with that portion of disposal operations; however, delays in disposal operations can only increase the already much larger cumulative risk of accidental release from storage.
- The committee recommended further study of an enhanced baseline system and of four alternative technology combinations for agent destruction, all based upon neutralization (chemical hydrolysis or solvolysis) of the agent as a first step. The four alternatives are (a) neutralization, followed by incineration of the hydrolysis products, either on-site or transported to another liquid incinerator-equipped site; (b) neutralization, followed by wet air oxidation, followed by biological oxidation; (c) neutralization, followed by supercritical water oxidation; and (d) neutralization followed by biological treatment.

a

3. U.S. Army 1994. *U.S. Army's Alternative Demilitarization Technology Report for Congress*, Program Executive Officer-Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., April.

In April 1994, the Army reported to Congress on its evaluation (U.S. Army 1994) of the recommendations by the NRC. The Army reviewed and considered each of the reconunendations offered by the NRC in their 1994 report. The NRC clearly indicated that all proposed changes in the demilitarization program should be assessed primarily in terms of the impact on total risk. This assessment of risk should be performed on a site-specific basis to account for the individual features of each site. The Army is in full agreement with this principle.

The NRC recommended neutralization followed by either incineration, wet air oxidation and biological processing, supercritical water oxidation, or biological processing as the four candidates for research. The Army has concluded that there is no advantage to the neutralization/incineration combination and has inserted stand-alone neutralization into the research and development program instead.

Based on the Army's analysis and evaluation of the NRC technology recommendations, a two-technology program to develop stand-alone neutralization and neutralization followed by biotreatment was developed and was recommended for implementation.

4. *NRC* (National Research Council) 1996. *Review and Evaluation of Alternative Chemical Disposal Technologies*, National Academy Press, Washington, D.C.

The NRC's committee on Alternative Chemical Demilitarization Technologies has evaluated selected alternative technologies and issued a report on its findings (NRC 1996). The report specifically focuses on destruction of the site-specific, bulk inventories of agent HD at Aberdeen Proving Ground (APG) in Maryland, and at the Newport Chemical Depot (NECD) in Indiana. The NRC was not asked to compare the alternative technologies **to** the baseline incineration process, nor was it asked to consider the applicability of the technologies to stockpile inventories at sites other than APG and NECD.

The NRC's study was comprehensive. The committee received a detailed briefing from the Army and the three commercial vendors who had proposed alternative disposal technologies. The NRC committee also met with members of the public near APG and NECD. The results of the preliminary accident hazard assessment of each technology were made available to the committee, as well as the technical results on small-scale testing of the vendor's technologies using actual chemical agents.

The report makes specific recommendations were made for the APG and NECD stockpiles. For the agent HD at APG, the NRC committee concluded that neutralization followed by biodegradation surpasses the other technologies with respect to NRC's evaluation criteria. Biodegradation at off-site treatment and disposal facilities was identified in the report as the most attractive of the neutralization configurations presented for review. For the agent VX at NECD, the NRC committee concluded that chemical neutralization followed by off-site treatment and disposal has the same relative advantages as for neutralization of agent HD at APG. However, one uncertainty was noted in regard to the appropriate disposal method for VX hydrolysate (i.e., the end product of the chemical neutralization of agent VX) due to its potential toxicity.

The NRC recommended pilot-scale demonstration of neutralization of agent HD at APG. The NRC also recommended pilot-scale testing of VX neutralization and additional investigation into the appropriate treatment and disposal of VX hydrolysate from chemical neutralization.

5. AMSAA (U.S. Army Materiel Systems Analysis Activity) 1996. *Summary Report: Technical and Economic Analysis Comparing Alternative Chemical Demilitarization Technologies to the Baseline,* Vol. 1, special Publication No. 75, AMSAA, Aberdeen Proving Ground, Md.

The AMSAA has evaluated the same processes as the NRC and issued a report on its findings. The areas addressed in the study include process operability (technical characteristics), process capability and throughput, safety (worker and public), environmental permitting, cost, and schedule.

The AMSAA study concluded that while none of the alternative technologies is as technically mature as the baseline incineration process, all have the potential to destroy the APG and NECD inventories with comparable safety and with costs and schedules comparable to or better than the baseline process.

The AMSAA identified no technical impediments to prevent any of the technologies from achieving an acceptable level of safety. When the AMSAA adjusted the projected schedules to account for potential risk-induceddelays in design, operability, and permitting, none of the alternative technologies were predicted to meet the December 2004 stockpile destruction deadline. However, no technical impediments were identified that would prevent any of the alternative technologies from potentially destroying the APG and NECD stockpiles by December 2004.

The AMSAA study recommended consideration of neutralization followed by biodegradation as the preferred disposal process for the agent HD at APG. A chemical extraction, molten-metal process was recommended as the preferred disposal process for the agent VX at NECD. This combined option reduces the overall risk, while providing significant cost savings. The AMSAA also found that this option provides a great deal of flexibility, since two separate technologies would be carried forward for further development.

6. PMCD (Program Manager for Chemical Demilitarization) 1996. *Alternative Technology Program Evaluation Report (Draft),* 9 September 1996, PMCD, Aberdeen Proving Ground, Md.

The PMCD also evaluated the same processes and issued a report on its findings. The evaluation was conducted by a team of subject matter experts (SMEs) selected from Army organizations and outside contractors. The evaluation followed a structured approach, developed by a team of decision analysts, based on commonly used decision analysis techniques. This structured approach provided a framework by which the SMEs could consider the multiple, and often interrelated, criteria involved in the decision. The evaluation was designed to focus the effort on those criteria that were the most important, as well as to minimize subjectivity and bias.

The SMEs noted that the principal weakness of the baseline (incineration) process is the relatively high level of public opposition to incineration. Because public opposition may delay the permitting process or effectively prevent the required permits from being issued, the SMEs concluded that incineration may not be a viable option at either APG or NECD.

In regard to the alternative chemical disposal processes, the SMEs found that, for destruction of agent HD at APG, neutralization followed by biodegradation is the preferred technology. For destruction of agent VX at NECD, the SMEs recommended neutralization followed by off-site shipment for treatment and disposal.

7. MITRETEK 1996. *Preliminary Risk Assessment of Alternative Technologies for Chemical Demilitarization,* 96W0000023, May.

MITRETEK performed a Preliminary Risk Assessment of the alternative technologies by developing failure modes and effect analyses. The baseline incineration process was not part of their assessment. Few serious safety risks were identified for any option, and none was identified that cannot be mitigated to acceptable levels through design modification.

The MITRETEK assessment is qualitative in nature because of the design immaturity of the alternatives. The key findings of the MITRETEK assessment can be summarized as follows:

- Few serious worker safety risks were associated with process failure modes. All identified risks could be mitigated through design modification.
- Public health risk resulting from process failure modes is negligible.
- The Army's neutralization/biodegradation and neutralization with off-site shipment have the most mature process and facility designs (60% design level) and have incorporated CSDP safety requirements to the greatest extent.
- More detailed process and design information is needed for all the alternative technologies to assess long-term risk to human health and the environment. Successful operation and

functioning of the containment and mitigation features of each alternative technology would preclude the release of chemicals into the environment outside of the facilities.

REFERENCES

AMSAA (U.S. Army Materiel Systems Analysis Activity) 1996. *Summary Report: Technical and Economic Analysis Comparing Alternative Chemical Demilitarization Technologies to the Baseline,* Vol. 1, Special Publication No. 75, AMSAA, Aberdeen Proving Ground, Md.

MITRETEK 1996. *Preliminary Risk Assessment of Alternative Technologies for Chemical Demilitarization*, 96W0000023, May.

NRC (National Research Council) 1993. *Alternate Technologies for the Destruction of Chemical Munitions and Agents*, National Academy Press, Washington, D.C.

NRC (National Research Council) 1994. *Recommendations for the Disposal of Chemical Munitions and Agents*, National Academy Press, Washington, D.C.

NRC (National Research Council) 1996. *Review and Evaluation of Alternative Chemical Disposal Technologies*, National Academy Press, Washington, D.C.

PMCD (Program Manager for Chemical Demilitarization) 1996. *Alternative Technology Program Evaluation Report (Draft)*, 9 September 1996, PMCD, Aberdeen Proving Ground, Md.

US. Army 1994. *U.S. Army's Alternative Demilitarization Technology Report for Congress,* Program Executive Officer-Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., April.

APPENDIX D

ENDANGERED AND THREATENED SPECIES

This appendix provides information on the potential impacts of the proposed action and alternatives on endangered and threatened species and critical habitat listed by the federal government. It includes copies of letters sent to the U.S. Fish and Wildlife Service (FWS) requesting information needed to prepare a Biological Assessment (BA) and their responses (Exhibits D. 1 through D.9), as required by Section 7 of the Endangered Species Act.

D.l CONSULTATION IN ACCORDANCE WITH THE FEDERAL ENDANGERED SPECIES ACT OF 1973.

In conjunction with the preparation of this EIS, and in accordance with Section 7 of the Endangered Species Act of 1973, as amended, a biological assessment (BA) has been prepared by the Army (see Exhibit D. 10). The BA describes the methods, results, and conclusions of the analysis of the potential impacts to federally protected species and habitat within 100 km (62 miles) of Newport Chemical Depot (NECD) for the proposed action, construction and pilot testing of the Newport Chemical Agent Disposal Facility (NECDF). The BA has been submitted to the U.S. Fish and Wildlife Service (FWS) for review with a request for concurrence with its conclusions.

Information on proposed and listed threatened and endangered species, and on proposed and designated critical habitat that could occur within 100 km (62 miles) of NECD, has been requested during various stages of planning over a period of several years, most recently in August of 1997 (Exhibits D.3, D.4, and D.6). Responses (Exhibits D. 1, D.2, DS, D.7, and D. 8) state that a total of 13 endangered or threatened species may be present: one mammal, one bird, nine freshwater mussels, and two plants (see Exhibit D.9 for list and status). There is no critical habitat for any of these species within the 100-km (62-mile) zone.

D. 2. CONCLUSIONS FROM THE BIOLOGICAL ASSESSMENT

Effects to bald eagles or Indiana bats from facility construction are considered unlikely. Bald eagles, if present, are too distant to be directly affected by construction activities. Effects, if any, of loss of potential Indiana bat foraging habitat should be minimal due to the small acreage that would be removed, as well as the availability of other existing habitat and maturing new foraging habitat. Similarly, no effects on these species from routine facility operations are expected due to low toxicity and to low potential for bioaccumulation of effluent constituents.

Threatened plant species are too distant from NECD to be affected by construction or routine operations. If an accident involving an atmospheric release were to occur, however, whether during continued storage (the no-action alternative) or during operation of the proposed pilot plant (the proposed action), threatened or endangered terrestrial species could be adversely affected. The extent of potential effects would depend, in part, on me meteorological conditions at the time of the accident and the amount of agent released.

In part because of their considerable distance from the proposed NECDF, endangered mussels are unlikely to be adversely affected by either construction, routine operations, or accidental releases of VX agent under the proposed action. Under the continued storage (no-action) alternative, however, the "worst case" accident involves a potentially greater quantity of agent VX released into the atmosphere than the "worst case" accident associated with pilot test operations. Thus, a greater probability exists that endangered mussels could be harmed by continued storage accidents.

As long as storage of the VX agent stockpile continues, there is a small probability of an accidental release and the associated potential for adverse effects on threatened and endangered species. With initiation of test operations, the possibility of an accidental release associated with the pilot tests would be added to this storage-associated threat. Once pilot testing is completed, the magnitude of potential effects from accidents to threatened and endangered species would be reduced by the destruction of about one third of the NECD stockpile. In addition, successful demonstration of the ability of the NECDF to safely dispose of VX agent would contribute in the long run to destruction of the remainder of the NECD stockpile. Consequently, the potential for accidents to adversely affect threatened or endangered species is assumed to be greater for continued storage than for the proposed action to pilot test the neutralization/supercritical water oxidation technology.

EXHIBIT D.l

United States Department of the Interior

FISH AND WILDLIFE SERVICE
BLOOMINGTON FIELD OFFICE (ES)
620 South Walker Street
Bloomington, Indiana 47403-2121
(812) 334-4261 FAX 334-4273

IN REPLY REFER TO

October 28, 1997

Hr. Harry Quarles, Ph.D.
Environmental Sciences Division
Post Office Box 2008
Oak Ridge, Tennessee 37831-6036

Dear Mr. Quarles:

This is in response to your letter dated August 19, 1997, requesting updated information regarding the potential occurrence of critical habitat and/or Federally endangered and threatened species within 100 km of the Newport Chemical Depot (Depot), Newport, IN for preparation of an environmental impact statement for construction of a facility to pilot test a chemical agent neutralization process. The site is located in Vermillion County, Township 16 North, Range 9 West, Section 4 of the Dapa Quadrangle.

These comments have been prepared under the authority of the Fish and Wildlife Coordination Act (16 U.S.C. 661 et. seq.) and are consistent with the intent of the National Environmental Policy Act of 1969, the Endangered Species Act of 1973, and the U. S. Fish and Wildlife Service's Mitigation Policy.

Any Covenant Not To Sue (CNTS) for natural resource damages granted by the State of Indiana under its Voluntary Remediation Program (VRP) would not represent nor perhaps encompass the position of the federal natural resource trustees under Section 122(j) of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) as amended. This letter does not represent formal review of this on project by the Department of the Interior (DOI) and therefore, this in no way should be construed to represent a position as to whether or not a CNTS for natural resource damages to federal trust resources would be appropriate.

THREATENED AND ENDANGERED SPECIES

The 100 km area described in your letter is within the range of the Federally endangered Indiana bat (*Myotis sodalis*), fanshell mussel (*Cyprogenia stegaria*), clubshell mussel (*Pleurobema clava*), and the Federally threatened bald eagle (*Haliaeetus leucocephalus*).

There are several nesting, as well as wintering, records for the bald eagle within the area of interest. Furthermore, the Wabash River throughout Parke, Vermillion. Fountain, and Warren Counties is considered a primary wintering area for eagles in Indiana. Bald eagles nest in close proximity to lakes, rivers. or reservoirs. They construct their nests near habitat ecotones, such as lakeshores, rivers, and timber

EXHIBIT D.l (continued)

2.

management areas (clearcuts or selective cuts). Tolerance of human activity during the nesting season has been variable, but, ideally, human disturbance of eagles should be avoided. The bald eagle's food base from the watershed includes carrion, waterfowl, and especially fish. The nest mentioned in the March 30, 1992 letter to Ms. Monica Satrape, has never been used (John Castrale, IDNR, pers. comm.).

There are two known Indiana bat maternity colonies within the Depot boundaries. The first colony's roost tree is in the north central portion of Section 6 (Township 16 North, Range 9 West); the second colony was found in the southwest quarter of Section 3. The bat uses woodlands during the summer when maternity colonies utilize trees with loose bark for nesting. These bats forage primarily over wooded stream corridors, although they have been collected in grazed woodlots, mature deciduous forests, and pastures with trees. We recommend that the EIS address any potential impacts (i.e. disturbance from construction activities) to the bats and roost trees that might occur as a result of project plans.

Finally, with regards to the two mussel species, the closest records occur in Tippecanoe County.

The National Wetland Inventory (NWI) map indicates that there are no wetlands in the immediate vicinity of the construction project; however, there may be riverine; palustrine, forested: palustrine, unconsolidated; palustrine, scrub-shrub: and palustrine, emergent wetlands within the area interest. Water and other habitat resources of palustrine wetlands are attractive to numerous wildlife species, including birds and bats. In particular, migratory birds such as wood ducks (*Aix sponsa*), mallards (*Anas platyrhynchos*), and tree swallows (*Tachycineta bicolor*) will utilize open-water wetlands and are subject to potential impacts from contaminants. We recommend that project plans be designed to avoid impacts to the wetland habitat, particularly regarding contamination,

Contamination from this site may migrate to nearby wetlands, waterways, or other areas of ecological significance. Pathways of migration may include leachate/ground water, surface water, and sediment. Under conditions that allow certain contaminants to accumulate in waterways, aquatic organisms can bioaccumulate these elements ; consequently, elevated or toxic concentrations may be reached. We recommend chat monitoring efforts address the potential for off-site migration of any possible contaminants.

The information provided does not include concerns for other wildlife resources. Therefore, we recommend that you also contact the Indiana Department of Natural Resources. Division of Nature Preserves, and Division of Fish and Wildlife concerning possible State-listed species and other resource concerns. Their addresses are:

Indiana Department of Natural Resources
Division of Nature Preserves
402 West Washington, Rm W267
Indianapolis, Indiana 46204

Indiana Department of Natural Resources
Division of Fish & Wildlife
b02 West Washington, Rm W273
Indianapolis, Indiana 46204

EXHIBIT D.l (continued)

3.

We appreciate the opportunity to comment at this early stage of project planning. If we can be of further assistance please contact Robin McWilliams of my staff at (812) 334-4261 ext. 207.

Sincerely yours,

for Michael S. Litwin acting
David C. Hudak,
Supervisor

CC: Director, Indiana Division of Fish and Wildlife, Indianapolis. IN
Katie Smith. Division of Fish and Wildlife, IDNR, Indianapolis, IN
IDNR, Division of Nature Preserves, Indianapolis. IN
Jim Smith, IDEM, Indianapolis, IN
Wayne Faatz, IDNR, Indianapolis, IN
IDEM, Emergency Response, Indianapolis, IN

EXHIBIT D.2

IN REPLY REFER TO:

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Rock island Field Office (ES)
4469 - 48th Avenue Court
Rock Island, Illinois 61201
Tel: 309/793-5800 Fax: 30917934804

September 2, 1997

Mr. Harry Quarles, Ph.D.
Environmental Science Division
Oak Ridge National Laboratory
P.O. Box 2008
Oak Ridge, Tennessee 3783 l-6036

Dear Mr. Quarles:

We have reviewed your August 19, 1997, request for updated information regarding threatened and endangered species within the project area for the proposed incineration facility at Newport Army Ammunition Plant and have the following comments.

After reviewing the September 24, 1992, letter on this subject, only the following corrections are indicated. The endangered Indiana bat (*Myotis sodalis*) is listed as currently distributed in Vermilion County, *Illinois.* The bald eagle (*Haliaeetus leucocephalus*) is now listed as threatened rather than endangered. No other changes are indicated.

These comments provide technical assistance only and do not constitute the report of the Secretary of the Interior on the project within the meaning of Section 2(b) of the Fish and Wildlife Coordination Act, do not fulfill the requirements under Section 7 of the Endangered Species Act, nor do they represent the review comments of the U.S. Department of the Interior on any forthcoming environmental statement. Thank you for the opportunity to provide comments early in the planning process. If you have any additional questions or concerns, please contact Heidi Woeber of my staff.

Sincerely,

Richard C. Nelson
Supervisor

D:\WP51\HEIDI\ORNL

EXHIBIT D.3

OAK RIDGE NATIONAL LABORATORY
MANAGED BY LOCKHEED MARTIN ENERGY RESEARCH CORPORATION
FOR ME U.S. DEPARTMENT OF ENERGY

POST OFFICE BOX 2008
OAK RIDGE, TN 37831-6036

PHONE: (423) 241-2412
FAX (423) 576-8543
E-mail: hq3@ornl.gov

August 19, 1997

Mr. David Hudak
US. Fish and Wildlife Service
Bloomington Field Office
620 South Walker Street
Bloomington, Indiana 47403

Dear Mr. Hudak:

The U.S. Department of the Army is preparing an environmental impact statement (EIS) for construction of a facility to pilot test the neutralization process as a potential disposal technology for VX chemical agent stored at the Newport Chemical Depot, in Newport, Indiana. In order to prepare the ecological resources section of the EIS for the Army, I am requesting updated information about terrestrial and aquatic species of plants and animals listed or proposed to be listed as endangered or threatened which may be present within 100 km of the site.

Your office has provided information on the species within 100 km of the site in letters of July 11, 1986, and March 30, 1992. Both letters and a map showing the area of concern are enclosed. I am interested in learning of 1) any additional species that may have been listed, or proposed for listing as threatened or endangered, 2) any changes in the listing status of species previously identified, and 3) the presence of any critical habitat which may have been designated within the 100 km zone since the previous information was provided. I understand that a recent survey has documented the presence of a colony of the endangered Indiana bat *(Myotis sodalis)* on the Depot.

Thank you. If you have any questions please call me at (423) 241-2412.

Sincerely,

Harry Quarles

Harry Quarles, Ph.D.
Environmental Sciences Division

Enclosures

ornl - *Bringing Science to Life*

EXHIBIT D.4

OAK RIDGE NATIONAL LABORATORY
MANAGED BY LOCKHEED MARTIN ENERGY RESEARCH CORPORATION
FOR ME U.S. DEPARTMENT OF ENERGY

POST OFFICE BOX 2008
OAK RIDGE, TN 37831-6036

PHONE: (423) 241-2412
FAX: (423) 576-8543
E-mail: hq3@ornl.gov

August 19, 1997

Mr. Richard Nelson
U.S. Fish and Wildlife Service
Rock Island Field Office
4469 48th Avenue Court
Rock Island, Illinois 61201

Dear Mr. Nelson:

The U.S. Department of the Army is preparing an environmental impact statement (EIS) for construction of a facility to pilot test the neutralization process as a potential disposal technology for VX chemical agent stored at the Newport Chemical Depot, in Newport, Indiana. In order to prepare the ecological resources section of the EIS for the Army, I am requesting updated information about terrestrial and aquatic species of plants and animals listed or proposed to be listed as endangered or threatened which may be present within 100 km of the site.

Your office provided information on the species within 100 km of the site in a letter of September 24, 1992. A copy of the letter and a map showing the area of concern are enclosed. I am interested in learning of 1) any additional species that may have been listed, or proposed for listing as threatened or endangered, 2) any changes in the listing status of species previously identified, and 3) the presence of any critical habitat which may have been designated within the 100 km zone since the previous information was provided. I understand that a recent survey has documented the presence of a colony of the endangered Indiana bat ***(Myotis sodalis)*** on the Depot.

Thank you. If you have any questions please call *me* at (423) 241-2412.

Sincerely,

Harry Quarles

Harry Quarles, Ph.D.
Environmental Sciences Division

Enclosures

ornl - *Bringing Science to Life*

EXHIBIT D.5

United States Department of the Interior

TAKE PRIDE IN AMERICA

FISH AND WILDLIFE SERVICE
Rock Island Field Office (ES)
4469 - 48th Avenue Court
Rock Island, Illinois 61201

IN REPLY REFER TO:

309/793-5800

September 24, 1992

Ms. Virginia R. Tolbert
Environmental Analyses Section
Environmental Sciences Division
Oak Ridge National Laboratory
P.O. Box 2008
Oak Ridge, Tennessee 37831

Dear Ms. Tolbert:

This is in response to your request of August 28, 1992, for information relative to federally listed threatened and endangered species adjacent to the proposed incineration facility at Newport Army Ammunition Plant. We understand that the U.S. Department of the Army is currently preparing an environmental impact statement (EIS) for the construction of the incineration facility for disposal of chemical agents and munitions at the Newport Army Ammunition Plant.

In accordance with Section 7(c) of the Endangered Species Act of 1973, as amended, we are providing the following list of endangered or threatened species that may be present in the area of the proposed action. Should the project site contain any habitat similar to that described below, it may be necessary to conduct a survey to determine the presence of the listed species. Should a listed species be found to occur on site, and the proposed project may affect it, the Federal agency responsible for actions authorized, funded, or carried out in furtherance of the construction project must enter into formal consultation with the U.S. Fish and Wildlife Service and prepare a Biological Assessment.

EXHIBIT D.5 (continued)

with respect to federally listed threatened or endangered species, the site is within the range of four federally listed species:

Classification	Habitat	County	Common Name	Scientific Name
Endangered	Caves and Riparian Habitat	State-wide	Indiana bat	Mvotig sodalis
Endangered	Wintering	Moultrie, Jasper	Bald eagle	Haliaeetus leucocephalus
Threatened	Virgin prairies	Ford	Mead's milkweed	Asclepias meadii
Threatened	Wet grassland	Iroquois	Eastern prairie fringed orchid	Platanthera leucophaea

The endangered Indiana bat (Myotis sodalis) is listed as statewide in distribution, and it frequents the corridors of small streams with well devaloped riparian woods, as well as mature upland forests during the summer months. St winters in caves and abandoned mines. The only Critical Habitat listed for this species in Illinois is the Blackball Mine on Pecumsaugen Creek in LaSalle County. If the project site contains any habitat that fits the above description, it may be necessary to conduct a survey to determine the presence of the bat. If the species is present, it must not be harmed, harassed or disturbed. If suitable habitat exists on the site, no trees may be cleared between the dates of May 1 and August 31.

The endangered bald eagle (Haliaeetus leucocephalus) is listed as wintering in Moultrie and Jasper Counties, Illinois, primarily along large rivers. During the winter, this species feeds on fish in the open water areas created by dam tailwaters, in the warm water effluents of power plants of municipal and industrial discharges, or in power plant cooling ponds. It roosts at night in large trees adjacent to the river. There is no Critical Wabitat designated for this species in Illinois and the only restrictions that apply to the eagle are that it not be harassed, harmed or disturbed when present.

Mead's milkweed (Asclepias meadii) is listed as threatened in Ford County, Illinois. It typically occurs in mesic to dry-mesic tallgrass prairies. There is no Critical Habitat designated for this species in Illinois. Federal regulations prohibit any commercial activity involving this species or the destruction,

EXHIBIT D.5 (continued)

malicious damage or removal of this species from Federal land or any other lands in knowing violation of State law *or regulation,* including State criminal trespass law.

The eastern prairie fringed orchid (Platanthera leucophaea) is listed as threatened in Iroquois County, Illinois. It occupies wet grassland habitats. There is no Critical Habitat *for* this species in Illinois. Federal regulations prohibit any commercial activity involving this species or the destruction, malicious damage or removal of this species from Federal land or *any* other lands in knowing violation of State law or regulation, including State criminal trespass law.

With respect to federal wildlife refuges, there are currently no wildlife refuges located in the Illinois portion of the area of concern. There are, however, numerous wetlands which are delineated on U.S. Fish and Wildlife Service National Wetland Inventory (NWI) maps currently available for that region. Due to the number of counties involved, it would probably be most expedient for your agency to obtain the necessary WWI maps directly from the following address:

U.S. Department of the Interior
Fish and Wildlife Service
National Wetlands Inventory
9720 Executive Center Dr.
Suite 101 *Monroe* Bldg.
St. Petersburg, FL 33702.

These maps *are* available on a scale of 1:24,000, and have the same quadrangle name as the geographically corresponding U.S. Geological Survey topographic map of the same scale.

We also recommend that you contact the Illinois Department of Conservation regarding more detailed species and habitat location information, which may be of more use to you later in conducting a biological assessment of the area of *concern.* The address is provided below:

Illinois Department of Conservation
Division of Fisheries/Wildlife Resources
600 North Grand Avenue West
Springfield, Illinois 62702.

Because this request for information precedes *specific* construction/operational plans for the proposed facility, and detailed project plans should be available at a later date and incorporated in the EIS, we cannot make a determination at this time as to whether there may be adverse impacts to Federal trustee resources either during the *incinerator* facility construction period or as a result of the operational facility.

EXHIBIT D.5 (continued)

These comments are provided as technical assistance only and do not represent the position of the Fish and Wildlife Service or the Department of the Interior on the project, or on any pending or forthcoming permits or environmental documents that may be required.

Please contact Melanie Young of this office if you should have any additional questions.

Sincerely,

Richard C. Nelson
Field Supervisor

MY:jp

EXHIBIT D.6

OAK RIDGE NATIONAL LABORATORY
MANAGED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE U.S. DEPARTMENT OF ENERGY

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

August 28, 1992

Mr. Richard Nelson, Supervisor
U.S. Fish and Wildlife Service
Rock Island Field Office (ES)
4469 48th Ave Court
Rock Island. Illinois 61201

Dear Mr. Nelson:

The U.S. Department of the Army is preparing an environmental impact statement (EIS) for construction of an incineration facility at Newport Army Ammunition Plant (NAAP) for disposal of chemical agents and munitions. The water used by this project will be withdrawn from the existing Ranney wells located adjacent to the Wabash River. In order to prepare the ecological resources section of the EIS, we are requesting updated information about terrestrial and aquatic species of plants and animals listed or proposed to be listed as endangered, threatened. candidate, or of special concern which may be present within the Illinois portion of a 100 km radius of the site.

The Indiana field office provided informatii on Federally listed species for the programmatic EIS for disposal of the existing U.S. chemical agent stockpile and updated information has been requested from that office for the State of Indiana. A copy of their July 11, 1986 letter and a *map* showing the area of concern are enclosed for your information. The location of threatened and endangered species, critical habitat, and important wetlands within the Illinois portion of the 100-km zone around NAAP would be most beneficial in assessing the potential for impacts and the continued applicability of the programmatic EIS.

Thank you for your assistance. If there are questions, please contact me at (815) 574-7288 or FTS 624-7288.

Sincerely,

Virginia R. Tolbert

Virginia R. Tolbert, PhD
Environmental Analyses Section
Environmental Sciences Division

a

EXHIBIT D.7

United States Department of the Interior

FISH AND WILDLIFE SERVICE
BLOOMINGTON FIELD OFFICE (ES)
718 North Walnut Street
Bloomington. Indiana 47404
(812) 334-4261 FAX 3344273

IN REPLY REFER TO

March 30, 1992

Ms. Monica Satrape
Chemical Demilitarization (SAIL-PMM-N)
Aberdeen Proving Ground, Maryland 21010-5401

Dear Ms. Satrape:

This regards a February 13. 1992 Federal Regrister Notice of Intent to prepare an Environmental Impact Statement (EIS) for the construction and operation of the chemical agent disposal facility at the Newport Army Ammunition Plant, Indiana.

This letter has been prepared under the authority of the Fish end Wildlife Coordination Act (16 U.S.C. 661 et seq.) and is consistent with the intent of the Nation81 Environmental Policy Act of 1969. the Endangered Species Act of 1973, and the U.S. Fish end Wildlife Service's Mitigation Policy.

Tho proposed project is within the range of the Fe&rally endangered Indiana bat (Myotis sodalis), and Federally endangered bald eagle (Haliaeetus leucocephalus). Recently, we were informed by the Indiana Department of Natural Resources (IDNR) that a pair of bald eagles have built a neat on the Wabash River across from Newport Army Ammunition Plant property. The EIS should address any potential impacts (i.e. disturbance from construction activities) to these birds that might result from this project.

If you have any questions regarding these comments, or require further technical assistance. please contact Dan Sparks of my staff at (812) 334-4265.

Sincerely Yours.,

David C. Hudak
Supervisor

cc: Regional Director, Ffsh and Wtldlffa Service, Twin Cities, MN
IDNR, Mitchell, IN (Castrale)

- -

EXHIBIT D.8

United States Department of the Interior

FISH AND WILDLIFE SERVICE

BLOOMINGTON FIELD OFFICE (ES)
718 North Walnut Street
Bloomington, Indiana 47401

IN REPLY REFER TO:

July 11, 1986

Dr. Lorene L. Sigal
Environmental Sciences Division
Oak Ridge National Laboratory
Post Office Box x
Oak Ridge, Tennessee 311331

Dear Dr. Sigal:

This letter is in response to your May 21, 1936 request for: information on endangered species, wildlife use areas, and wetlands for use in your preparation of a programmatic environmental impact statement (EIS) for the disposal of chemical agents and munition. We will be providing you information for the State of Indiana as our Regional Office has assigned individual field offices the responsibility for responding to requests such as yours. As you mentioned in your letter, the information sought is very extensive, therefore, we have limited our response for wildlife use areas and wetlands to major areas only. Every county in Indiana has some areas that are important to some form of fish or wildlife. If you need more specific information than we are providing, please contact us directly.

Your map and additional information indicate that, except for a few counties in extreme northeastern Indiana, virtually the entire state will be potentially affected. In a telephone conversation between Don Staffeck of this office and Virginia Tolbert of your staff on July 8. 1986, it was agreed that the information requested would be sent on state maps that include counties.

Federally endangered species that occur within Indiana are listed in Table 1. The occurrence of these species by county is presented in Figure 1. The Indiana bat (Myotis sodalis) is found statewide. This species winters in caves in southern Indiana and some of these areas are designated as critical habitat. During the spring and summer Indiana bats disperse for breeding and may be found statewide. The bald eagle (Haliaeetus leucocephalus) occurs in various counties during the winter months. There is an ongoing program in progress at Lake Monroe, Monroe County, where young eagles are being hacked (reared) to encourage breeding of this species in the state. There ue currently 4 mussels on the endangered species list for the State of Indiana. However, an additional 3 species may occur within the state but have not been collected in recent years. These additional species include the orange-footed pimpleback mussel (Plethobasis cooperianus), the rough pigtoe (Pleurobema plenum), and the white cats paw pearly mussel (Epioblasma obliquata perobliqua). In addition, there are a number of plant and animal species currently under review for inclusion on the Indiana endangered species list.

Major wildlife and fish management areas ue shown in Figure 2. This list includes mostly State areas, but does show Indiana's only National Wildlife Refuge. The Patoka River bottomlands in Pike county are currently under review

EXHIBIT D.8 (continued)

2.

for inclusion into the National Wildlife Refuge system. Indiana Dunes National Lakeshore in Lake and Porter Counties is part of the National Park System, and is managed by the National Park Service. In addition, there are streams in Porter, LaPorte, and St. Joseph counties that are tributaries to Lake Michigan and are managed as migratory salmonid waters.

Your request for important wetlands is especially difficult for us to respond to. The great majority of Indiana's original wetlands have been drained for various reasons. Hence, existing wetlands have a relatively increased value because of their scarcity. We have indicated the major rivers, reservoirs, and lakes in Figure 3. However, smaller wetland • reas of importance are too numberous to list seperately. The U. S. Fish and Wildlife Service and the Indiana Department of Natural Resources (IDNR) are currently involved in a joint project to inventory the states existing wetlands. The northern one-third of Indiana is completed, with the rest of Indiana due to be done within the next 3 years. If you have specific questions regarding wetlands at a certain location please contact this office. The completion of the wetland inventory maps will provide much more detailed information than we can efficiently do in this correspondence. Indiana has a number of waterways and ♋••□♍♓♋♦♏♎ wetlands, hence the movement □♐ chemical • 9mu and munitions will occur in areas that contain important wetlands virtually throughout the state.

To our knowledge the State has not designated specific protected groundwater recharge arms. The State is currently reviewing and updating its groundwater protection policies, therefore, we recommend you get additional information from the IDNR or Indiana Department of Environmental Management.

We hope the enclosed information is helpful to you and look forward to reviewing the EIS and subsequent documents. If you have any questions regarding information contained this letter please contact me or Don Steffeck of my staff at 812-334-4261.

Sincerely yours,

J. David C. Hudak
Supervisor

EXHIBIT D.9

Exhibit F.9. List of federal threatened, endangered, proposed threatened, and proposed endangered *species* identified by the U.S. Fish and Wildlife Service *as* occurring within 100 km (62 miles) of Newport Chemical Depot.

	Status[a]
Mammals	
Indiana bat (*Myotis* soda/is)	E
Birds.	
Bald eagle (*Hiliaeetus leucocephalus*)	T
Mussels	
Fanshell mussel (*Cyprogenia stegaria*)	E
Clubshell mussel (*Pleurobema clava*)	E
White wartyback mussel (*Plethobasus cicatricosus*)[b]	E
Orange-footed pimpleback mussel (*Plethobasus cooperianus*)[c]	E
Rough pigtoe mussel (*Pleurobema plenum*)[c]	E
Fat pocketbook pearly mussel (*Potamilus capax*)[b]	E
Pink mucket pearly mussel (*Lampsilis orbiculata*)[b]	E
Tuberculed-blossom pearly mussel (*Epioblasma torulosa torulosa*)[b]	E
White cats paw pearfy mussel (*Epioblasma obliquata perobliqua*)[c]	E
Plants	
Eastern prairie fringed orchid (*Platanthera leucophaea*)	T
Meads milkweed (*Asclepias meadii*)	T

[a]T=Threatened, &Endangered

[b]Presence based on personal communication of D.C. Hudak and R.C. Nelson. both of U.S. FWS, to L.L. Sigal, Oak Ridge National Laboratory, Oak Ridge. Tenn., June 17, 1986.

[c]No recent collections of this species.

EXHIBIT D.10

DEPARTMENT OF THE ARMY
PROGRAM MANAGER FOR CHEMICAL DEMILITARIZATION
ABERDEEN PROVING GROUND. MARYLAND 21010-5401

October 9, 1998

Environmental
Monitoring Office

Ms. Robin McWilliams
U.S. Fish and Wildlife Service
620 South Walker Street
Bloomington, Indiana 47403

Dear Ms. McWilliams,

Title 14, Part B, Section 1412, of Public Law 99-145, as amended, requires the U.S. Army to destroy the entire U.S. stockpile of lethal unitary agents and munitions. Approximately 4% of this stockpile is stored at the Newport Chemical Depot (NECD), Indiana. The inventory at NECD consists of the nerve agent VX, which is stored in liquid form inside steel ton containers located in the east central part of the NECD. There are no explosive components associated with the NECD inventory.

This office, with the assistance of Oak Ridge National Laboratory, is currently preparing an environmental impact statement on a proposed chemical neutralization process followed by supercritical water oxidation (SCWO) to study the merits of this type of technology for accomplishing the required stockpile destruction at NECD. The proposed action is to construct and pilot test a chemical neutralization/SCWO facility at NECD. Pilot test operations are expected to last nine months. During the pilot test operations, liquid process effluent will be piped to the existing NECD sewage treatment plant, and then discharged in the Wabash River.

Enclosed is a copy of the biological assessment prepared to assess the potential impacts of the proposed action on threatened and endangered species around the location of the proposed facility. This office requests you make a biological determination of the potential for this project to affect threatened and/or endangered species on or around the NECD.

EXHIBIT D.10 (continued)

-2-

If you have any questions concerning this matter, please do not hesitate to contact Mr. Matthew Hurlburt, of my staff at (410) 4357027.

Sincerely,

9 Oct 98

William J.B. Pringle
Chief, Environmental and
Monitoring Office

Enclosure

EXHIBIT D.10 (continued)

ATTACHMENT A

Endangered Species Act

BIOLOGICAL ASSESSMENT

for

**THREATENED AND ENDANGERED SPECIES
NEAR THE PROPOSED SITE FOR PILOT TESTING NEUTRALIZATION/
SUPERCRITICAL WATER OXIDATION OF VX AGENT AT
NEWPORT CHEMICAL DEPOT, INDIANA**

EXHIBIT D.10 (continued)

BIOLOGICAL ASSESSMENT

FOR THREATENED AND ENDANGERED SPECIES NEAR THE PROPOSED SITE FOR PILOT TESTING NEUTRALIZATION/ SUPERCRITICAL WATER OXIDATION OF VX AGENT
AT **NEWPORT** CHEMICAL DEPOT, **INDIANA**

INTRODUCTION

An Environmental Impact Statement (EIS), *Pilot Testing of Neutralization/Supercritical Water Oxidation of VX Agent at Newport Chemical Depot, Indiana*, is being prepared by the U.S. Department of the Army. It addresses the potential impacts of 1) pilot testing of neutralization/ supercritical water oxidation of VX agent at the proposed Newport Chemical Agent Disposal Facility (NECDF) using a portion of the agent currently stored at Newport Chemical Depot (NECD), and 2) the no-action alternative of continuing to store the NECD inventory of VX agent.

In conjunction with preparation of the EIS, and in accordance with Section 7 of the Endangered Species Act of 1973, as amended, this biological assessment (BA) has been prepared. This BA describes the methods, results, and conclusions of the analysis of the potential impacts to protected species and habitats within 100 kilometers (62 miles) of the proposed NECDF site for each of the alternatives considered in the EIS (see Fig. 1 at the end of this BA). Figure 1 displays the counties within this zone, as well as those within a radius of 50 kilometers. The BA is being submitted to the U.S. Fish and Wildlife Service (FWS) for review with a request for concurrence with its conclusions.

BACKGROUND

The proposed action is on-site pilot testing of neutralization/supercritical water oxidation of some of the VX agent currently stored at NECD, a 2,860-hectare (7,100-acre) Army installation located in west central Indiana about 3 kilometers (2 miles) to the west of the Wabash River (see Fig. 2 at the end of this BA). The proposed NECDF site is adjacent to the existing bulk agent storage building. Approximately 16 hectares (40 acres) would be disturbed by the construction of the physical plant structure and support facilities (such as the personnel maintenance building), and between 4 and 12 hectares (10 and 30 acres) for utility rights-of-way. The vegetation in these areas is primarily fescue-dominated pasture interspersed with occasional clumps of small brush; however, of the total, about 2.7 hectares (6.6 acres), to the south of the proposed facility in the headwaters of Little Raccoon Creek, would be cleared of deciduous trees for the construction of a lined storm-water detention basin.

Over a period of about 9 months, approximately one-third of the VX stockpile (615 of the 1690 ton containers comprising the stockpile) would be used in the pilot test. The process consists of pumping the VX agent from the existing ton containers into a holding tank and from mere to a reactor vessel where the agent would be neutralized by mixing with a solution of sodium hydroxide in water near the boiling point. After neutralization, the process effluent (also called "hydrolysate") would be passed to the next stage of processing, which involves the supercritical water oxidation (SCWO) and evaporator unit. The resulting SCWO effluent (also called "process distillate" in this BA) would be further treated at the existing Federally Owned Treatment Works (FOTW) before final discharge to the Wabash River. This-final discharge would be accomplished through the existing discharge outfall from NECD and would comply with allowable discharge concentrations for pollutants as specified in the National Pollutant Discharge Elimination System (NPDES) permit. The proposed set of redundant process control systems are intended to ensure that no residual agent VX would be discharged through the existing wastewater treatment facility and into the Wabash River.

EXHIBIT D.10 (continued)

As demonstrated in the EIS, no adverse effects on aquatic life are expected from the proposed action under routine incident-free pilot-testing. Moreover, none of these aquatic organisms are listed as threatened or endangered by the FWS. Therefore, for aquatic organisms, this assessment focuses on the potential for direct impacts to threatened and endangered species from accidents, that is, accidental releases of bulk VX agent.

Two terrestrial species which are listed as threatened or endangered by the FWS, bald eagle and Indiana bat, occur near the proposed NECDF. Therefore, for terrestrial species, potential effects from facility construction and routine incident-free pilot-testing are considered in addition to the effects of accidental release of VX.

Two types of accidents are considered: (1) a release of bulk agent during continued storage (the "no action" alternative) or (2) a release of bulk agent during on-site pilot testing. In both scenarios, an aircraft crash or earthquake that results in a fire could consume all but a small fraction of the agent involved; the surviving agent would be lofted by the heat of the fire to become atmospherically dispersed through the breach in the damaged structure. As discussed in Sect. 4.1.3 of the EIS, such an accident could result in a downwind no-effects plume distance of 60 kilometers (37 miles) during pilot testing. During continued storage (see Sect. 4.2.2 of the EIS), this accident could result in a no-effects distance exceeding 100 kilometers (62 miles). Ecological resources within a zone of 60 kilometers (37 miles) and 100 kilometers (62 miles) downwind from NECD are considered in this assessment for accident scenarios for the proposed action and the no-action alternative, respectively.

As long as storage of the VX agent stockpile continues, there is a small probability of an accidental release and the associated potential for adverse effects on threatened and endangered species. With initiation of test operations, the possibility of an accidental release associated with the pilot tests would be added to this storage-associated threat. Once pilot testing is completed, the magnitude of potential effects from accidents to threatened and endangered species would be reduced by the destruction of about one third of the NECD stockpile. In addition, successful demonstration of the ability of the NECDF to safely dispose of VX agent would contribute in the long run to destruction of the remainder of the NECD stockpile. Consequently, the potential for accidents to adversely affect threatened or endangered species is assumed to be greater for continued storage than for the proposed action to pilot test the neutralization/supercritical water oxidation technology.

ECOLOGICAL DESCRIPTION OF PROTECTED SPECIES AND HABITATS

Terrestrial species

Four federally designated threatened or endangered terrestrial species have been reported within 100 kilometers (62 miles) of the NECD site (Hudak 1997; Nelson 1997; Nelson 1992): Indiana bat (*Myotis sodalis*) endangered, bald eagle (*Hiliaeetus leucocephalus*) threatened, Eastern prairie fringed orchid (*Platanthera leucophaea*) threatened, and Mead's milkweed (*Asclepias meadii*) threatened.

Indiana bat is distributed in the eastern U.S. from Oklahoma, Iowa, and Wisconsin east to Vermont and south to northwestern Florida. The estimated population is less than 400 thousand, 85% of which hibernate in only seven known mine and cave locations in Missouri, Indiana, and Kentucky. In the summer, females form maternity colonies under loose bark of large hardwood trees in both riparian and upland forests throughout the range, though riparian areas appear to be favored. Males apparently roost nearby, though exactly where is not known. Young are born in June: animals depart for hibernation sites in September. Indiana bats forage primarily in closed canopy riparian woodlands and upland forest. They are primarily insectivorous and feed on terrestrial insects in the forest canopy (Brack 1988, in Evans et al. 1998). Cope et al. (1978) and Lowe (1990) reported that Indiana bats preferred to forage in riparian areas that were at least 60.5 meters (200 feet) wide and composed of mature riparian vegetation (in Evans et al. 1998). Foraging ranges appear to be influenced by reproductive stage and were largest in postlactation females (212.7 hectares [526 acres]), and smallest in juvenile males (28.5 hectares [70 acres]) (Garner and Gardner 1992, in Evans et al. 1998).

EXHIBIT D.10 (continued)

Two maternity colonies of Indiana bats have been discovered at NECD: one about 1.5 kilometers (0.9 mile) to the northeast, the other about 3.2 kilometers (2 miles) northwest, of the proposed pilot test facility. These colonies contain from 13 to 21 individuals each (PRC 1997, Whitaker 1998). Individual bats have been captured in foraging habitat in the drainage area of Raccoon Creek, Vermillion Creek, and an unnamed tributary to the Wabash. The closest capture location to the proposed pilot test facility is to the south in the Little Raccoon Creek drainage area at a distance of approximately 0.5 kilometer (0.3 mile) (Whitaker et al. 1998).

Bald eagle is listed as threatened throughout the 48 conterminous States (FR, July 12, 1995; 60 FR 35999). It is a large raptor which feeds primarily on fish but also takes a variety of birds, mammals, and turtles (live and as carrion) when fish are not readily available. The breeding season varies with latitude. The tendency is for winter breeding in the South with a progressive shift toward spring breeding in northern locations. Bald eagle nests are large, sometimes measuring up to 6 feet in diameter, and many nests are used year after year. Bald eagles use stretches of the Wabash River immediately east of NECD, and throughout Park, Fountain, and Warren counties, Indiana as wintering areas (Hudak 1997). Eagles are often sighted moving through these reaches of the Wabash from January through March. A pair was reported building a nest along the river across from NECD in 1992 by the Indiana Department of Natural Resources (Hudak 1992), but the nest has never been used (Hudak 1997). Bald eagle wintering areas also occur along large rivers in Moultrie and Jasper counties, Illinois, about 100 kilometers (62 miles) southwest of NECD (Nelson 1992).

Eastern prairie fringed orchid is a perennial herb which requires full sunlight and usually inhabits tall grass prairies and wetlands (FR, September 28, 1989; 54 FR 39857). The greatest populations of the eastern prairie fringed orchid historically were in Illinois, but at present it is found only at 25 Illinois sites, some of which have only one or two individuals (Keibler 1997). This plant occurs in wet grassland in Iroquois County, Illinois, which is about 70 kilometers (43 miles) north-northwest of NECD.

Mead's milkweed is a perennial that usually occurs as a solitary plant or with a few closely associated individuals. Historically it ranged throughout much of the "tall grass" prairie. It is now restricted to 81 known sites in 23 counties in 4 states (FR, September 1, 1988; 53 FR 33992). Three of the counties are in Illinois; one of these, Ford, is about 70 kilometers (43 miles) northwest of NECD. In Ford County, Mead's milkweed occurs in virgin prairies (Nelson 1992).

Aquatic species

Six federally designated endangered aquatic species have been reported within 100 kilometers (62 miles) of NECD (Hudak 1997; Hudak 1986), all of them freshwater mussels (see Table 1 at the end of this BA): the fanshell (*Cyprogenia szegaria),* clubshell (*Pleurobema clava*), white wartyback (*Plethobasus cicatricosus*) fat pocketbook (*Potamilus capax*), pink mucket (*Lampsilis orbiculata*), and tubercled-blossom (*Epioblasma torulosa torulosa)* pearly mussels. These bivalved molluscs, all members of the family Unionidae, dwell on river bottoms of gravel and/or sand (the fat pocketbook also tolerates mud bottoms) (Cummings and Mayer 1992). Food consists primarily of bacteria, plankton, and detritus filtered from the water through their incurrent siphons (FWS 1992). Wastes are pumped out into the surrounding water through the excurrent siphon.

The reproductive cycle is unique among molluscs, involving shedding of sperm into the open water by males, entry of sperm into the gill pouches (marsupia) of females where fertilization of eggs discharged from the oviducts takes place. Thousands of the resulting larvae, called glochidia, are discharged into the water where some will encyst as parasites in the gills or fins of a host fish to complete their development to the juvenile phase. After metamorphosis into juvenile mussels (a period ranging from about one week to several months depending on the species and other factors), the cysts rupture and the juveniles fall to the bottom. Development into reproductive adults may take from one to four years (FWS 1992). Where plentiful, these animals remove considerable quantities of suspended solids from the water column and serve as an important source of food for a number of other important species including muskrats, otters, raccoons, turtles, and fish (FWS 1992). including the reach nearest the proposed site in Vermillion County (FWS 1998).

EXHIBIT D.10 (continued)

The nearest reported recent occurrences of the fanshell and clubshell pearly mussels (small, apparently non-reproducing populations) are from the Tippecanoe River, a tributary of the Wabash River in Tippecanoe County, Indiana, 85 kilometers (53 miles) or more to the northeast of the site of the proposed facility (FWS 1992). The white warty-back pearly mussel, once a resident of the Wabash River, including Vermillion County in which the site of the proposed action is located, is now described as "most likely extirpated" from Indiana and other mid-western states (Cummings and Mayer 1992), but still persists in the Tennessee River (FWS 1992, 1998). The fat pocketbook pearly mussel is reported to reside in the lower Wabash River, but no closer to the proposed site than 100 kilometers (62 miles) according to county fists of the FWS (1998) for Indiana and Illinois. The nearest pink mucket pearly mussel population is believed to occur in the lower Wabash River no closer than 180 kilometers (110 miles) to the NECD site (FWS 1998). The tubercled-blossom pearly mussel is described by the Illinois Natural History Survey (1992) and the FWS (1992) as extirpated from Indiana and most other mid-western states, but populations are known to have resided in the past along much of the Wabash River's length, including the reach nearest the proposed site in Vermiilion County (FWS 1998).

Three additional species, the orange-footed pimpleback (*Plethobasus cooperianus*), rough pigtoe (*Pleurobema plenum*), and white cats paw pearly mussels (*Epioblasma obliquata perobliqua*), may occur within the State of Indiana, but have not been collected in recent years (Hudak 1986). A total of five endangered mussel species have been collected from the Wabash River in the past, but the most recent surveys have yielded none from the reach nearest the NECD, nor from the smaller streams such as Little Raccoon Creek which drain the NECD property (Miller 1984; Bender and Pearson 1984).

The endangered status of these mussels is attributable primarily to impoundment by dams, dredging and channeiization, siltation and other forms of pollution, and overharvesting (FWS 1992). Critical habitat has not been designated by the FWS for any of these endangered mussels, in part to protect mussel populations from vandalism and harvesting.

POTENTIAL IMPACTS TO LISTED SPECIES

No endangered aquatic species are known to reside anywhere on or near the proposed NECDF site, and effluent discharged during routine operations would likely have no adverse effects on downstream organisms in the Wabash River (see also Sects. 4.1.1.4 and 4.1.2.4 of the EIS). Project construction and routine operations, therefore, are not expected to adversely affect endangered mussels. The following analysis of the impacts of construction and operation of the proposed NECDF thus focuses on the impacts to terrestrial species. The impacts of an accidental release of VX agent during operation of the proposed facility and during continued storage to protected species and habitat are discussed in the subsequent sections of this assessment.

Impacts of construction of the NECDF. As stated earlier, construction of the pilot facility would include disturbance of existing land areas and destruction of existing vegetation. About 2.7 hectares (6.6 acres), to the south of the proposed facility in the headwaters of Little Raccoon Creek, would be cleared of deciduous trees for the construction of a lined storm-water detention basin.

The Indiana bat is the only federally designated threatened or endangered species known to occur within the confines of the NECD installation. The two maternity colonies are probably too distant (1.5 kilometers [0.9 mile]; and 3.2 kilometers [2 miles]) from the site of the proposed facility to be directly affected by impacts of construction which would be localized. Utilities would be routed away from maternity colonies, and foraging habitat. If it is necessary to route utility rights-of-way through bat foraging habitat the area cleared would be minimized. The area to be permanently cleared for the storm-water detention basin in the headwaters of Little Raccoon Creek (2.7 hectares [6.6 acres]), however, is suitable Indiana bat foraging habitat. An individual was recently captured 0.5 kilometers (0.3 mile) from the area to be cleared (Whitaker et al. 1998), and the riparian deciduous habitat in the proposed basin location is an unbroken extension of the foraging habitat where the individual was captured.

EXHIBIT D.10 (continued)

The effects of the loss of this habitat should be minimal. The 2.7-hectare (6.6-acre) loss would be less than 10% of the foraging range of just one juvenile bat, and less than 2% of that for one postlactation female (Garner and Gardner 1992). There is extensive nearby deciduous riparian vegetation comprising suitable foraging habitat further downstream in the Little Raccoon Creek drainage, as well as suitable upland habitat. In addition, forestry programs at NECD are underway which involve periodic replanting of deciduous trees creating areas that will mature into foraging habitat; 16 hectares (40 acres) have recently been planted (Rudduck 1998). Use of existing underutilized habitat and maturing new habitat should offset the effects (if any) to Indiana bats due to the loss of foraging habitat caused by construction of the pilot test facility.

Bald eagles should not be affected by construction of the NECDF. The closest bald eagle nest is across the Wabash River about 4.6 kilometers (2.8 miles) from the site of the proposed facility, and this nest is believed never to have been used (Hudak 1997). This distance should be well beyond that required to avoid noise or other direct interference with eagles if any should be present. Erosion and siltation controls to be employed during construction activities should prevent degradation of nearby streams and mortality to fish on which eagles could potentially feed. Effects on other eagle prey such as small mammals and birds of land clearing and other construction activities, due to the relatively small scale and large acreage of surrounding undisturbed area, are expected to be so small as to be inconsequential.

Populations of Eastern prairie fringed orchid, and Mead's milkweed, are far too distant from the construction zone (70 kilometers [43 miles]) to be impacted.

impacts of operation of the NECDF. For incident-free operations, the only significant potential for impacts to threatened and endangered terrestrial organisms would be via consumption of water from the Wabash River near the existing NECD outfall. In addition to the removal of agent VX during the neutralization process, the resulting hydrolysate would be treated in the SCWO/evaporator unit. The resulting process distillate would be diluted by a factor of 62 when mixed with the wastewater currently being fed to the existing FOTW. After full mixing in the Wabash River, the FOTW effluent would be further diluted by an additional factor of approximately 2,800, for a combined final dilution ratio of approximately 1: 174,000.

Toxicity studies have recently been conducted on the process distillate (as discharged from the SCWO/evaporator unit). These studies indicate that effects, if any, to terrestrial organisms should be negligible (USACHPPM 1998). Rats that were fed pure process distillate failed to show any toxic signs at any dose; there were no observed differences from the control group receiving deionized/sterile water (USACHPPM 1998). Based upon the lack of toxic effects from exposure to undiluted process distillate, and upon consideration of the significant dilution that would occur before any possible exposure, it is not expected that any terrestrial organisms, including Indiana bats or bald eagles, could consume enough of the discharged effluent to cause any toxic effects.

Because of their potential toxicity, two hypothetical constituents (both organophosphates) in the FOTW affluent are worthy of further investigation. These two constituents are any residual agent VX or EA-2192 (a co-product similar in toxicity to VX) which survived both the neutralization and subsequent SCWO processes. None of the possible chemical agent breakdown products are as acutely toxic as the agent VX from which they would be derived (U.S. Army 1988, Appendix B). Movement of any organophosphate constituents, including agent VX and EA-2192, from the FOTW effluent and into the terrestrial food chain is not expected. Based on what is known about the nature of organophosphate contamination of vegetation or agricultural systems, these compounds are not accumulated and would not affect food chains beyond herbivores (U.S. Army 1988, Appendix O). Due to the lower toxicity and generally low concentrations of non-organophosphate constituents in the effluent, concentration in the food chain in levels sufficient to cause problems is unlikely.

EXHIBIT D.10 (continued)

Bald eagles and Indiana bats may use the potentially impacted reach of the Wabash River. Bald eagles have been sighted along the River east of NECD; the foraging *area* of the Indiana bat has *been* documented to occur within about a kilometer of the outfall location (PRC 1997). As discussed above, it is unlikely that organophosphate constituents would survive the neutralization and SCWO/evaporation processes and be discharged into the Wabash River. Even if such constituents were present, the following discussion highlights the rationale for concluding that there would be no impacts. It is doubtful that bald eagles or Indiana bats could consume (i.e., via drinking water from the Wabash River) significant quantities of NECDF-produced organophosphate constituents. Thus, if bald eagles or Indiana bats are present the only manner in which they might be affected would be through any loss of prey such as fish (for eagles) and insects with an aquatic stage (for bats) due to any organophosphate toxicity to the prey animals. Evidence indicates, however, that these constituents would neither bioaccumulate nor persist in such potential prey (see above). The significance of the impacts would be determined by the extent to which prey animals would be reduced in numbers, if at all, over the g-month operating span of the neutralization pilot test.

Populations of Eastern prairie fringed orchid, and Mead's milkweed, are far too distant from the location of the pilot test facility (70 kilometers [43 miles]) to be impacted by routine operations.

Impacts of accidental release from the proposed NECDF

Terrestrial species. Wildlife downwind of an accidental release within the 60-kilometer (37-mile) no-effects distance associated with potential accidents during pilot test operations-as discussed in Sect. 4.1.4.3 of the EIS-could die from direct inhalation or contact with aerosolized and/or volatilized VX. Due to the relatively low sensitivity (i.e., high tolerance) of plants to VX, it is expected that impacts of deposition on the growth of vegetation beyond the pilot test facility site would generally not be significant.

Both Indiana bat colonies are within 3.2 kilometers (2 miles) of the proposed pilot test facility and are therefore well within the no-effects distance. Some or all individuals could be killed from inhalation or contact with aerosolized and volatilized VX if downwind from an accidental release. Similarly, if bald eagles were present along the Wabash adjacent to NECD during an accidental release of VX, they could be adversely affected or killed if the plume moved to this area. Any eagles present along the Wabash further from NECD in Parke, Fountain, and Warren counties would be within the no-effects distance, and could also be affected if the plume spread to these areas. The eagle wintering areas in Moultrie and Jasper Counties, Illinois, are well beyond the no-effects distance and impacts to individuals are less likely. The locations of both of the threatened plant species are well beyond the no-effects distance. Because of the great distance, and the low sensitivity of plants to VX, it is extremely unlikely that individuals of either Mead's milkweed or eastern prairie fringed orchid would be affected.

Aquatic species. Under the proposed pilot testing of neutralization/supercritical water oxidation of VX agent at NECD, the "worst case" accident scenario involves failure of the two holding tanks containing the drained agent awaiting neutralization. Because containment structures and sumps within the proposed facilities are expected to adequately contain the entire contents of the holding tanks, direct contamination of surface waters and consequent harm to aquatic life by overland flow are highly unlikely. Similarly, a spill of untreated hydrolysate or other liquids involved in the process within the on-site processing area should be adequately contained by the curbs, dikes, berms, and sumps planned for the project, and would therefore be unlikely to enter area surface waters and adversely affect aquatic life.

However, if the VX holding tanks were damaged by direct impact of an aircraft and a subsequent fire, an atmospheric plume containing as much as 36 kg (80 lb) of potentially lethal aerosolized agent and combustion products could be blown many kilometers downwind. Such a plume could drift over the Wabash River as well as many smaller streams, lakes, and ponds, depending on wind velocity and direction (prevailing winds are from the south). Any endangered mussels residing within water bodies encompassed by the plume could be exposed to VX agent following deposition of the agent directly onto surface waters and by entry of runoff from contaminated land. The following analysis of potential impacts of the plume of VX agent generated by the postulated accident under conditions prevailing during the proposed action is based on several additional assumptions:

EXHIBIT D.10 (continued)

- The affected areas under the VX plume and the cumulative percent VX depletion (deposition) from the plume at (I) the 1% human lethality downwind contour, (2) the "no human deaths" contour, and (3) the "no human effects" contour, are as estimated by the D2PC atmospheric dispersion model (see Sect. 4. I .3 and Appendix E of the EIS for a discussion of the application of this model).

- Plume passage over a given point lasts between 30 and 60 minutes. Table 2 presents the post-accident mean area1 deposition of VX in mg/m^2 for two wind speeds (1 and 3 meters per second) at varying distances from the accident source.

- Mean area1 deposition of VX on flowing streams in the path of the plume is equivalent to deposition on land (this is a conservative assumption for receiving streams as opposed to still waters such as ponds and lakes because, barring unusual meteorological conditions, an aliquot of flowing water within a stream crossed by the plume would probably be subject to VX deposition for a shorter time than land).

- The receiving water body is a stream either 10 centimeters deep or 1 meter deep.

- Deposited VX is rapidly and completely mixed in the receiving water body (generally, in still waters mixing would be much slower than in streams). Table 3 shows calculated VX concentrations in surface waters at various distances from the NECD site of release.

- The nearest populations of endangered mussels are in the Tippecanoe River at least 85 kilometers from the postulated release from the NECDF.

There are few data available concerning the aquatic toxicity of VX, and none for toxicity to freshwater mussels. Therefore, for the purpose of this analysis, it is necessary to assume the limited toxicity information available for fish is also applicable to mussels. Using limited data on VX toxicity to striped bass (Weimer et al. 1970), a mathematical expression for estimating the median lethal exposure times (LT50s) for a given concentration of agent was developed for the U.S. Army's (1988) Final Programmatic Environmental Impact Statement for the Chemical Stockpile Disposal Program. This analysis used that expression to calculate the LT50s for fish at various concentrations estimated for different combinations of distance from the release point and receiving water depth

$$\log(LT50) = a - b \log(C)$$

where LT50 = median lethal exposure time; C = VX concentration in ppm (mg/L) in water; and a and b are constants (a = 1.52; b = 0.63).

Moreover, for the purpose of comparing exposure concentrations to a generally recognized benchmark of acute toxicity, the 96-hr LC50 (concentration lethal to 50 % of the test organisms after 96 hrs exposure), a LT50 value of 96-hrs exposure time was used in the above expression to back-calculate to a 96-hr LC 50 of 0.28 μg/L. It is important to note the uncertainty surrounding these values accruing from the fact that not only is the above expression derived from very limited data, but the lowest concentration tested (20 μg/L) was considerably higher than me extrapolated 96-hr LC50 of 0.28 μg/L.

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EXHIBIT D.10 (continued)

Table 3 shows the results of this comparative analysis. The fish LT.50 of 19 minutes (compared to a plume passage time of at least 30 minutes) for a lo-centimeter deep body of water less than 2 kilometers from the site of the release suggest that shallow ponds and *creeks* such as Little Raccoon Creek and Little Vet-million Creek lying in the path of the plume could sustain VX concentrations high enough to kill many if not most of the organisms residing there. However, the nearest known populations of endangered mussels are at least 8.5 kilometers away in the Tippecanoe River. Although predicted deposition values under the D2PC dispersion model extend no further than about 60 kilometers from the source, it is safe to say that fish LT50s will exceed 17 days for a l-meter deep stream (4 days for a lo-centimeter stream) should the plume pass over the Tippecanoe River. Because this length of time is far greater than the one hour or so that mussels in the Tippecanoe River would likely be exposed to the contaminated water under a passing plume, it appears unlikely that exposed mussels would incur serious injury or death (again, assuming equivalent toxicity to mussels). Despite their greater distance from the source of the hypothetical release, however, the fat pocketbook and pink mucket pearly mussels *in* the lower Wabash River may experience somewhat higher concentrations of VX should a *north* wind blow the plume along the length of the river, particularly at more or less the same speed as the river current, thereby allowing a greater deposition of VX or its combustion products, if any, per unit area under the plume. The available information is insufficient to estimate what these exposures might be quantitatively, but the brevity of exposure would tend to reduce the possibility of injury to exposed mussels under these unusual conditions.

Based on the above analysis, although other aquatic species residing in closed, lentic waters such as ponds and lakes may be harmed by deposition and subsequent persistence of VX, the federally listed endangered mussels residing in flowing streams would probably not be seriously harmed should the VX plume pass their way. It should be noted, however, that the limited toxicity data currently available is for fish, not freshwater invertebrates. It is possible that freshwater mussels are more sensitive to VX than fish due, for example, to inherent physiological *or* behavioral differences (e.g., mussels are filter feeders residing permanently on the bottom of rivers).

Impacts of accidental VX release during continued storage

Terrestrial species. Because of the differences in the much greater amount of agent that would be released, impacts from continued storage (the no-action alternative) accidents would exceed those associated with on-site pilot test neutralization. The downwind no-deaths distance associated with the largest accidental release of VX under worst-case meteorological conditions at NECD is greater than 100 kilometers (62 miles) for continued storage (see Sect. 4.2.2.3 of the EIS). The 100-kilometer (62-mile) zone considered for protection of ecological resources includes 38 counties *or* parts of counties in Indiana and Illinois. Any of the threatened or endangered species in this zone and downwind of an accidental release of VX could be seriously affected. Because of the uncertainty associated with the D2PC meteorological model beyond 100 kilometers (62 miles), the no-deaths and no-effects distances for continued storage are not considered beyond this distance even though impacts within the plume area would occur.

The conclusions of the accident impact analysis discussed for operation of the proposed pilot plant above, are therefore qualitatively correct, but understated with respect to accidents for continued storage. Indiana ɔats and bald eagles downwind of a release of VX throughout the 100-kilometer (62-mile) zone could be negatively impacted or killed. The bald eagle wintering areas in Moultrie and Jasper counties, Illinois, are within :his zone. If winds from the northeast spread plumes to these areas when eagles were present they could be affected. The possibility of significant damage to vegetation is greater than for the pilot plant accident, but is still mlikely.

Aquatic species. Under continued storage, the "worst case" accident scenario would release about 34,000 kg (75,000 lbs) of VX into the atmosphere. This is approximately 940 times the release assumed under :he proposed action to pilot test neutralization/supercritical water oxidation of VX and its hydrolysis products. Uncertainties in the D2PC dispersion model do not allow confidence in extrapolation beyond 100 kilometers (62 miles). It is nevertheless evident that the nearly 1000-fold increase in the quantity of VX released and ıltimately deposited on the land and water from the maximum credible accident associated with continued storage vould be far more likely to adversely affect endangered mussels beyond 100 kilometers (62 mile) from the site of he accident than would an accident associated with the proposed action.

EXHIBIT D.10 (continued)

CONCLUSIONS

Effects to bald eagles or Indiana bats from facility construction are considered unlikely. Bald eagles, if present, are too distant to be directly affected by construction activities. Effects, if any, of loss of potential Indiana bat foraging habitat should be minimal due to me small acreage that would be removed, as well as the availability of other existing habitat and maturing new foraging habitat. Similarly, no effects on these species from routine facility operations are expected due to low toxicity and to low potential for bioaccumulation of effluent constituents.

Threatened plant species are too distant from NECD to be affected by construction or routine operations. If an accident involving an atmospheric release were to occur, however, whether during continued storage (the no-action alternative) or during operation of the proposed pilot plant (the proposed action), threatened or endangered terrestrial species could be adversely affected. The extent of potential effects would depend, in part, on the meteorological conditions at the time of the accident and the amount of agent released.

In part because of their considerable distance from the proposed NECDF, endangered mussels are unlikely to be adversely affected by either construction, routine operations, or accidental releases of VX agent under the proposed action. Under the continued storage (no-action) alternative, however, the "worst case" accident involves a potentially greater quantity of agent VX released into the atmosphere than the "worst case" accident associated with pilot test operations. Thus, a greater probability exists that endangered mussels could be harmed by continued storage accidents.

As long as storage of the VX agent stockpile continues, there is a small probability of an accidental release and the associated potential for adverse effects on threatened and endangered species. With initiation of test operations, the possibility of an accidental release associated with the pilot tests would be added to this storage-associated threat. Once pilot testing is completed, the magnitude of potential effects from accidents to threatened and endangered species would be reduced by the destruction of about one third of the NECD stockpile. In addition, successful demonstration of the ability of the NECDF to safely dispose of VX agent would contribute in the long run to destruction of the remainder of the NECD stockpile. Consequently, the potential for accidents to adversely affect threatened or endangered species is assumed to be greater for continued storage than for the proposed action to pilot test the neutralization/supercritical water oxidation technology.

REFERENCES

Bender, E.S., and J.G. Pearson. 1975. *Results from Aquatic Ecological Surveys at Newport Army Ammunition Plant, Newport, Indiana.* Edgewood Arsenal Technical Report EB-TR-75044. Dept. Army, Headquarters, Edgewood Arsenal, Aberdeen Proving Ground, MD.

Brack, V., Jr. 1988. The Indiana bat. Pages 602-624 *In* W.C. Chandler (ed.) *Audubon wildlife report, 1988/1989.* The National Audubon Society, NY.

Cope, J.B., A.R. Richter, and D.A. Searley. 1978. *A survey of the bats in the Big Blue Lake Project area in Indiana.* Final Rep., U.S. Army Eng. District, Louisville.

Cummings, K. S. and C. A. Mayer. 1992. *Field Guide to Freshwater Mussels of the Midwest.* Illinois Natural History Survey Manual 5. Champaign, Illinois.

Evans, D.E., W.A. Mitchell, and R.A. Fischer. 1998. *Species Profile: (Indiana Bat (Myotis sodalis) on Military Installations in the Southeastern United States.* Headquarters, U.S. Army Corps of Engineers.

Garner, J.D., and J.E. Gardner. 1992. *Determination and summer distribution and habitat utilization of the Indiana bat (Myotis sodalis) in Illinois.* Illinois Department of Conservation. Final Project Report No. E-3. Springfield, IL.

EXHIBIT D.10 (continued)

Hudak, D.C. 1997. Letter from David Hudak, U.S. Fish and Wildlife Service, Bloomington, IN, to Harry Quarles, Oak Ridge National Laboratory, Oak Ridge, TN, October 28, 1997.

Hudak, D.C. 1992. Letter from David Hudak, U.S. Fish and Wildlife Service, Bloomington, IN, to Monica Satrape, Oak Ridge National Laboratory, Oak Ridge, TN, March 30, 1992.

Hudak, D.C. 1986. Letter from David Hudak, U.S. Fish and Wildlife Service, Bloomington, IN, to L.L. Sigal, Oak Ridge National Laboratory, Oak Ridge, TN, July 11, 1986.

Keibler, J. 1997. Giving orchids a helping hand. *Endangered Species Bulletin,* Volume XXII No. 6, November/December 1997.

Lowe, D.W. 1990. The Indiana bat, *Myotis sodalis.* Pages 506-508 *In* J.R. Matthews and C.J. Moseley (eds.). *The official world wildlife guide to endangered species of North America.* Beachum Publishing, Inc., Washington, DC.

Miller, A.C. *1984. A Mollusc Evaluation at the Newport Army Ammunition Plant, Newport, Indiana. NOV, 29,* 1984 Report, U.S. Army Waterways Experiment Station, Corps of Engineers, Vicksburg, MS.

Nelson 1992. Letter from Richard Nelson, U.S. Fish and Wildlife Service, Rock Island, IL, toV.R. Tolbert, Oak Ridge National Laboratory, Oak Ridge, TN, September 24, 1992.

Nelson 1997. Letter from Richard Nelson, U.S. Fish and Wildlife Service, Rock Island, IL, to Harry Quarles, Oak Ridge National Laboratory, Oak Ridge, TN, September 2, 1997.

PRC Environmental Management, Inc. (PRC) 1997. *Biological Survey of Federal Endangered Bats at Newport Chemical Depot,* Army Material Command Contract No. DAAA08-94-D-007, Delivery Order 0022.

Rudduck, K. 1998. Assistant Environmental Engineer for NECD, personal communication to H. Quarles, ORNL, August 25, 1998.

U.S. Army. *1988. Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement.* Aberdeen Proving Ground, MD.

USACHPPM 1998. Interim Rat Oral LD, of Process Distillate, Slide prepared by the U.S. Army Center for Health Promotion and Preventive Medicine, Aberdeen Proving Ground, Md.

U.S. Fish and Wildlife Service (FWS). *1992. Endangered and Threatened Species of the Southeastern United States* (The Red Book) FWS Region 4. Atlanta, Georgia.

U.S. Fish and Wildlife Service *(FWS). 1998. County List of Federal Threatened, Endangered and Proposed Species - Indiana* (February 1998). Accessed Sept. 18, 1998. http://www.fws.gov/r3pao/eco_serv/endangrd/lists/indiana.html.

Weimer, J.T., et al. *1970. Toxicity of VX and GD in Aquatic Animals Indigenous to the Carroll Island Test Area Water,* Edgewood Arsenal Technical Report 4441. U.S. Department of the Army, Edgewood Arsenal, MD.

Whitaker, J.O., J. Veilleux, and E. Vincent. 1998. *Progress Report Status of Myotis sodalis and other bat species at Newport Chemical Depot.* Report issued to Philip Cox, 28 July 1998.

EXHIBIT D.10 (continued)

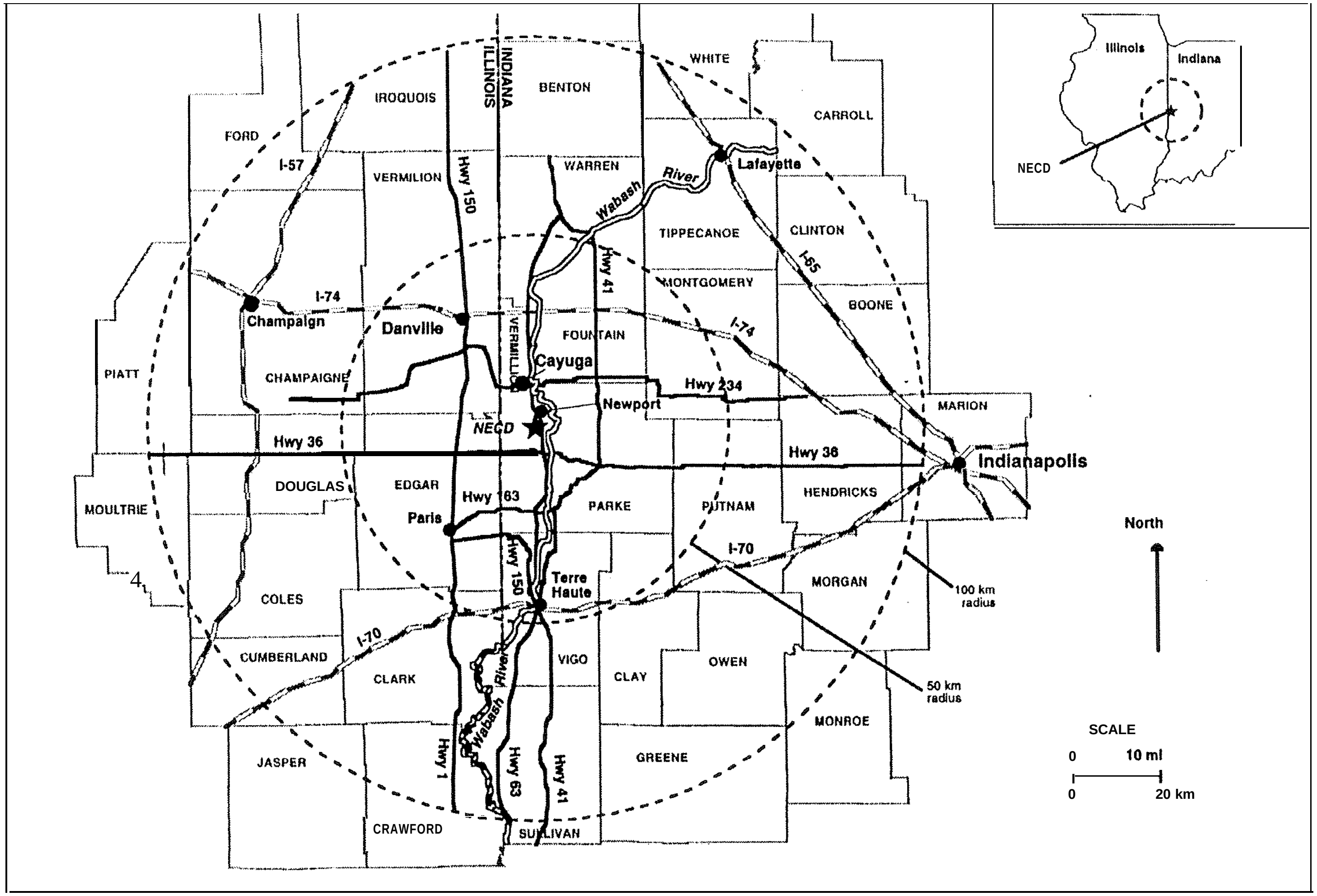

Fig. 1. Regional map of the Newport Chemical Depot area.

ORNL DWG 97C-315

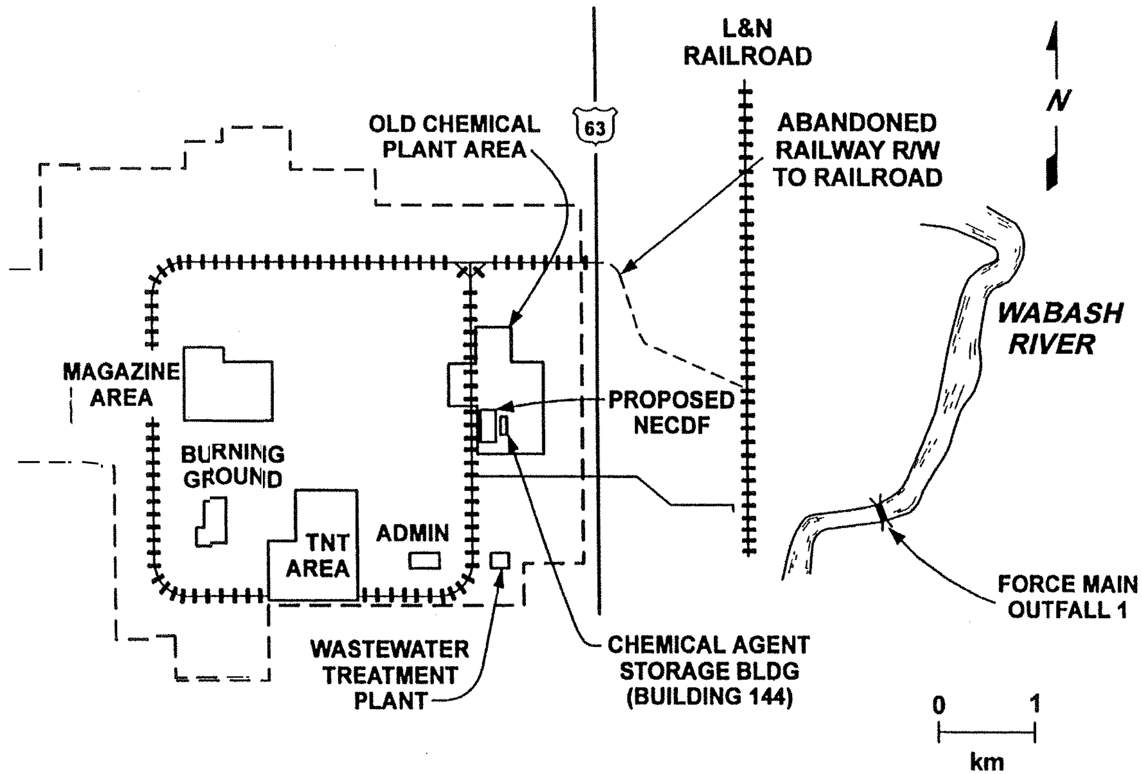

Fig. 2. Location of the proposed NECDF in relation to existing facilities at and around the Newport Chemical depot, Indiana

Table 3. Predicted post-accident deposition and post-dilution concentrations of VX in receiving waters compared to aquatic toxicological benchmarks after accidental release of 36.4 kg (80 Ibs) of VX into the atmosphere.

Distance (km)	Mean Areal Deposition (mg/m^2)	Concentration 10-cm deep* pool or stream (∝g/L)	Concentration 1-m deep” pool or stream (∝g/L)	Fish LT50[b] 10-cm deep* pool or stream	Fish LT50[b] l-m deep” pool or stream	Haz Quotient’ (10-cm deep) Conc / LC50 (0.28 ∝g/L)	Haz Quotient’ (l-m deep) Conc/LC50 (0.28 ∝g/L)
CASE 1: Mean Wind Speed = 1 m/s							
1.6 [d]	210	2100	210	19 min	1.5 hr	7600	760
2.1 [e]	5.4	54	5.4	3.5 hr	15 hr	190	19
7.6 [f]	1.4	14	1.4	8 hr	35 hr	50	5.0
CASE 2: Mean Wind Speed = 3 m/s							
6.3 [d]	3.6	36	3.6	4.5 hr	19 hr	130	13
8.5 [e]	0.32	3.2	0.32	21 hr	3.7 d	11	1.1
57 [f]	0.028	0.28	0.028	4 d	17 d	1.0	0.10

Rapid and complete dilution of deposited VX in (a) 10-cm deep pool or stream, and (b) l-m deep pool or stream, is assumed.

[b]LT50 = median lethal time = time required to kill half the fish exposed to a given concentration of agent. LT50 values are calculated from mathematical expression relating concentration and median lethal time for striped bass provided in Appdx 0 in U.S. Army 1988.

[c]Hazard quotient = ratio of the post-dilution concentration of VX in the receiving water body to the calculated 96-hr LC50 for striped bass using the mathematical expression relating concentration and median lethal time for striped bass provided in Appdx 0 in U.S. Army 1988.

[d]Distance from site of accident (proposed facility) to plume contour for 1% human lethality.

Distance from site of accident to plume contour at which no human lethality occurs. [f]

EXHIBIT D.10 (continued)

Table 1. List of federal threatened, endangered, proposed threatened, and proposed endangered species identified by the U.S. Fish and Wildlife Service as occurring within 100 km (62 miles) of Newport Chemical Depot.

	Status[a]
Mammals	
Indian bat (*Myotis sodalis*)	E
Birds	
Bald eagle (*Hiliaeetus leucocephalus*)	*T*
Mussels	
Fanshell mussel *(Cyprogenia stegaria)*	E
Clubshell mussel *(Pleurobema clava)*	E
white wartyback mussel *(Plethobasus cicatricosus)*[b]	E
Orange-footed pimpleback mussel *(Plethobasus cooperianus)*[c]	E
rough pigtoe mussel *(Pleurobema plenum)*[c]	E
Fat pocketbook pearly mussel *(Potamilus capax)*[b]	E
Pink mucket pearly mussel *(Lampsilis orbiculata)*[b]	E
Tuberculed-blossom pearly mussel *Epioblasma torulosa torulosa)*[b]	E
White cats paw pearly mussel *(Epioblasma obliquata perobliqua)*[c]	E
Plants	
Eastern prairie fringed orchid *(Platanthera leucophaea)*	T
Mead's milkweed *(Asclepias meadii)*	T

[a]T = Threatened, E = Endangered.

[b]Presence based on personal communication, letters from D.C. Hudak, U.S. Fish and Wildlife Service, Bloomington, Ind., to L.L Sigla, Oak ridge National Laboratory, Oak Ridge, Tenn., June 17, 1986, and R. C. Nelson, U.s. fish and Wildlife Service, Rock Island, Ill., to L. L. Sigal, Oak Ridge National Laboratory, Oak Ridge, Tenn., June 17, 1986.

[c]No recent collections of this species.

EXHIBIT D.10 (continued)

Table 2. Predicted post-accident deposition of VX on land aud water surfaces after accidental release of 36.4 kg (80 lbs) of VX into the atmosphere (Based on application of the D2PC dispersion model discussed in Sect. 4.1.3 of the FEIS).

Distance (km)	Plume Area[d] (km^2)	Cumulative Percent VX Deposition [e]	AVX Deposition' (kg)	Mean Areal Deposition (mg/m^2)
CASE 1: **Mean Wind Speed = 1 m/s**				
1.6 [a]	0.087	50	18	210
2.1 [b]	0.15	51	0.36	5.4
7.6 [c]	2.0	58	2.6	1.4
CASE 2: **Mean Wiid Speed = 3 m/s**				
6.3 [a]	2.8	28	10	3.6
8.5 [b]	5.1	30	0.73	0.32
57 [c]	230	47	6.2	0.028

[a] Distance from site of accident (proposed facility) to plume contour for 1% human lethality.
[b] Distance from site of accident to plume contour at which no human lethality occurs.
[c] Distance from site of accident to plume contour at which no human health effects occur.
[d] Cumulative plume area from source to selected distance from source.
[e] Cumulative fraction of total released VX that deposits on surfaces within given plume distance contour.
[f] Total VX deposited within successive distance contours. In Case 1, for example, 0.36 kg is deposited from the plume between 1.6 and 2.1 km from the source of the release.

APPENDIX E

APPROACH TO THE ASSESSMENT OF IMPACTS FROM POTENTIAL ACCIDENTS

This appendix contains information about the release of agent VX in the event of an accident either during continued storage of VX-filled ton containers at the Newport Chemical Depot (NECD) or during the proposed chemical neutralization of agent VX. The approach to the assessment of impacts from such accidents is described in this appendix. Infornation regarding the quantity of released material (i.e., the "source term") is also presented in this appendix and has been incorporated directly into the assessment of impacts in Chapter 4 of this Environmental Impact Statement (EIS).

To assess the environmental impacts of accidents and the accidental release of chemical agent, it is necessary to identify the hypothetical accident scenarios that could occur. The evaluation of the consequences of such a hypothetical accident begins with identification of the quantities of chemical agent that could be potentially released. It also requires an understanding of the method by which the material is released into the environment: it can be spilled, vaporized by an explosion, lofted by a fire, or released by some combination of these modes. Furthermore, the accident analysis requires information on the duration of release. The ways in which the chemical agent is dispersed after a release are called environmental pathways. Once the extent of the accident and the environmental pathways are defmed, the magnitude of potential impacts to humans or to the environment can be identified, quantified, and/or evaluated.

This appendix first describes the hypothetical accident scenarios and then discusses the applicable environmental pathways. A discussion of accidents specific to NECD then follows. This appendix closes with an assessment of the potential impacts of such accidents upon human health. The assessment of other impacts-particularly to ecological resources-is contained in Chapter 4 of this EIS.

E. 1 ACCIDENT SCENARIOS

A hazard is generally defined as a source of danger, death, or injury for humans, animals, or the environment. In the context of the proposed pilot test operations and continued storage at NECD, a hazard initiates a sequence of events (also called a "scenario") leading to an accidental release of a toxic substance, including chemical agent VX. The analysis of hazards and accident scenarios in this EIS is solely intended to provide estimates of the extent of the zone of potential impact from accidents at NECD. As such, the accident analysis presented in this appendix should not be considered to be a detailed safety assessment.

The hazards analysis for the proposed action concentrated on several activities associated with pilot test operations. Accident initiators included human error and equipment failures, as well as external events (e.g., seismic events, tornadoes and high winds, lightning, and air crashes).

The impact analyses are based on the accidents that are specific to the implementation of each alternative under consideration in this EIS. In all cases, the impact analyses are based on “credible accidents. " A credible accident is defined as an accident with a probability of 1 in 100 million, or greater. The choice of 1 in 100 million reflects the fact that our society is generally willing to spend resources on mitigating harmful events that have probabilities of 1 in 100,000 to 1 in 1 million. The value 1 in 100 million reflects two orders of uncertainty to achieve a conservative position with respect to those accidents of concern.

E. 1.1 Continued Storage

As part of the assessment of impacts in the Final Programmatic Environmental Impact Statement (FPEIS) for the Chemical Stockpile Disposal Program (CSDP), an analysis was performed to identify the hazards associated with accidents that might occur during the continued storage of agent VX at NECD (GA Technologies, Inc. 1987; U.S. Army 1988, Vol. 3, Appendix J).

Potential accidents during continued storage are related to two factors: (1) handling associated with routine maintenance, and (2) external events that occur while the ton containers are stored. Handling accidents include dropping of ton containers and forklift collisions resulting in puncture or fire. External events include tornadoes and impact of associated wind-borne debris; earthquakes; lightning; and large or small aircraft crashes into the storage warehouse.

The accidental release of agent VX is the only significant hazard associated with continued storage. The greatest concern for impacts following a storage accident would be the airborne hazard created by agent VX. In addition, spilled liquid agent could also impact surface areas and/or surface water and groundwater resources.

E. 1.2 Chemical Neutralization

In 1996, an analysis was conducted on the risks of the neutralization technology proposed for the agent VX at NECD (MITRETEK 1996). The analyses in this EIS are based on the NECD pilot test facility conceptual design. As the Army’s program progresses, changes in design may occur that differ from the design described in this EIS. Before implementation, all proposed design changes will be screened to ensure they do not result in increased risk to the public or the environment.

MITRETEK's risk analysis for the proposed action concentrated on several activities associated with pilot test operations. Accident initiators included the usual processing plant equipment failures, as well as external events and human error.

In regard to the likelihood of accidents-during the pilot testing, MITRETEK concludes that the inherent risks of the neutralization technology are not severe. External events, such as aircrash or earth uakes, were judged to be highly unlikely initiators of accidents at NECD. No more than 1.9 m^4 (500 gal) of agent VX would be released in any of the accident scenarios evaluated by MITRETEK for neutralization operations.

The greatest concern for impacts following a release of chemical agent would be the airborne hazard. In addition, spilled liquid agent could also impact surface areas and/or surface water and groundwater resources.

E.2 ENVIRONMENTAL PATHWAYS

Chemical agent can be dispersed after an accidental release through various environmental pathways. The basic pathways include movement of small droplets in the air; movement of vapor in the air; deposition or scavenging of the airborne material onto underlying land, vegetation, or water; movement into bodies of water through spill runoff or atmospheric deposition; and movement into groundwater. Once chemical agent is released into the environment, it may affect human health, ecological systems, water use, and/or socioeconomic resources. The dispersion processes determine the form and level of the contaminant in the environment and, in turn, the response of various ecological systems to the contaminant.

E.2.1 Atmospheric Dispersion Analysis

Potential accidental releases were analyzed using an air dispersion model developed by the U.S. Army's Chemical Research Development and Engineering Center. This model, a computer code named D2PC (Whitacre et al. 1986), incorporates detailed information on the type of accident, type of agent, type of release (e.g., explosion, fire, or spill), and duration of release. It incorporates atmospheric assumptions that have been extensively documented and are currently in use in a variety of other atmospheric dispersion models. A vapor depletion technique is also included in D2PC to estimate the removal of agent vapor from the atmosphere by deposition or scavenging by surfaces. The D2PC code predicts the inhalation dose of agent expected at locations downwind of the release. (Dosage is defined as the mathematical product of airborne agent concentration and the duration of exposure.) D2PC was used in this study to estimate airborne concentrations of chemical agent that could result in human fatality rates of 0 % , 1% , and 50 % . The dosage corresponding with the 0 % rate — also known as the "no-deaths* dose — is the largest dosage that would result in no fatalities to healthy adult males.

The D2PC model provides conservative estimates of (i.e., it overestimates) the region impacted by atmospheric dispersion of chemical agent because (1) no credit was taken for the potential confinement of the atmospheric plume by terrain effects, and (2) worst-case meteorological conditions were assumed to last continuously over the entire period [up to 28 hr to reach 100 km (62 miles)]. Modeling results are subject to several qualifications, as documented in Sect. E.3.2 below (e.g., estimates of downwind no-death distances are accurate to within ±50%).

Atmospheric dispersion, as well as the extent of impacts, could vary considerably according to meteorological conditions during an accidental release. Worst-case (WC) meteorological conditions are credible conditions that result in near-maximum downwind doses. The WC conditions presume a stable atmosphere [stability Class E (Pasquill 1961)] with a wind speed of 1 m/s (2.2 mph). Conservative most-likely (CML) conditions are frequently occurring meteorological conditions that provide greater dispersion (i.e., dilution) of agent but still result in relatively large downwind doses of agent. CML conditions presume a neutral stability (Class D) with a wind speed of 3 m/s (6.7 mph). A given quantity of chemical agent accidentally released under WC conditions would result in a greater downwind distance for the no-deaths concentration and a greater number of potential fatalities than the same release under CML conditions.

The downwind distances used in the analysis are for locations along the center of the plume or cloud of agent as it travels downwind. Doses of agent are greater along this centerline than to either side and are predicted by the D2PC code to decrease from the centerline according to a Gaussian distribution. Contours can be drawn graphically to depict a given dosage; these contours form an ellipse (see Fig. E.l). The shape of the ellipse is dependent on the meteorological conditions.

To simplify the analysis of the many different possible accidental releases, the impacts of releases were examined by grouping the quantity of accidentally released agent into categories, as shown in Table E. 1. It should be noted that in Table E. 1, each accident category has a unique downwind no-deaths distance associated with both the CML and WC meteorological conditions. Grouping by categories does not significantly degrade the results because large inaccuracies already exist in any atmospheric dispersion model (EPRI 1985), including D2PC. For the region around the location of the proposed pilot facilities at NECD, Fig. E.2 shows the boundaries associated with each accident category.

E.2.2 Deposition Analysis

Surface deposition or scavenging of chemical agent from atmospheric releases is of interest in terms of contamination of ecological resources, surface water, and physical aspects of the socioeconomic environment. To estimate deposition or scavenging within accident categories, the amount of material deposited was estimated by multiplying the airborne concentration by a deposition velocity. For agent VX accidents, the agent was assumed to be uniformly deposited over the area based on the concentration and the time of cloud passage. Because deposition calculations are quite imprecise (see U.S. Army 1988, Vol. 3, Appendix K), the estimated values can only be assumed to be accurate to within one order of magnitude.

E.2.3 Spills

A spill of chemical agent is me release mode by which the largest impacts might be produced in surface waters or groundwater. Surface waters could be contaminated in four ways: (1) a spill might cause contaminants to directly enter surface water-for example, a spill could migrate into a drainage ditch or small tributary of a waterbody; (2) agent might be deposited from an airborne plume or cloud onto surface water; (3) if a heavy rain occurred shortly after an accident, agent could be washed-into surface waters in runoff from land that had been contaminated by the spill or by deposition or scavenging; and (4) contaminated groundwater might discharge to surface waters and carry agent back to the surface.

Chemical agent could reach groundwater if agent on contaminated land were carried by water infiltration into the soil and percolated downward. In addition, agent could reach groundwater from contamination of surface water because some groundwater is recharged by surface waters.

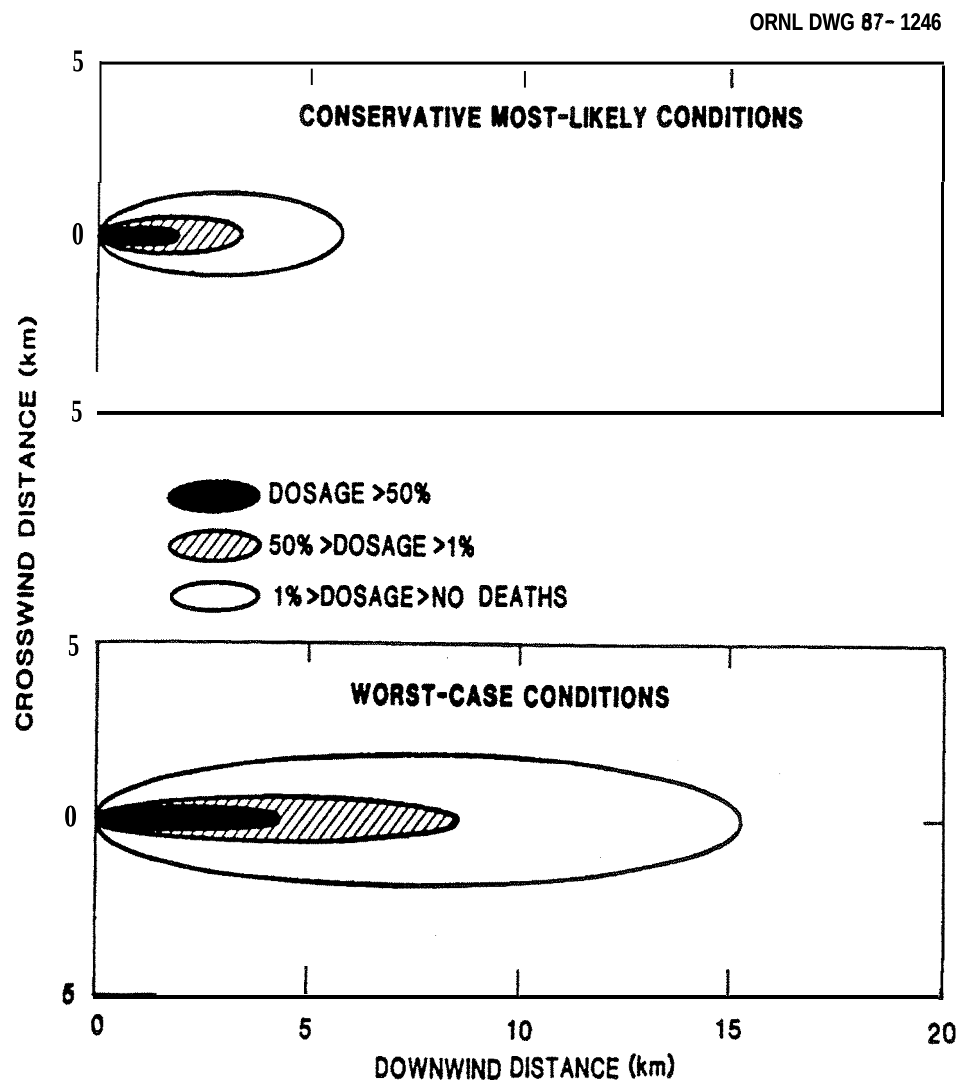

Fig. E.l. A hypothetical scenario illustrating relationships between plume distances and shapes for accidents releasing the same quantity of chemical agent under different meteorological conditions.

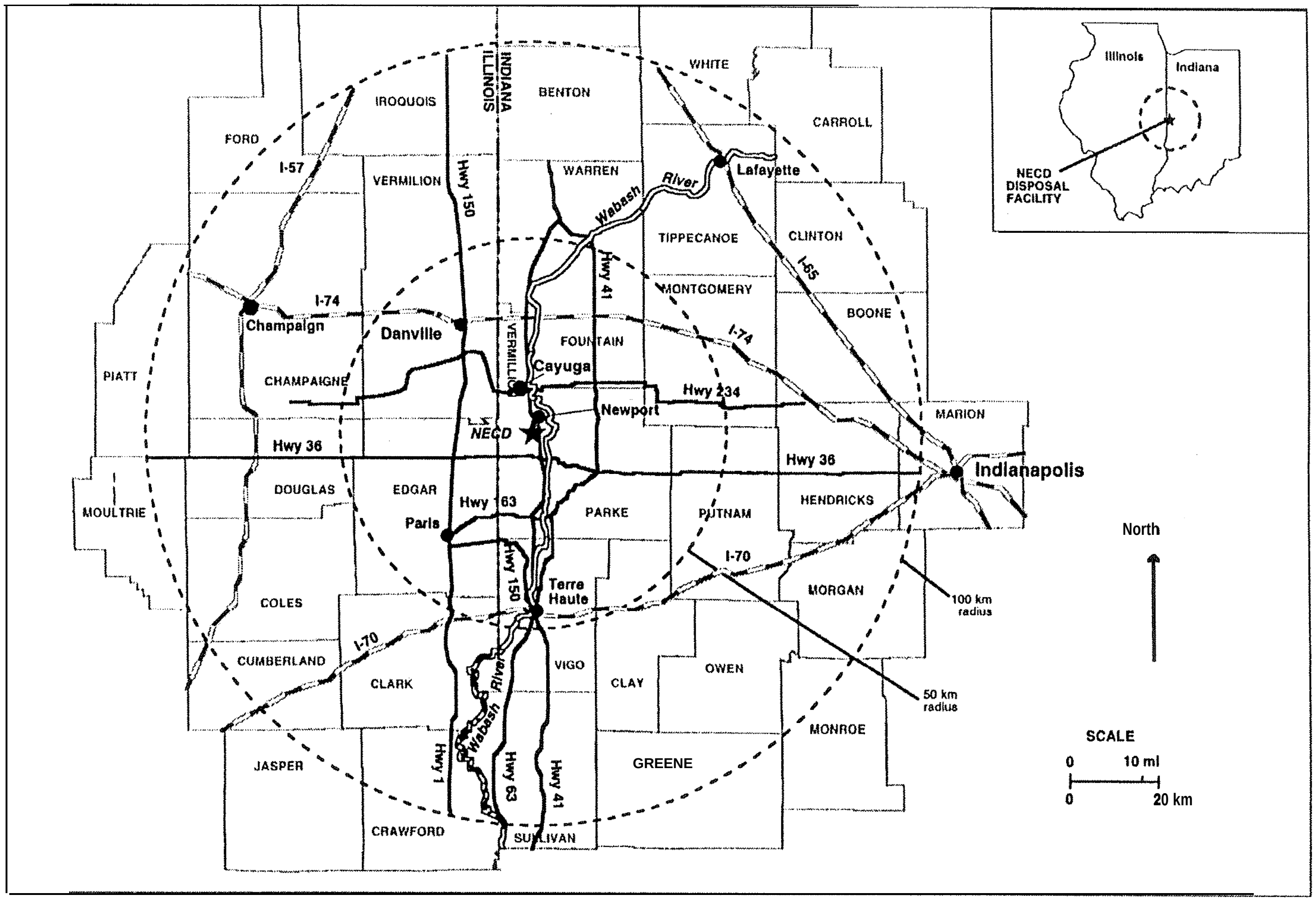

Fig. E.2. Zones of potential impact, as determined from accident categories, around the Newport Chemical Depot. The concentric rings indicate the distance from the site of the proposed chemical neutralization pilot facility.

Table E.l. Accident cateogires used to characterize hypothetical chemical agent releases at the Newport Chemical Depot

Accident category	Under Conservative-Most-Likely weather conditions[a] Lethal downwind distance	Associated plume area[c] (km^2)	Under Worst Case weather conditions[b] Lethal downwind distance	Associated plume area[c] (km^2)
Category 0	< 500m	0.02	< 2 km	0.14
Category I	500 m to 1 km	0.07	2 to 5 km	0.85
Category II	1 to 2 km	0.28	5 to 10 km	3.4
Category III	2 to 5 km	1.8	10 to 20 km	14
Category IV	5 to 10 km	7.0	20to 5okm	85
Category V	10 to 20 km	28	50 to 100 km	340
Category VI	20 to 50 km	176	> 100 km	> 340

[a] "Conservative-Most-Likely" conditions are representative of commonly occurring meteorological conditions in the area and are typical of daytime conditions that would readily disperse gaseous hazards. For the purpose of analysis, the "conservative-most-likely" conditions are defined as Stability Class D with a wind speed of 3 m/s.
[b] "Worst-Case" conditions are representative of infrequently occurring meteorological conditions and are typical of nighttime conditions mat would produce higher concentrations of a gaseous hazard at greater downwind distances than would conservative-most-likely conditions. For the purpose of analysis, the "worst-case" conditions are defined as Stability Class E with a wind speed of 1 m/s.
"To convert to English units, 1 km^2 = 0.386 miles*.

E.3 IMPACT ASSESSMENT

Instead of computing the downwind distance for each of the many individual hypothetical accidents, the analysis in this appendix groups these accidents into categories based upon the downwind distance over which fatalities might be expected to occur (see Table E. 1). These "accident categories" can be used to identify impacts from accidental releases of chemical agent upon the various environmental resources (e.g., human health or aquatic ecology). The accident category for each accident scenario is closely linked to the downwind distance associated with the no-deaths dose-response contour (see Fig. E.l).

The impact analyses are based on the accidents that are specific to the implementation of each alternative under consideration in this EIS. The largest such accidents (also called "worst-case accidents") are described below.

E.3.1 Identification of Worst-Case Accidents

Continued Storage. The risk assessment conducted for the FPEIS (GA Technologies, Inc., 1987 and U.S. Army 1988, Vol. 3, Appendix J), found that the worst case accident during the continued storage of ton containers at NECD involved either an earthquake or an aircrash into the existing storage warehouse. Each of these accidents involved an ensuing fire that affected the entire inventory in the warehouse. Ton containers could be ruptured in each of these accident scenarios. A portion of the agent VX would be consumed in the ensuing fire, but 2.5% would survive the fire and would be lofted by the heat of the fire to become atmospherically dispersed.

The lethal downwind hazard distance associated with such accidents under the most unfavorable meteorological conditions would exceed 100 km (62 miles). Under more typical conditions for NECD, the lethal downwind hazard distance would be less than 50 km (32 miles). According to Table E. 1, this event would be classified as a Category VI accident.

Neutralization Pilot Testing. With respect to the release of agent VX, MITRETEK found that the worst case accident during neutralization at NECD involved an aircrash that would rupture the drained-agent holding tanks with an ensuing fire. Both of the active 0.9-m^3 (240-gal) holding tanks could be involved. The tanks were assumed to be 75 % full. The quantity of agent VX involved in such an accident would therefore be 1.3 m^3 (360 gal).

During routine operations, two ton containers could be simultaneously in the demilitarization building awaiting punch and drain operations. MITRETEK found that there is sufficient separation between the agent-holding tanks and the ton containers awaiting processing that an aircrash would be unable to rupture both the holding tanks and the ton containers in the same accident. If the accident involved only the two ton containers [each containing 0.7 m^3 (190 gal)] and not the holding tanks, then 1.4 m^3 (380 gal) of agent VX could be involved. This quantity is similar to, but slightly larger than, the quantity involved in the holding tank accident.

The aircrash accident involves an ensuing fire that would consume all but 2.5 % of the agent VX involved. The surviving agent would be lofted by the heat of the fire to become atmospherically dispersed through the breach in the structure created by the aircrash. An evaluation of the accident involving the two ton containers yields a lethal downwind hazard distance of 8.5 km (5.3 miles) under the most unfavorable meteorological conditions. According to Table E. 1, this would be classified as a Category II accident. Under more typical conditions for NECD, the lethal downwind hazard distance for this same accident would be about 2 km (1.2 miles).

E.3.2 Estimation of Potential Fatalities from Chemical Agent Releases

The human health impacts of an accidental release of agent VX stored at NECD would include fatalities and sublethal effects. Becausesublethal effects would vary with the exposure concentrations, the exposure duration, and the health status and number of people exposed, it is inappropriate to attempt to definitively quantify such effects. In contrast, the number of potential fatalities would vary directly with the accident size and the population exposed, both of which can be readily quantified.

Estimates of potential fatalities require (1) a description of the population distribution around the accident site, (2) a description of how large an area would be affected by chemical agent if there were an accident, and (3) a method of combining these descriptions to produce an estimate. Each of these elements is described in the paragraphs below.

Populations. For this EIS, the latest, 1990 census data (U.S. Department of Commerce 1991) have been used to develop estimates of the spatial distribution of the residential population around NECD. The proposed site for the pilot test facility was used as the center of this estimation process. The coordinates of the site are 39.850°N latitude and 87.424°W longitude.

The 1990 census information was used to create population distributions for both the *local* level [i.e., within 10 km (6 miles)] and the *regional* level [i.e., within 50 km (31 miles)] centered on the location of the proposed pilot facility. The census information contains 1990 population counts by location (latitude and longitude) for various hierarchical data levels down to the individual block level (e.g., a neighborhood area bounded by four streets).

For the distribution of local population, the block level data were used as input to an interpolation algorithm to compute a population density matrix based on a rectangular grid of cells measuring 2 seconds of one degree in latitude or longitude on each side. First, the interpolation algorithm approximated the block boundaries with polygons computed by using each blocks' latitude and longitude locations as generator points. An initial interpolation was then performed to estimate population densities at the corners of the each calculated polygon. The resulting estimated population distributions were transferred onto the grid of rectangular cells by using the centers and corners of each block polygon. Finally, a normalization procedure was used to ensure that the population computed within the area of interest was accounted for accurately.

A similar procedure was used to compute the regional distribution of population between 10 and 100 km (6 and 62 miles) from the proposed pilot test facility. Block group (e.g., aggregations of blocks) population counts were extracted from the census information and subjected to a similar interpolation routine; however, the resulting grid of rectangular cells was based upon a cell size with 12 seconds of one degree in latitude or longitude on each side.

Dose Contours and Fatality Rates. The area affected by a plume from an accident depends upon the meteorological conditions at the time of release, the amount released, and the manner in which it is released. This input was obtained from the FPEIS hazard analysis using the D2PC atmospheric dispersion model described in Sect. E-2.1.

The computational methodology used to estimate fatalities assumed that any person at the point of the release would have a 100% probability of dying. Farther downwind from the point of the release-as the agent disperses-a boundary exists as defined by the 50% lethal dose (see Fig. E. 1). That is, people on this boundary would have a 50 % chance of dying from exposure to the chemical agent. It was assumed that the entire population within the area between the point of release and the 50% lethal dose boundary would receive a dose midway between the 100% and 50% levels. Therefore, the fatality rate would be 75 % for this population.

A similar assumption was made at the tower dose levels. Thus, it was assumed that the fatality rate for persons who would receive exposures between the 50% lethal dose and the 1% lethal dose would average 25 %, and that the fatality rate for persons receiving exposures between the 1% lethal dose and no-deaths dose would be 0.5 % . The FPEIS identifies these as conservative assumptions that tend to overestimate the number of fatalities, because the time-weighted dose concentration declines at a greater than linear rate as downwind distance increases, and because the dose per unit of area also declines at a greater than linear rate as downwind distance increases.

Plume **Overlays.** To estimate the potential maximum fatalities for a specific accident category, the 50 %, 1% , and no-deaths dose contours from the D2PC atmospheric dispersion model were overlain on the grid of population around NECD; the number of persons in each of the three dose areas was counted; and the number of fatalities was computed using the fatality rates previously described. The downwind plume direction was then rotated in increments of one compass degree around the release site, and the estimate of fatalities was recomputed at each increment. This process was repeated for the full 360" around the site to identify which wind direction would cause the most fatalities. The resulting fatality estimates for each accident category are shown in Table E.2.

These fatality estimates are subject to several qualifications as documented in the FPEIS (U.S. Army 1988, Vol. 1, Sect. 4.2.3.1):

1. As noted above, the assumption that 75 % , 25 %, and 0.5 % of the population would die within a dose-exposure contour is conservative (i.e., it overpredicts the actual fatality rates).
2. The estimates of fatalities are based on dose data that characterize the expected response of healthy young males.
3. The downwind distance estimates from the D2PC atmospheric dispersion code are accurate within ±50%. As a result, the fatality estimates based upon these distances, affected by area as well as distance relationships, have corresponding ranges on the order of -75% to +25%.
4. Real variations in wind speed and direction during a release would cause the plume from an accident to have a more complex shape over real terrain than the elliptical, non-meandering shape used here.
5. The population counts for very large accidents have been truncated at 100 km (62 miles) downwind of the release point, because it is impossible to estimate the shape of a very large plume contour.
6. The census data used for determining the population distribution reflect places of residence and are thus more representative of nighttime than of daytime accidents.
7. The point of release for all accidents was assumed to be the proposed location for the pilot facility at NECD.

It was assumed that no emergency response or protective actions would occur within or outside NECD in response to an accident. The human health impacts are therefore expressed in numbers of potential fatalities without any credit for possible reductions due to such actions. Hence, the fatalities estimated in this appendix are likely to exceed those that would actually be experienced in the unlikely event of an accident. Hence, the values in Table E.2 can therefore be considered to represent an upper bound on the potential number of fatalities that might result from an accidental release of chemical agent.

Table E.2. Estimated number of potential off-site fatalities associated with hypothetical accidents involving agent VX at the Newport Chemical Depot

	Under Conservative-Most-Likely weather conditions”		Under Worst Case weather condition?	
Accident category	Lethal downwind distance	Maximum potential fatalities’	Lethal downwind distance	Maximum potential fatalities’
Category 0	< 500 m	0	< 2 km	1
Category I	500 m to 1 km	0	2 to 5 km	15
Category II	1 to 2 km	1	5 to 10 km	50
Category III	2 to 5 km	30	10 to 20 km	230
Category IV	5to 10 km	90	20 to 50 km	1,900
Category V	10 to 20 km	320	50 to 100 km	18,500
Category VI	20 to 50 km	5,000	> 1oolcm	18,500”

[a] “Conservative-Most-Likely” conditions are representative of commonly occurring meteorological conditions in the area and are typical of daytime conditions that would readily disperse gaseous hazards. For the purpose of analysis, the “conservative-most-likely” conditions are defined as Stability Class D with a wind speed of 3 m/s.

[b] “Worst-Case” conditions are representative of infrequently occurring meteorological conditions and are typical of nighttime conditions that would produce higher concentrations of a gaseous hazard at greater downwind distances than would conservative-most-likely conditions. For the purpose of analysis, the “worst-case” conditions are defined as Stability Class E with a wind speed of 1 m/s.

The fatality estimates are rounded.

[d]The atmospheric dispersion model is truncated at 100 km; hence, fatality estimates for the preceding category have been used.

E.4 CONCLUSIONS

The data in Table E.2 can be used to compare the impacts of accidentally released agent VX at NECD. The “worst case accident during continued storage would involve an earthquake or the crash of an airplane directly into the existing storage warehouse. Either of these events could be followed by fire. These accidents would be Category VI accidents (as defined in Table E. 1). Such an accident could cause 5,000 fatalities under typical meteorological conditions and up to 18,500 fatalities under unfavorable meteorological conditions. These fatalities would occur among the off-site population near NECD. On-site populations were not included in the analysis.

In comparison, the “worst case” accident during the proposed neutralization operations would be an aircrash involving two ton containers awaiting processing. This would be a Category II accident (see the more detailed description in Sect. E-3.1). Such an accident could cause one fatality under typical meteorological conditions and up to 50 fatalities under unfavorable meteorological conditions.

E.5 REFERENCES

EPRI (Electric Power Research Institute) 1985. *Operational Validation of Gaussian and First-OrderClosure Plume Models at a Moderately Complex Terrain Site*, EA-3759, Project 1616-9, Palo Alto, Calif.

GA Technologies, Inc. 1987. *Risk Analysis of the Continued Storage of Chemical Munitions,* reports GAC-18564 and SAPEO-CDE-IS-87009, prepared for Program Executive Officer—Program Manager for Chemical Demilitarization by GA Technologies, Inc., La Jolla, Calif.

MITRETEK 1996. *Preliminary Risk Assessment of Alternative Technologies for Chemical Demilitarization*, MTR-96W0000023 (Rev. 1), prepared for Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., by MITRETEK, McLean, Va.

Pasquill, F. 1961. "The Estimation of the Dispersion of Windbome Material," The *Meteorological Magazine* 90, 33–49.

U.S. Army 1988. *Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement*, Vols. l-3, Aberdeen Proving Ground, Md.

U.S. Department of Commerce 199 1. *1990 Census of Population and Housing; Public Law 94-171 Data*, Bureau of the Census, U.S. Government Printing Office, Washington, D.C.

Whitacre, G. C., et al. 1986. *Personal Computer Program for Chemical Hazard Prediction (D2PC)*, U.S. Army Chemical Research and Development Center, Aberdeen Proving Ground, Md.

APPENDIX F

CONSULTATION IN ACCORDANCE WITH THE NATIONAL HISTORIC PRESERVATION ACT OF 1966

F.1 INTRODUCTION

Section 106 or the National Historic Preservation Act of 1966 (NHPA) as amended [(16 U.S.C. Sect. 470), Pub. L. 89-665, October 15, 1966; amended by Pub. L. 91-243, 93-54, 94-422, 94-458, 96-199, 96-244, 96-515, and 98-483] requires federal agencies to take into account the effects of their proposed actions on properties listed on or eligible for the National Register of Historic Places. Prior to approval of an action, federal agencies must give the Advisory Council on Historic Preservation (the Advisory Council) a reasonable opportunity to comment on the proposed action. In addition, Sect. 110(f) of the NHPA requires specific planning and actions to minimize harm to any national historic landmarks that may be directly and adversely affected by a federal agency's actions.

The National Register of Historic Places is a listing of "districts, sites, buildings, structures, and objects significant in American history, architecture, archaeology, engineering, and culture" [NHPA, Sect. 101(a)(l)(A)]. They may be of national, regional, state, or local significance. National Historic Landmarks are those items on the National Register of Historic Places which are judged to possess national significance in illustrating or commemorating the history and prehistory of the United States and which have been so designated by the National Park Service on behalf of the Secretary of the Interior.

F.2 PROCESS

The first step in complying with the Section 106 requirements is to identify and evaluate historic properties. The federal agency (in this case the U.S. Army) with the assistance of the State Historic Preservation Officer (SHPO) in the state in which the proposed action will take place locates and evaluates the eligibility of possible historic properties for the National Register. If there are no properties on or eligible for listing on the National Register of Historic Places in the area of the proposed action, the agency must provide documentation of the fact to the SHPO and notify other interested parties. If historic properties are present, the agency must determine whether the proposed action could affect the properties in any way. Formal consultation with the Indiana SHPO will be initiated by the NECD Cultural Resources Manager.

F.3 CORRESPONDENCE

Formal consultation with the Indiana SHPO has been initiated. Exhibit F. 1 documents the SHPO's finding that no known historical or archaeological sites listed in or eligible for inclusion in the National Register of Historic Places will be affected by any projects at the NECD.

EXHIBIT F-l

01/09/98 12:15 FAX 317 2454500 NEWPORT CD- 002

cc: DHW

DNR

INDIANA DEPARTMENT OF NATURAL RESOURCES PATRICK R. RALSTON, DIRECTOR

Division of Historic Preservation
and Archaeology
402 W. Washington St., Rm. 274
Indianapolis, Indiana 46204
317-232-1646

RECEIVED NOV 17 1995 FAC. ENGR.

RECEIVED NOV 15 1995 PLANT MANAGER

RECEIVED NOV 1 1995 ENGINEERING DEPARTMENT

November 3, 1995

D.A. Lichtenberger
Plant Manager
Mason & Hanger-Silas Mason Co., Inc.
Newport Chemical Activity
Post Office Box 458
Newport, Indiana 47966-0458

Dear Mr. Lichtenberger:

We have reviewed your request for an extension of the exemption of submitting projects involving built cultural resources at the Newport Chemical Activity (plant) in Vermillion County, Indiana.

We are of the opinion that the buildings and structures at the plant will not attain historical or architectural significance in the next five years. In other words, no known historical or architectural sites listed in or eligible for inclusion in the National Register of Historic Places will be affected by any projects at the plant. Therefore, the Newport Chemical Activity is exempt from a case by case State Historic Preservation Officer (SHPO) concurrence on the disposal, rehabilitation and modification of existing buildings and structures through 1999. Before the close of 1999, please coordinate with our office for a reevaluation of an extension.

Please keep in mind that this exemption does not include archaeological concerns. Please submit those types of activities that may affect archaeological sites to this office far review and comment.

If you have questions, please call Sue Becher Gilliam at 317/232-1646.

Very truly yours,

Patrick R. Ralston
State Historic Preservation Officer

PRR:SBG:sbg

"EQUAL OPPORTUNITY EMPLOYER"

APPENDIX G

SEISMICITY

Previous investigations of the seismic hazards at the Newport Chemical Depot (NECD) in Indiana are documented in Blume (1987) and Weston (1996). Relevant details from those assessments are summarized and presented in this appendix.

G.l SEISMIC HAZARDS

The seismic hazard at a particular location is related to the probability of exceeding a specified ground motion [commonly expressed as a peak ground acceleration (PGA)] as a function of time. Figure 6.1 illustrates one such measure of the seismic hazard in the United States. These PGA contours have also been used to develop "seismic zones" (see Fig. 6.2) for use in the design and construction of buildings.

Seismic information played a role in the Final Programmatic Environmental Impact Statement (FPEIS) (U.S. Army 1988) through the consideration and evaluation of accidents initiated by seismic activity, particularly for those accidents that could occur during continued storage of the agent VX stockpile at NECD. The analysis of seismic hazards in the FPEIS was based on earthquake data provided by the Applied Technology Council (ATC 1978). Based on currently available data, the seismic hazard at NECD remains unchanged from the FPEIS.

G.2 DETERMINISTIC HAZARD ANALYSIS

Eight major fault systems within 320 km (200 miles) of NECD were active during Paleozoic time (Blume 1987; Mitchell et al. 1992). Locations of the Ste. Genevieve, Cottage Grove, Rough Creek, Pennyrile, Shawneetown, Kentucky River, Wabash Valley, and New Madrid fault systems are shown in Fig. G.3.

Seismic reflection surveys reveal the presence of a Precambrian rift zone across the Wabash Valley (Sexton et al. 1986). The southern end of this rift zone apparently terminates against the Shawneetown fault.

Bristol and Treworgy (1979) describe the Wabash Valley fault system in southeastern Illinois. The latest ruptures along this fault system are post-Pennsylvanian and pre-Pleistocene in age. These faults were detected in oil wells, and they have no surface expression. The southern end of the Wabash Valley fault system lies immediately north of the Shawneetown-Rough Creek fault systems, and the northern end lies in Wabash County, Ill., about 160 km (100 miles) south of NECD. According to Mitchell et al. (1992), Paleozoic and more recent faults in the New Madrid fault system do not extend across the Shawneetown-Rough Creek fault system into the Wabash Valley.

ORNL-DWG 92-13202

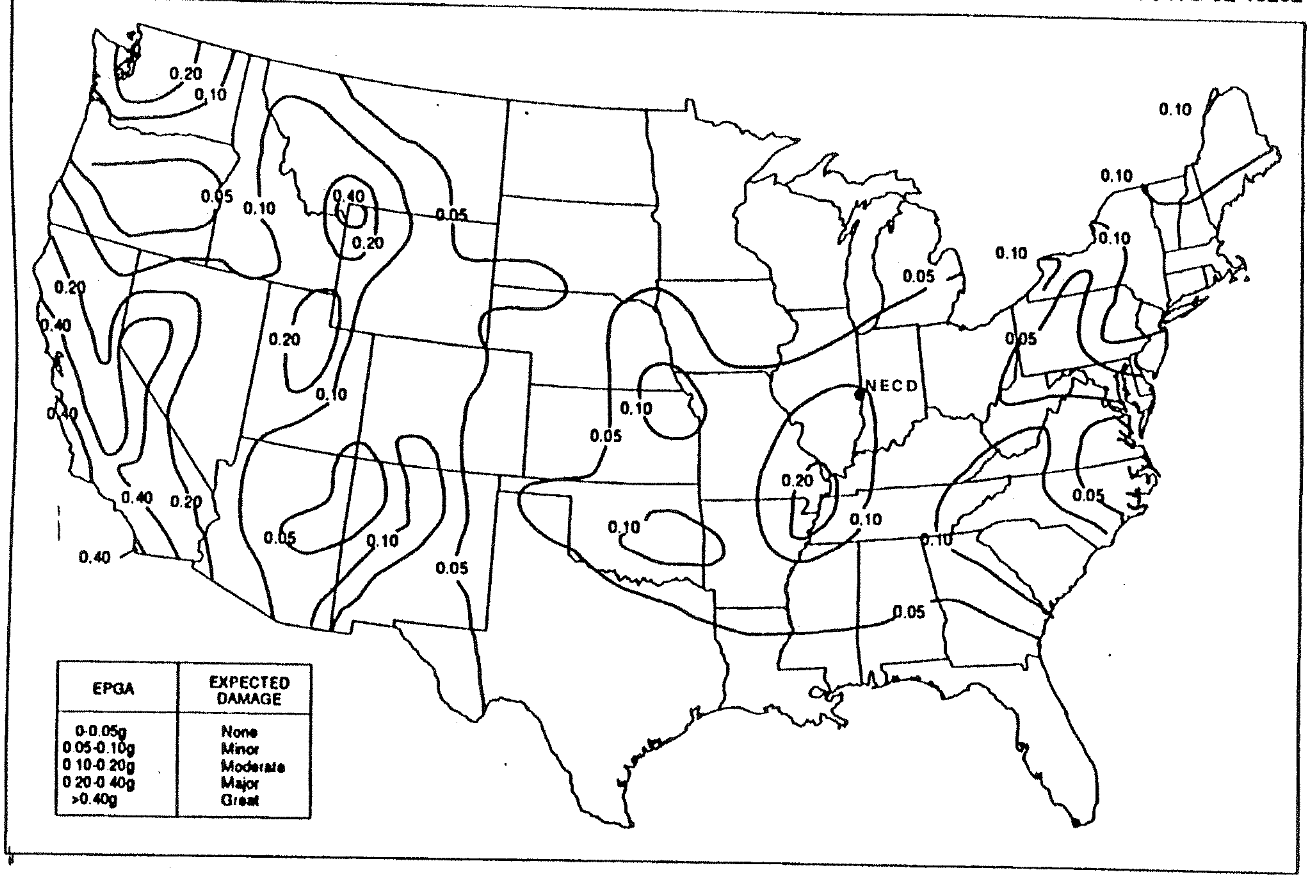

Fig. G.1. Effective peak ground acceleration (EPGA) with a 10% probability of exceedance at least once in 50 years in the eonterminous United States, showing the location of the Newport Chemical Depot (NECD). Sources.. Modified from *Tentative Provisions for the Development of Seismic Regulations for Buildings,* Applied Technology Council, National Bureau of Standards, Special Publication NBS SP-5 10, U.S. Government Printing Office, Washington, D.C., 1978. *NEHRP (National Earthquake Hazard Reduction Program) Recommended Provisions for the Development of Seismic Regulations for New Buildings,* Part 2, Earthquake Hazard Reduction Series 18, Federal Emergency Management Agency, Building Seismic Safety Council, Washington, D.C., 1988.

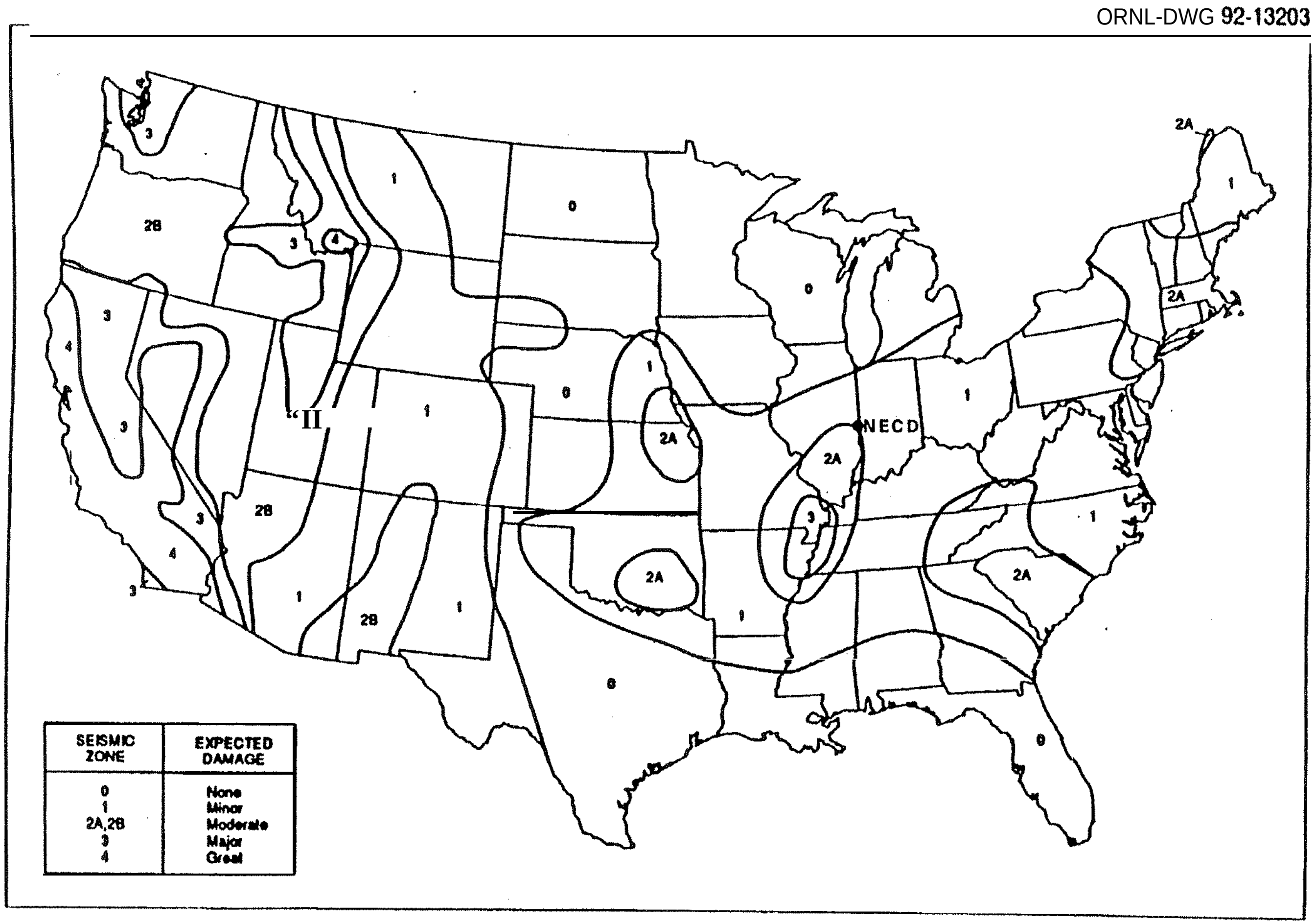

Fig. G.2, Seismic zone map of the conterminous United States showing the location of the Newport Chemical Depot (NECD).
Source: Modified from *Uniform Building Code*, International Conference of Building Officials, Whittier, Calif., 1988.

ORNL-DWG 92-13205

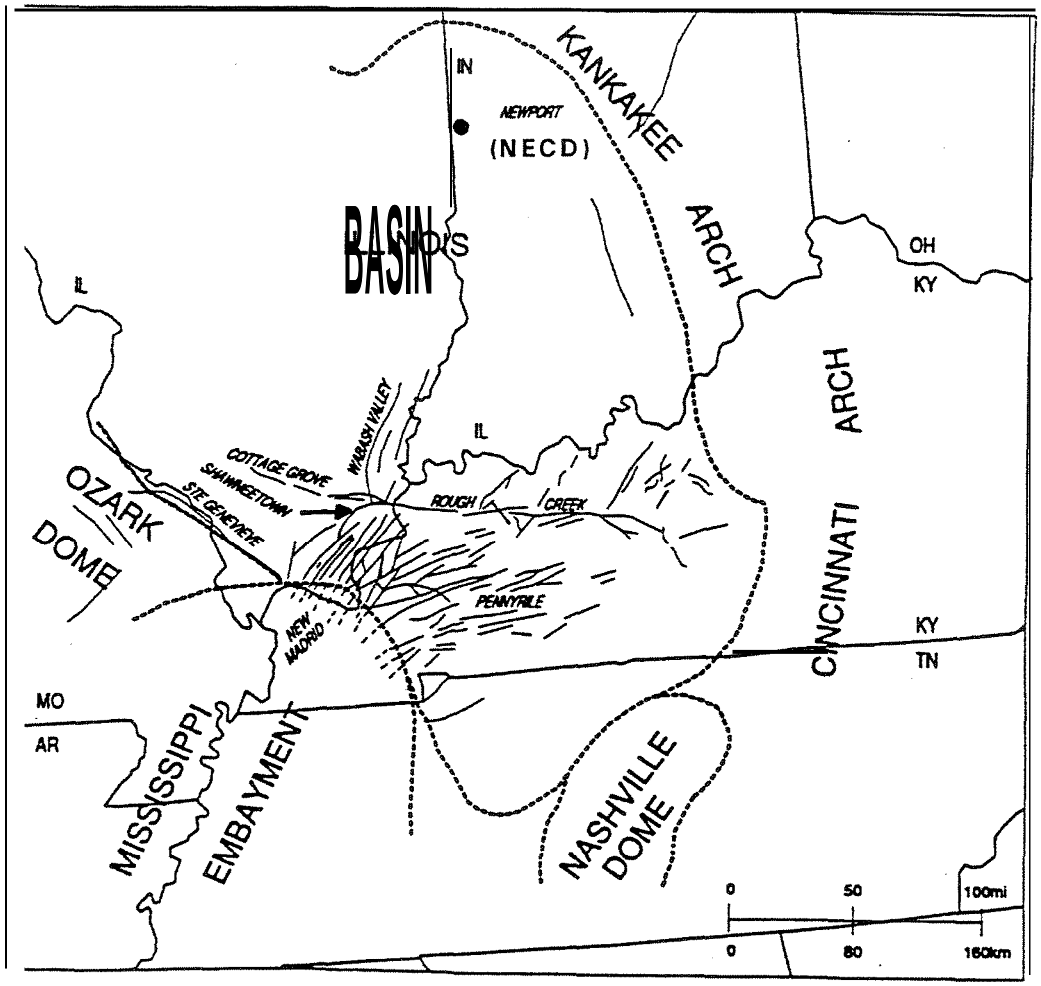

Fig. 6.3. Major shallow geologic structures (faults, domes, basins, and arches) in southeastern Missouri and adjacent states. *Source:* K. C. Bayer, *Generalized Structural, Lithologic, and Physiographic Provinces in the Fold and Thrust Belts of the United States,* U.S. Geological Survey, Denver, 1983.

The relationship between historical seismicity and the fault systems shown in Fig. G.3 has been the subject of widespread speculation in recent years. Hadley and Devine (1974) presents a map (Fig. G.4) illustrating a Y-shaped region of historical seismicity. The contour lines in Fig. G.4 indicate the number of earthquakes of $I_0 \geq III$ per 10,000 km^2 during the years 1800-1972. (I, is the modified Mercalli intensity at the epicenter of an earthquake.) The western branch of the Y-shaped region extends northwest along the Mississippi River, the eastern branch extends northeast along the Wabash River, and the southern branch extends south-southwest along the Mississippi River. Although the relationship between seismic events and the New Madrid fault system (the southern branch of Hadley and Devine's Y-shaped region) has been well established (Stauder et al. 1976), such relationships are uncertain in other nearby regions. Fault systems outside Hadley and Devine's Y-shaped region (Rough Creek and Pennyrile) have very few historical earthquakes in their vicinity.

Keller, Bland, and Greenberg (1982), Braile et al. (1982), and Black (1986) discuss the relationship between historical seismicity and a proposed Precambrian rift zone complex in the Mississippi, Ohio, and Wabash river valley regions. These authors present interpretations of maps of gravity and magnetic anomalies that show a strong correlation between locations of dense, strongly magnetic, and Precambrian oceanic crust (outlined by the heavy lines in Fig. G.4) on the one hand and historical seismicity on the other. There are four arms in the proposed rift system. The southern Indiana arm extends northeast from the Wabash Valley into central Indiana, where the historical seismicity is less intense. The St. Louis and Reelfoot arms are moderately and strongly active seismic regions, respectively, but the Rough Creek graben of this proposed rift system is more or less aseismic.

Pleistocene and Holocene ruptures along the Kentucky River and New Madrid fault-systems [described by VanArsdale (1986), Russ (1982), and VanArsdale and Sergeant] display reverse and strike-slip motion. These directions of motion are consistent with region-wide (eastern North America and western Atlantic Ocean) horizontal compression from the northeast (Zoback and Zoback 1980).

Many earth scientists now believe that horizontal compression on a global scale is the cause of occasional strong-motion earthquakes on ancient intraplate faults (persistent zones of weakness that fully penetrate the earth's brittle crust). However, strong-motion earthquakes on intraplate faults are much less frequent than those on boundaries between plates (e.g., the San Andreas fault in California). No crust-penetrating faults have been identified in the region surrounding NECD. Furthermore, the historical record of seismicity does not support speculation that reactivated Wabash Valley faults might underlie the proposed site.

Figure G.5 shows the locations (NOAA 1989) of all the largest historical strong-motion earthquakes body-wave magnitude (m_b) $\geq$ 6.0; $I_0 \geq$ VIII] in seismic source zones (Blume 1987) within 320 km (200 miles) of NECD. Some seismic source zones have not experienced such large earthquakes in historical time, in which case, only the largest earthquake is shown. For example, the nearby western Indiana earthquake (I, = VII, central United States) of July 19, 1909, is also shown on this figure. These important earthquakes are numbered in Fig. G.5 according to their chronological sequence of occurrence. Important parameters related to these earthquakes are listed in Table G. 1. The majority of strong-motion earthquakes are found in or near the New Madrid fault zone and the Wabash Valley.

ORNL-DWG 92-13206

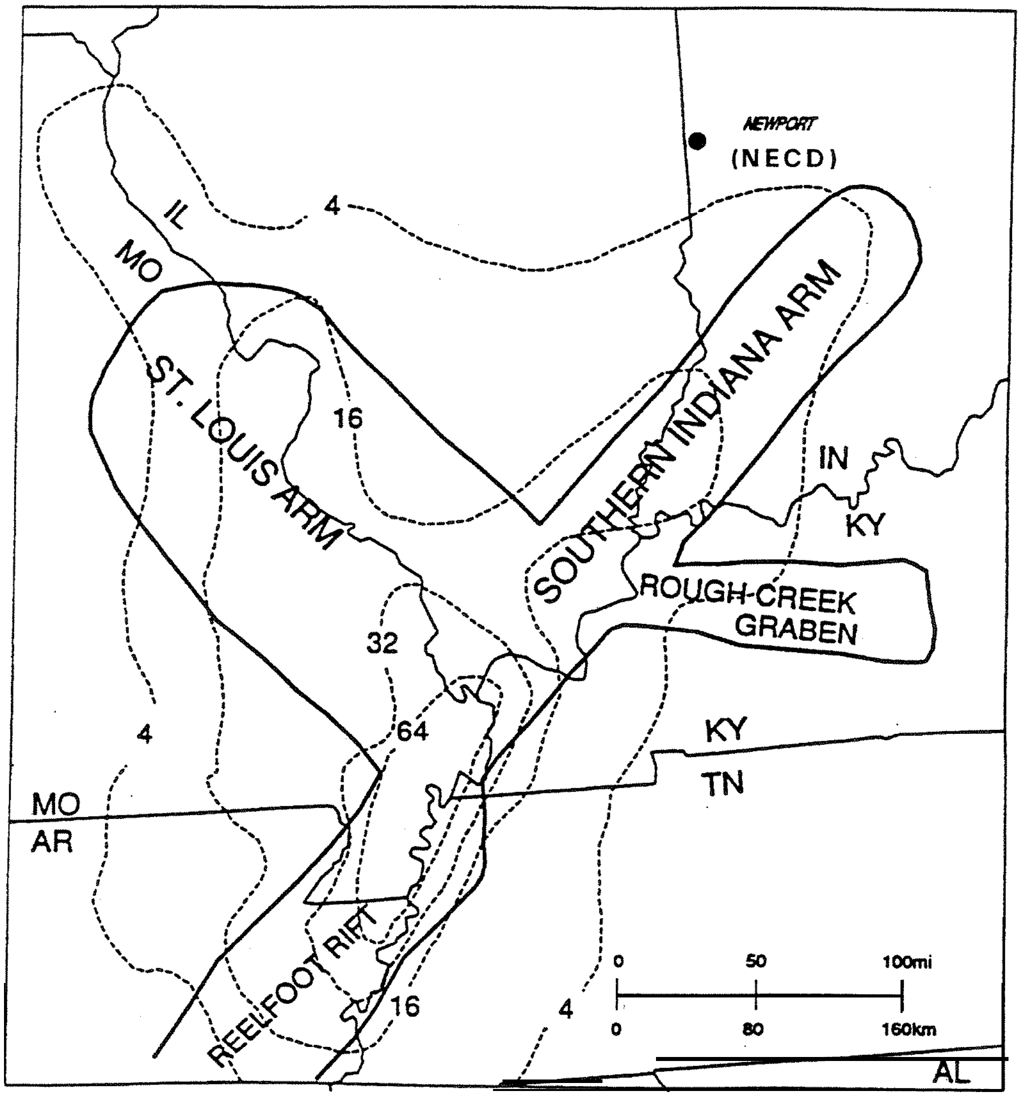

Fig. 6.4. Historical seismicity map superimposed on generalized regions of dense and strongly magnetic basement rocks (deeply buried, inferred oceanic crust) of southeastern Missouri and adjacent states. *Sources:* L. W. Braile et al., "An Ancient Rift Complex and Its Relation to Contemporary Seismicity in the New Madrid Seismic Zone," *Tectonics* 1(2), 225–37 (1982). J. B. Hadley and J. F. Devine, *Seismotectonic Map of the Eastern United States,* U.S. Geological Survey, Map MF-620, Denver, 1974.

ORNL-DWG 92-13207

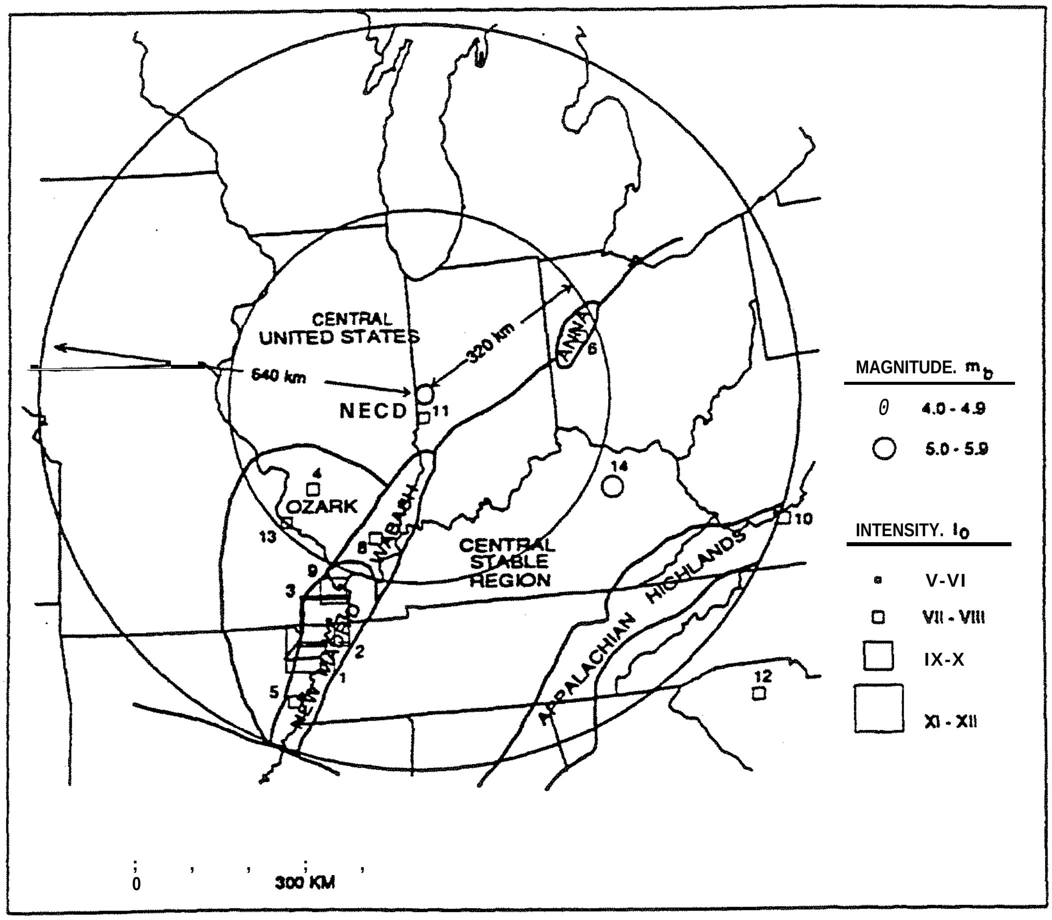

Fig. 6.5. Largest historical strong-motion earthquakes in seismic source zones within 320 km (200 miles) of the Newport Chemical Depot (NECD) in Indiana. *Source: Computer-Stored Earthquake Data,* National Oceanic and Atmospheric Administration, Geophysical Data Center, Boulder, Coio., 1989.

Table G.1. Largest earthquakes in seismic source zones of Fig. G.5

Earthquake no.	Date	Magnitude or intensity	Seismic source zone
1	12-16-1811	XI	New Madrid
2	1-23-1812	XI	New Madrid
3	2-7-1812	XII	New Madrid
4	6-9-1838	VII	Ozark
5	1-4-1843	VIII	New Madrid
6	6-18-1875	VIII	Anna
7”	8-31-1886	X	Charleston, S.C.
8	9-27-1891	VIII	Wabash
9	10-31-1895	VIII	New Madrid
10	5-31-1897	VIII	Appalachian Highlands
11	7-19-1909	VII	Central United States
12	1-1-1913	VII-t-	Blue Ridge and Piedmont
13	4-9-1917	VII	Ozark
14	7-27-1980	5.1 (VII)	Central Stable Region

[a]Not shown in Fig. 6.5.

Figure 6.6 shows the locations of all strong-motion earthquakes ($m_b \geq 5.0$; $I_0 \geq$ VII) in seismic source zones (Blume 1987) within about 320 km (200 miles) of NECD. Although the pattern of seismicity is more diffuse than in Fig. G.5, strong-motion earthquakes are still concentrated in the New Madrid fault zone, the Wabash Valley, and adjacent regions. Some of the smaller earthquakes may be duplicates or aftershocks in NOAA’s data-file.

Figure G.7 shows the locations of a larger set of strong-motion earthquakes ($m_b \geq 4.0$; I, ≥ V). The smaller earthquake locations in the New Madrid (and to some extent, the Wabash) region are so dense that individual earthquakes are difficult to discern at the chosen map scale. Smaller earthquakes are sparsely scattered throughout the central United States (where NECD is located) and Central Stable regions. Again, some of the smaller earthquakes may be duplicates or aftershocks.

The locations and intensities of earthquakes that occurred more than 50 years ago are not well known. Epicentral locations of older events may be off by as much as 100 km, and their sizes may be off by one intensity unit. More recent events were recorded by modem seismic instruments; their locations and sizes are known to within 10 km and 0.1 to 0.2 magnitude units, or better. Although the record of historical seismicity begins about 300 years ago in the eastern United States, a complete historical record of strong-motion earthquakes is less than 200 years old.

Table G.2 is a compilation of the maximum historical earthquakes (m_b or I_0) in Blume's (1987) seismic source zones (Fig. 6.5). Also shown are maximum expected earthquakes in each zone, the minimum distance from each zone to NECD, and the predicted maximum expected magnitudes (m,) and intensities (I_{mm}) and their corresponding PGAs at NECD. Maximum expected earthquakes are generally one-half magnitude unit and one intensity unit greater than maximum historical earthquakes.

ORNL-DWG SZ-13208

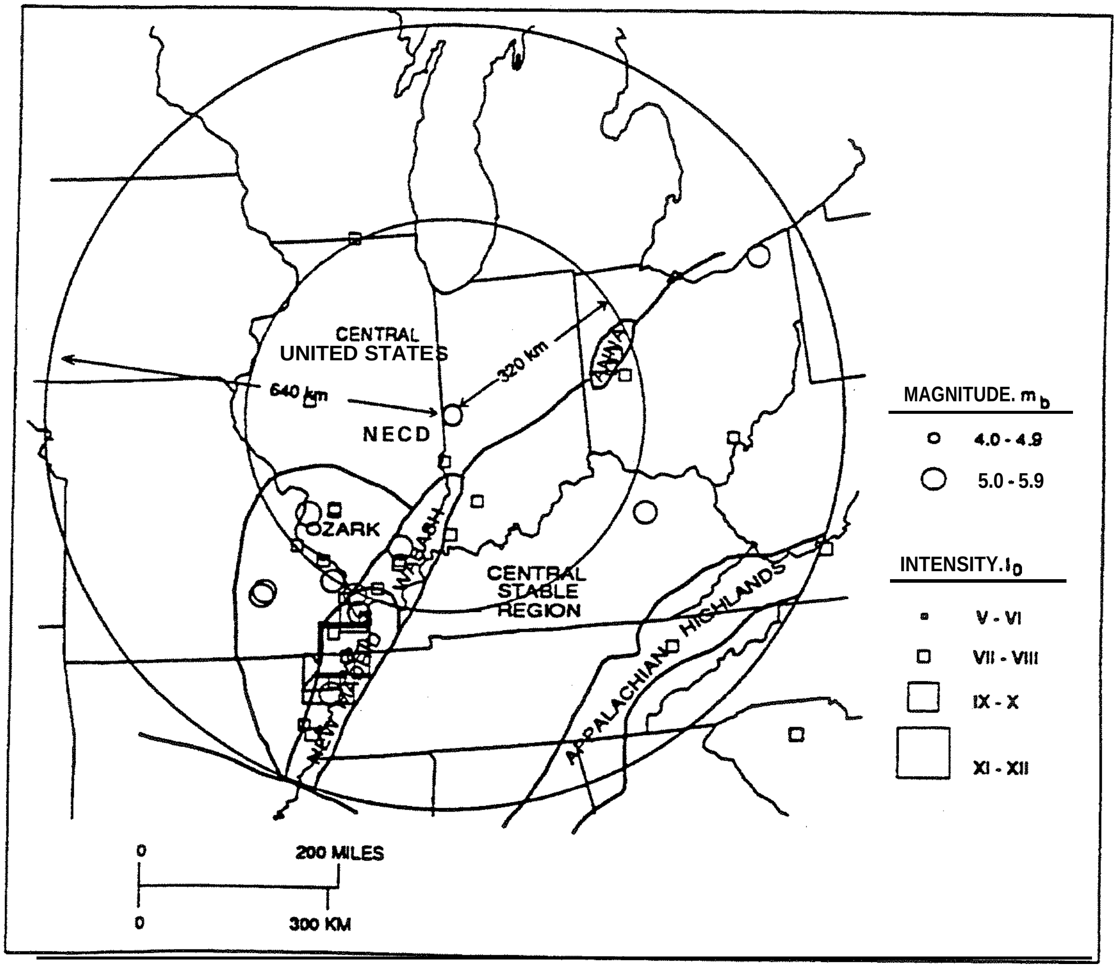

Fig. G.6. Historical strong-motion earthquakes (m_b ≥ 5.0; I,, ≥ VII) in seismic source zones within 320 km (200 miles) of the Newport Chemical Depot (NECD) in Indiana. Source: *Computer-Stored Earthquake Data,* National Oceanic and Atmospheric Administration, Geophysical Data Center, Boulder, Colo., 1989.

ORNL-DWG 92-13209

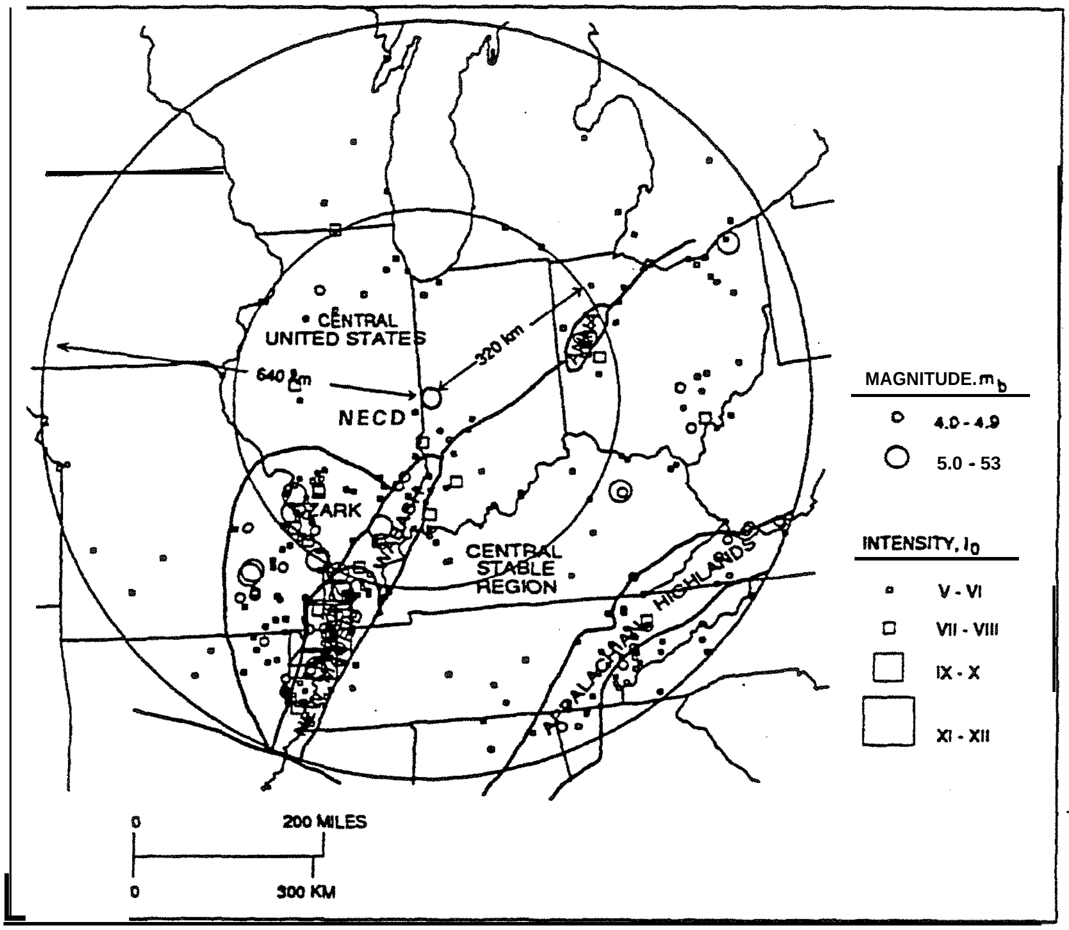

Fig. G.7. Historical strong-motion earthquakes (m, ≥ 4.0; I_0 ≥ V) in seismic source zones within 320 km (200 miles) of the Newport Chemical Depot (NECD) in Indiana. *Source: Computer-Stored Earthquake Data,* National Oceanic and Atmospheric Administration, Geophysical Data Center, Boulder, Coio., 1989.

Table G.2. Estimated maximum modified Mercalli intensities (I, and I,,,,), body-wave magnitudes (m,), and associated peak ground accelerations (PGAs) on rock at the Newport Chemical Depot (NECD) site

						Maximum expected PGA (g)			
						Intensity-based estimates		Magnitude-distance-based estimates	
Physiographic province or tectonic zone	Locale' (date)	Maximum historical earthquake I_0/m_b	Maximum expected earthquake I_0/m_b	Minimum distance (km) from NECD	Intensity at NECD	Blume" 1987	Trifimac and Brady 1975	EPRI[c] 1988	Nuttli and Herrmann 1987
Central United States	Near Newport, Ind., 11 (7-19-1909)	VII/	VIII/S.5	10	VIII	0.18	0.25	0.29	0.28
Central Stable	Sharpsburg, Ky., 14 (7-27-1980)	VII/5.1	VIII/5.5	95	V	0.03	0.03	0.02	0.03
Wabash Valley	Southern Ill., 8 (7-27-1891)	VIII/	IX/6.5[d]	90	VI+	0.08	0.09	0.05	0.10
Ozark	Southeastern Mo., 13 (4-9-1917)	VII/	IX/6.5	140	VI	0.06	0.06	0.03	0.06
Anna	Anna, Oh., 6 (6-18-1875)	VII+/	VIII/6.0	250	III	<0.01	<0.01	0.01	0.02
New Madrid (Reelfoot Rift)	New Madrid, Mo., 3 (2-7-1812)	XII/	XII/7.5	300	VIII[e]	0.18[e]	0.25[e]	0.02	0.06

'Numbers correspond to locations on Fig. GS.
[b]Based on Herrmann (1981).
'Electric Power Research Institute's (EPRI's) "base case."
'Based on Obermeier et al. (1991).
[e] Modified Mercalli intensity from Algermissen and Hopper (1984).

Source: Modified from Blume (1987).

According to Blume (1987) a near-field (less than 10 km away) earthquake in the central United States region seismic source zone would produce the ***largest*** expected ground motion at NECD. However, the more recent findings in Weston (1996) suggest that the *most likely* contributor to seismic ground motions would be a moderately large event occurring at considerable distance from the NECD site.

Boundaries of the seismic source zones in Table 6.2 (from Blume 1997) are neither unique nor universally accepted. Many other sets of seismic source zones have been proposed for the eastern United States (Algermissen and Perkins 1976; EPRI 1988a; Bernreuter et al. 1989; Mitchell et al. 1992). For example, Mitchell's Wabash Valley seismic source zone extends much closer to NECD than does Blume's.

G.3 PROBABILISTIC HAZARD ANALYSIS

Deterministic intensity-acceleration relationships are no longer used to calculate PGAs as input for the seismic design of high hazard facilities; however, such relationships were widely used at the time of publication of the FPEIS (U.S. Army 1988). Site-specific, probabilistic seismic hazard analyses, such as those of Bemreuter et al. (1989) and the Electric Power Research Institute (EPRI 1988a), use more recently developed methodologies than the intensity-acceleration relationships and standardized spectral analyses used by Blume (1987). A probabilistic seismic hazards analysis has recently been conducted for NECD (Weston 1998). The findings of that analysis are presented below.

The Weston (1998) analysis was conducted with the EPRI (1988a) methodology to estimate the annual likelihood of occurrence of seismic ground-motion events at the NECD site. The hazard results from the Weston report will be integrated into a risk/failure assessment of structures and subsystems to be constructed as part of the proposed facilities at NECD.

Earthquakes the size of the New Madrid and Charleston, South Carolina, events have a relatively low probability of occurrence at NECD. The frequency of occurrence of large earthquakes in the eastern United States would be on the order of 1×10^{-5} to 1×10^{-6} events per year per 10,000 km^2 (3,860 $miles^2$) or about 1% to 10% of the frequency of such events on crustal plate boundaries, such as the San Andreas fault zone in California (an active continental margin). This estimate is based on data provided by Johnston and Kanter (1990).

In the Weston report, the seismic hazards were found to be consistent with other hazard estimates made previously for the U.S. mid-continent. The report includes recommendations of site-specific seismic design criteria that take into consideration the soil overburden thickness determined from site investigations conducted at NECD in March 1998.

G.4 REFERENCES

Algermissen, S. T., and Hopper, M. G. 1984. *Estimated Maximum Regional Seismic Intensities Associated with an Ensemble of Great Earthquakes That Might Occur Along the New Madrid Seismic Zone, East-Central United States*, U.S. Geological Survey, Miscellaneous Field Studies Map MF-17 12, Denver.

Algermissen, S. T., and Perkins, D. M. 1976. *A Probabilistic Estimate of Maximum Acceleration in Rock in the Contiguous United States*, U.S. Geological Survey, Open-File Report 76-416, Denver.

ATC (Applied Technology Council) 1978. *Tentative Provisions for the Development of Seismic Regulations for Buildings*, ATC, National Bureau of Standards, Special Publication NBS SP-510, U.S. Government Printing Office, Washington, D.C.

Bemreuter, D. L., et al. 1989. *Seismic Hazard Characterization of 69 Nuclear Plant Sites East of the Rocky Mountains*, Vol. 1, NUREGICR-5250, prepared by Lawrence Liver-more National Laboratory for the U.S. Nuclear Regulatory Commission, Washington, D.C.

Black, D. F. B. 1986. "Basement Faulting in Kentucky," *Proceedings of the 6th International Conference on Basement Tectonics*, 125-39.

Blume (Jacobs Engineering Group, Inc., and URS/John A. Blume and Associates, Engineers) 1987. *Geological-Seismological Investigation of Earthquake Hazards for a Chemical Stockpile Disposal Facility at the Newport Army Ammunition Plant, Indiana*, contractor report to the U.S. Army Engineer Division, Huntsville, Ala., prepared under contract number DACA87-86-D-0085 by the Jacobs Engineering Group, Inc., San Francisco, and URS/John A. Blume and Associates, Engineers, San Francisco.

Braile, L. W., et al. 1982. "An Ancient Rift Complex and Its Relation to Contemporary Seismicity in the New Madrid Seismic Zone," *Tectonics* 1(2), 225-37.

Bristol, H. M., and Treworgy, J. D. 1979. *The Wabash Valley Fault System in Southern Illinois,* Illinois State Geological Survey Division, Circular 509, Urbana, Ill.

EPRI (Electric Power Research Institute) 1988a. *Seismic Hazard Methodology for the Central and Eastern United States*, Vols. l-10, EPRI Final Report NP-4726, Projects P101-38, -45, and -46 and 2556-14, EPRI, Palo Alto, Calif.

Hadley, J. B., and Devine, J. F. 1974. *Seismotectonic Map of the Eastern United States,* U.S. Geological Survey, Map MF-620, Denver.

Herrmann, R. B. 1981. "Progress in Modeling the Ground-Shaking Hazard," pp. 25-52 in *Earthquakes and Earthquake Engineering—Eastern United States*, ed. J. E. Beavers, Ann Arbor Science Publications, No. 1, Ann Arbor, Mich.

Johnston, A. C., and Kanter, L. R. 1990. “Earthquakes in Stable Continental Crust,” *Scientific American* 262, 68–75.

Keller, G. R., Bland, A. E., and Greenberg, J. K. 1982. “Evidence for a Major Late Precambrian Tectonic Event (Rifting?) in the Eastern Midcontinent Region, United States,” *Tectonics* 1(2), 213–23.

Mitchell, B. J., et al. 1992. “Seismotectonics of the Central United States,” *Neotectonics of* North *America*, DNAG volume, ed. D. M. Slemmons et al., Geological Society of America. CSMV-1.

NOAA (National Oceanic and Atmospheric Administration) 1989. *Computer-Stored Earthquake Data*, NOAA, Geophysical Data Center, Boulder, Colo.

Obermeier, S. F., et al. 1991. “Evidence of Strong-Motion Earthquake Shaking in the Lower Wabash Valley from Prehistoric Liquefaction Features," *Science* 25 1, 106 l-63.

Russ, D. P. 1982. “Style and Significance of Surface Deformation in the Vicinity of New Madrid, Missouri,” *Investigations of the New Madrid, Missouri Earthquake Region,* ed. F. A. McKeown and L. C. Pakiser, U.S. Geological Survey, Professional Paper 1236-H, Denver.

Sexton, J. L., et al. 1986. “Seismic Reflection Profiling Studies of a Buried Precambrian Rift Beneath the Wabash Valley Fault Zone," *Geophysics* 5 l(3).

Stauder, W., et al. 1976. “Seismic Characteristics of Southeastern Missouri as Indicated by a Regional Telemetered Microearthquake Array,” *Bulletin of the Seismological Society of America* 66, 1953-64.

U.S. 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.

VanArsdale, R. B. 1986. “Quatemary Displacement on Faults Within the Kentucky River Fault System of East-Central Kentucky," *Geological Society of America Bulletin* 97, 1382-92.

VanArsdale, R.B. and Sergeant, R.E. 1992. “Post-Pliocene Displacement of Faults Within the Kentucky River Fault System of East-Central Kentucky,” Kentucky Geological Survey Reprint 34, Series XI, Univ. of Kentucky at Lexington.

Weston 1998. *Probabilistic Seismic Hazard Analysis of the Newport AAP, Indiana, Chemical Agent Demilitarization Facility (Final Report Revision 01)*, prepared for Science Applications International Corp., Abington, Md., by Weston Geophysical Corp., Northboro, Mass., June.

Zoback, M. L., and Zoback, M. D. 1980. "State of Stress in the Conterminous United States," *Journal of Geophysical Research* 85, 6113-56.

APPENDIX H

PUBLIC COMMENTS ON THE DRAFT VERSION OF THIS ENVIRONMENTAL IMPACT STATEMENT

This appendix displays copies of letters received from agencies and the public commenting on the Draft Environmental Impact Statement (EIS). All letters received by the Army during the comment period (June 12 to July 27, 1998) are included verbatim. Two of the comments displayed in this appendix were received in writing during a public meeting held in Newport, Indiana, on July 7, 1998. Another set of remarks was provided at that meeting and is displayed in the transcript of that meeting in this appendix.

Individual comments from each agency or person were assigned numbers, as shown in boldface in the left margins of the letters displayed on the following pages. Army responses are provided on the right-hand side of the same page that displays the subject letter. In each response, the Army states either that (1) the text was revised for this Final EIS, (2) provides an explanation of why the text in the Draft EIS was adequate and did not need to be revised, or (3) answers questions that were asked by the commentor. If the response does not mention text revisions, then the corresponding text in the Draft EIS was not revised. Note that section numbers in this Final EIS are the same as those in the Draft EIS; however, page numbers referenced in letters commenting on the Draft EIS are not necessarily the same as the page numbers in this Final EIS.

INDEX TO COMMENTS AND RESPONSES FOR THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

Name	Affiliation	Comment Number(s)	Page Number(s)
Michael W. MacMullen	U.S. Environmental Protection Agency	1-l to 1-15	H-3 to H-10
Al Fenedick	U.S. Environmental Protection Agency	1A-1	H-11
Willie R. Taylor	U.S. Department of Interior	2-1 to 2-15	H-12 to H-16
Harvey W. Rodgers	Department of Health & Human Services (Center for Disease Control)	3-l to 3-4	H-17 to H-18
Larry D. Macklin	Division of Historic Preservation and Archaeology, Indiana Department of Natural Resources	4-1 to 4-3	H-19
Patrick R. Ralston	State Emergency Management Agency	5-l	H-20
Earl Charbagian	private citizen	6-l	H-21
Mark Hudson and Rainer Zangerl	on behalf of CAIN (Citizens Against Incineration at Newport)	7-1 to 7-8	H-22
Carolyn Jeffers and John Jeffers	private citizens	8-1	H-23
Marilyn Russell	private citizen	9-1	H-24
Louis Wailly	Medical Imaging Facilities, Inc.	10-l	H-25 to H-26
Kevin Rudduck	Environmental Coordinating Officer Newport Chemical Depot, Internal Army	11-1 to 11-7	H-27
Jerry Mullinix	Corps of Engineers, U.S. Army Engineer Division	12-1	H-28
Art Dohnrman	Corps of Engineers, U.S. Army Engineer Division	13-1 to 13-4	H-29
Dr. Sang	Corps of Engineers, U.S. Army Engineer Division	14-1 to 14-4	H-30
R. Waits	Corps of Engineers, U.S. Army Engineer Division	15-1 to 15-2	H-3 1
Transcript of Newport Chemical Agent Disposal Facility, Draft Environmental Impact Statement, Public information Session, on July 7, 1998. Lane Ralph, representing U.S. Senators Richard G. Lugar and Dan Coats.			H-32 to H-39

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

"JUL 2 8 1998

REPLY TO THE ATTENTION OF:
B-19J

U.S. Army Program Manager for Chemical Demilitarization
ATTN: Environmental & Monitoring Office (Matt Hurlburt)
Building E4517
Aberdeen Proving Ground, Maryland 21010-5401

Dear Mr. Hurlburt:

In accordance with our responsibilities under the National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act, the U.S. Environmental Protection Agency (U.S. EPA) Region 5 is providing comments lo your Agency on the Draft Environmental Impact Statement (DEIS) for the Pilot Testing of Neutralization/Supercritical Water Oxidation of VX Agent at Newport Chemical Depot, Indiana.

The proposed action would involve the design of a full-scale facility for the Newport Chemical Depot (NECD) with pilot testing lo be done on a single train of a multiple-train full scale facility. The VX agent would be neutralized with near boiling sodium hydroxide followed by the post-treatment step consisting of Supercritical Waler Oxidation (SCWO). The Department of Army proposes lo construct this facility by December 1999, run preoperational tests by March of 2002, begin pilot tests using VX agent by March 2003 end complete pilot testing, destroying approximately one-child of the VX arsenal (615 of 1690 Ion containers) by December 2003.

As discussed in this letter, U.S. EPA has specific objections with the DEIS for the proposed pilot testing of VX Agent. Wc have rated the DEIS for this project as a "EO-2". See the enclosed Summary of Rating Definitions. The "EO" rating has been used because the U.S. EPA has identified some potentially significant environmental impacts that may require substantial changes lo the preferred alternative or consideration of other project alternatives. The "2" rating has been used lo express U.S. EPA's concerns with the amount of information included in this DEIS to folly assess the impacts lo the environment. U.S. EPA also believes that additional alternatives within the spectrum of alternatives analyzed in the DEIS may have the potential lo reduce environmental impacts. Our objections are centered around the Range of Alternatives Evaluated, Scope, end Environmental Consequences Documented in the DEIS.

<u>Range of Alternatives Evaluated</u>

1-1 The U.S. EPA acknowledges the numerous studies that the Army has conducted to evaluate methods for destroying its chemical stockpile. For clarity in the FEIS, the Department of Army should make a concentrated effort lo specify when its research end its conclusions are directed et the entire chemical stockpile or when it applies strictly lo VX. The distinction between the lwo

1-1. Appendix A has been completely restructured in response to the comment. Information in the Draft EIS version of Appendix A refers to technologies for bulk agent stored at Aberdeen Proving Ground (mustard agent I-ID) and Newport Chemical Depot (VX agent). Table A.2 applies to mustard agent as well as nerve agents VX and GB.

was not always apparent in the DEIS and this could have led to confusion. For example, it is not clear in Table A-2 if the alternative technologies studied were considered as methodologies for the entire chemical stockpile or just for VX.

At the time the Final Programmatic EIS for Chemical Stockpile Disposal Program (CSDP) was published in 1988, high temperature incineration was identified as the preferred alternative. The U.S. EPA understands and supports the need of the CSDP to evaluate technological alternatives to incineration. The studies conducted by the Alternative Technologies Program (ATP) and the U.S. Army's Program Manager for Chemical Demilitarization (PMCD) starting in 1993 and continuing through 1996 have all evaluated relevant alternative technologies that could be used for destroying the VX stockpile. All studies have indicated that the neutralization process along with some other post-treatment should be brought forward to the pilot stage [National Research Council (NRC) and ATI' studies in 1994). Subsequent studies by Science Applications International Corp. (SAIC) in 1995 and the U.S. Army Materiel Systems Analysis Activity (AMSAA) in 1996 indicated that other alternatives in addition to the SCWO method such as the electrochemical oxidation method and the molten metals method could also be applied to the VX stockpile. These alternatives were described as being advanced and safe technologies that have been demonstrated at the commercial scale. The 1996 NRC report recommended neutralization and off-site post-treatmend, on-site commercial processes other than biodegradation and electrochemical oxidation (in that order). No mention was made of the supercritical water oxidation methodology but instead the electrochemical oxidation method was discussed as the
1-2 technology that should be pilot tested at the Newport site. It is not clear how the 1995 and 1996 studies were accounted for in the decision to pilot test the SCWO methodology. Thus, the decision to evaluate only SCWO for use in conjunction with the neutralization process in the pilot test program has not been well established by the studies summarized in the DEIS.

1-3 The 1994 Army report to Congress discussed the Army's conclusion that further evaluation of the technical, cost, and schedule implications of other post-treatment technologies led the Army lo pursue chemical neutralization followed by SCWO as the methodology to use for the NECD stockpile. This conclusion is not supported in the DEIS because the basis for eliminating other post-treatment methodologies from consideration in a pilot test is not adequately described in the DEIS. If technical, financial or scheduling constraints are the basis for eliminating alternative technologies from pilot test consideration then additional supporting documentation is needed in this DEIS to support that claim. The U.S. EPA believes that these other methodologies should be included as alternatives for study under the pilot test Environmental Impact Study or substantially more information should be included to demonstrate why these methodologies have been eliminated from further consideration.

1-4 Similarly, the on-site neutralization/off-site disposal option should be further addressed in the Final Environmental Impact Statement (FEIS). Reasons for eliminating this as an option must be clearly articulated. Additionally, the forthcoming report to be issued by the Alt Tech Panel will assess whether the alternative technologies are at a level of maturity and efficiency to be
1-5 considered for pilot demonstrations. This assessment would be instrumental in the this pilot

1-2. Appendix A has been completely restructured in response to the comment. The Army hopes that the new version of Appendix A provides the clarification requested in the comment.

1-3. Text has been added to Appendix A (see Sect. A.5 in the revised Appendix) characterizing the selection of SCWO in response to the comment. In addition, Sect. 1.6.2 has been revised to incorporate the new information provided in Appendix A.

In regard to the range of viable alternatives, it is emphasized that the proposed action is a research and development activity focused on the disposal of bulk agent VX stored at NECD, rather than an operational component of the Chemical Stockpile Disposal Program.

The proposed pilot facility would use a chemical neutralization process followed by supercritical water oxidation (SCWO) of the neutralization reactor effluent (also called hydrolysate) to destroy a portion of the nerve agent VX current stored at NECD to determine whether these processes could be a potentially viable disposal option for the remainder of the NECD inventory of chemical agent.

1-4. Text has been added to Sect. 1.6.2 to provide the information requested in the comment.

1-5. The findings and recommendations of the recently released report of the NRC (the report referenced in the comment) have been included in Section A.5.2 in Appendix A. The NRC identified a number of technical challenges facing SCWO that are currently being addressed in ongoing R&D of the Alternative Technologies and Approaches Program of PMCD. These include, but are not limited to, materials of construction for the SCWO reactor vessel, destruction kinetics of SCWO, and full-scale performance of the proposed NECDF SCWO installation. Lessons learned from this ongoing R&D will be incorporated into the design and operation of the proposed facility.

3

1-6 decision and it should be considered prior to project implementation. The memos generated by the Assistant Secretary of the Army for Research, Development and Acquisition and the Defense Department Acquisition Executive referenced in the DEIS and shown in the Appendices only serve to show that the pilot plant should utilize the neutralization methodology. Neither memo specifies the post-neutralization step that should be used in the pilot, In fact, the Assistant Secretary of the Army letter discusses on and off-site post treatment alternatives without specifying the supercritical water oxidation method.

Scope

1-7 For the reasons stated above, the U.S. EPA does not agree with the statement made on page I-8 that "A detailed evaluation of the potential environmental impacts from additional alternative disposal technologies is beyond the scope of this EIS." NEPA requires that a rigorous exploration and objective evaluation of all reasonable alternatives is conducted and documented. Explanations as 10 the reasons why alternatives were eliminated from detailed study also need lo be included in DEIS. Ultimately the EIS should fully evaluate and discuss each alternative considered in detail so that reviewers may evaluate their comparative merits.

1-8 The U.S. EPA is also concerned with the lack of any documentation in the DEIS io support the destruction of one-third of the VX arsenal under a pilot test mode. it appears that the objectives of a pilot-testing facility may be achieved much earlier in the scheduled 9 months of pilot testing with VX. The Department of Army should either evaluate additional upper limit quantities for pilot testing or substantiate why the treatment of the contents of615 ton containers is necessary to achieve pilot test goals.
1-9 The Army may also want to consider the alternative of linking the successful completion of the pilot program with the treatment of the total inventory of VX agent. Assuming that the pilot test mode of the proposed project preforms as described in the DEIS, this analysis and documentation could eliminate the need for any additional NEPA documentation for the destruction of the remaining VX agent.

Environmental Consequences Documented in the DEIS

U.S. EPA has concerns regarding the incomplete document&ion of environmental impacts. The initial steps of the proposed action include moving the ton containers from the existing storage warehouse to the proposed facility and mechanically punching the containers, allowing the VX to
1-IO drain and pumping the material into a holding lank. Material handling, storage and transport are operational steps that often contribute lo accidents and spills. The amount of information in the DEIS regarding each of these steps is inadequate for any chemical but especially inadequate given the toxicity of the VX agent. The FEIS should document in detail how the containers will be transported, drained, and how the VX will be pumped etc. The design and operation of this process are critical to avoiding accidents and spills. In particular, the FEIS should address the
1-11 types of secondary containment and other spill prevention measures that will be used when transporting containers.
1-12 To the extent that indoor transport of the material is possible it should be preferred over outdoor transport where spills would be harder IO contain. The Department of

1-6. Text has been added to Sect. 1.3.2 to more clearly define the Army's decision process and the role of the letters referenced in the comment on that decision process. The Test and Evaluation Master Plan (TEMP) is the management document specifying the requirements of the test program that must be obtained in each part of testing. The document has a number of testing phases, called milestones. At each milestone the Army decision authority, upon obtaining test results, independent evaluations, and recommendations from the program manager, will decide whether or not the project can proceed to the next phase. The criteria on which the decision is made, called critical technical parameters, are defined in the TEMP. Failure to obtain a critical technical parameter will result in a determination that the program has failed.

The milestone 0 decision is the decision to pursue testing for an alternative technology. Congress made this decision. Milestone 1-2 has been described thoroughly in this document. It was the decision to perform laboratory and bench scale testing (the Kaminski and Decker letters referred to in the comment). Milestone 3 is the decision that pilot testing on a full scale unit has been successful and it is permissible to destroy the stockpile at Newport. The Milestone 3 decision would be made by the same decision authorities as made the Milestone 1/ 2 decision.

Additional information regarding the testing program and the schedule for different stages of testing has been added to Sect. 2.2.1 of this Final EIS.

See also response to Comment I-5.

1-7. See responses to Comments 1-3 and 1-4.

1-8. The number of ton containers (615) mentioned in the EIS is representative of the upper limit on the amount of agent VX that could be required during completion of all aspects of the Army's proposed pilot-plant and demonstration test, Additional discussion of the test and evaluation program planned for the proposed action, including testing to date as well as critical technical parameters, plant availability, processing rates, and total agent to be destroyed during the proposed pilot-plant testing of NECDF, has been added to Sect. 2.2. 1 of this Final EIS. Table 2.3 has also been revised to incorporate additional information regarding test parameters and objectives.

1-9. The Army cannot link the successful completion of the pilot program with the treatment of the total inventory at NECD because the pilot program is a research and development activity and not an operational part of the Chemical Stockpile Disposal Program (CSDP). If the neutralization/SCWO technology is successful (as the Army anticipates it will be), the Army can at that time recommend to Congress that the CSDP he modified to incorporate the use of this alternate technology for the NECD inventory. Neither that recommendation nor the assessment of impacts resulting from the use of neutralization/SCWO for the remainder of the NECD inventory can precede the successful completion of the proposed R&D effort. See also the response to Comment l-6.

l-10. As stated in Sect. 1.5 of the EIS, the specific design details for the proposed facility have not yet been finalized. Such details, as requested in the comment, will be available for public and agency review as part of the RCRA permitting process for the facility. Operations inside the proposed facility will be conducted within ventilated rooms and enclosures that move the air from areas of least contamination potential to areas with greater contamination potential. The atmospheric discharge of this air is accomplished only after passing through carbon filtration designed to remove any VX agent present in the air. In addition, there is no potential for discharge of liquid effluents to surface waters on NECD since all such effluents will be discharged to the wastewater treatment plant at NECD prior to discharge to the Wabash River.

See also response to Comment l- 11.

l-11. The agent in the ton containers will be monitored in the storage building. It will then be transported by forklift from the storage building to the demilitarization plant, where it will be monitored again. Once in the building it is in a ventilated area with secondary containtnent.

The metal shells of the ton containers themselves provide a substantial degree of containment to prevent spills. The Army has a Chemical Accident and Incident Response and Assistance (CAIRA) and a Spill Prevention Plan in place at NECD. Policies and procedures in these documents provide the information requested in the comment.

In regard to transportation of containers from storage to the proposed facility, the transport distance for any individual container would be less than 250 feet and would be accomplished by forklift. In the event of a VX spill, the agent itself is not very susceptible to evaporation (Le., it was designed to be a persistent warfare agent). Spill response teams would be positioned nearby to quickly contain any accidental spills. In addition, previous risk assessments have established a probability in the range of one in ten billion for a forklift accident releasing quantities of VX that could produce lethal airborne concentrations more than 1500 feet downwind.

1-12. See the response to Comment 1-11. The Army believes that the lack of potential risk obviates the need for an enclosed transportation corridor. The Army intends to conduct appropriate safety reviews of its proposed transportation plan to ensure the level of safety suggested in the comment.

Army should consider the safest means of transporting the ton containers as possible.

1-13 The **DEIS** continually refers to the need for the Newport Chemical Agent Disposal Facility (NECDF) to acquire Resource Conservation and Recovery Act (RCRA), Clean Air Act (CAA), and Clean Water Act (CWA) permits. The FEIS should specify the parts of the process that require such permits. The FEIS should clearly specify if VX, the VX hydrolysate, and the liquid/solid wastes from the SCWO process are RCRA regulated hazardous wastes. Also, the
1-14 FEIS should **specify** how the Department of the **Army** calculated the volume and concentrations of gaseous emission (Table **2.8),** solid waste (Table 2.9). and Process liquid **effluents** (Table 2. IO), were generated.

1-15 The U.S. EPA is concerned by **the** statement on page 1-9, that indicates the U.S. EPA is a cooperating agency on this project. Appropriate staffmembers of the U.S. EPA in Region 5 and within the **Office** of Federal Activities are not aware of any agreement by this agency to act in the capacity of a "Cooperating Agency" for the VX pilot project. This point should be corrected or clarified in the FEIS.

Thank you for the **opportunity** to review and provide comments on this **DEIS.** We are willing to meet and discuss our comments with you. If you should have any questions about this matter, please contact Sherry **Kamke** at 312-353-5794.

Sincerely,

Michael W. **MacMullen**
Manager, Environmental Review Group
Office of Strategic Environmental Analysis

Enclosure

cc: Kevin Rudduck, Newport Chemical Depot

1-13. None of the information provided in the permit applications referenced in the comment have yet been approved by the State of Indiana or EPA. The status and/or processes associated with these permit applications is described in new text added to Sect. 4.9 in this Final EIS. RCRA and NPDES permit applications have already been submitted to the State of Indiana and EPA. Information in those applications were obtained from bench-scale testing and engineering evaluations (see response to Comment 1-14).

1-14. Text has been added in sect. 2.2.3.4 to explain how volumes and concentrations in the referenced tables were calculated. Engineering evaluations, based on a variety of standard approaches (including mass/material balance, energy balance, design information, applicable method detection limits (MDLs), theoretical chemistry, process calculations, and design requirements/specifications) and sources (including RCRA Part B and NPDES permit applications) were used to develop these values.

I-15. Representatives of EPA Region 5 RCRA office were involved in the WIPT and the cooperating agency review meeting of the Draft EIS. The Army mistakenly assumed that constituted cooperating agency status and regrets the misunderstanding.

SUMMARY OF RATING DEFINITIONS
AND FOLLOW UP ACTION*

Environmental Impact of the Action

LO-Lack of Objections
The EPA review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

EC-Environmental Concerns
The EPA review has identified environmental impacts that should be avoided in order to fully protect the envimnment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impacts. EPA would like to work with the lead agency to reduce these impacts.

EO-Environmental Objections
The EPA review has identified significant environmental impacts that must be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

EU-Environmentally Unsatisfactory
The EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potential unsatisfactory impacts are not corrected at the final EIS sate, this proposal will be recommended for referral to the CEQ.

Adequacy of the Impact Statement

Category 1-Adequate
The EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alterative and those of the alternatives reasonably available to the project or action. No further analysis or data collecting is necessary, but the reviewer may suggest the addition of clarifying language or information.

Category 2-Insufficient Information
The draft EIS does not contain sufficient information for the EPA to fully assess the environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the

action. The identified additional information, data, analyses, or discussion should be included in the final EIS.

<u>Category 3-Inadequate</u>
EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the NEPA and/or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

*From EPA Manual 1640 Policy and Procedures for the Review of the Federal Actions Impacting the Environment

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

REPLY TO THE ATTENTION OF:
B-19J

NOV 0 3 1998

U.S. Army Program Manager for Chemical Demilitarization
ATTN: Environmental & Monitoring Office (Matt Hurlburt)
Building E4517
Aberdeen Proving Ground, Maryland 21010-5401

Dear Mr. Hurlburt:

This letter is a follow-up to the information provided by the Department of Army in response to the U.S. EPA comments on the Draft Environmental Impact Statement for the Pilot Testing of Neutralization/Supercritical Water Oxidation of VX Agent at Newport Chemical Depot, Indiana.

As we communicated to you by way of our July 28, 1998 letter, US. EPA expressed objections with the Draft Environmental Impact Statement for the proposed pilot testing of VX Agent. Specifically, our objections were based on information documented in the DEIS dealing with the Range of Alternatives Evaluated, Scope of the DEIS, and Environmental Consequences Documented in the DEIS. The changes that you have proposed in your Preliminary Final Environmental Impact Statement as amended by information supplied in your October 28, 1998 letter will address the issues that we have articulated in our July 28, 1998 letter. Unless significant changes warrant the identification of new issues, we will provide your agency with a letter removing our environmental objections to the proposed project when we have completed our review of the Final Environmental Impact Statement.

We understand that additional National Environmental Policy Act (NEPA) documentation will be prepared for any stockpile destruction activities that will occur at the Newport Chemical Depot beyond the scope of this pilot test and we will look forward to reviewing that subsequent NEPA documentation.

We appreciate your responsiveness to our letter. If you have any questions, please contact Sherry Kamke at 312-353-5794.

Sincerely,

Al Fenedick

Al Fenedick
Acting Manager, Environmental Review Group
Office of Strategic Environmental Analysis

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DEPARTMENT OF THE ARMY
PROGRAM MANAGER FOR CHEMICAL DEMILITARIZATION
ABERDEEN PROVING GROUND, MARYLAND 21010-5401

November 4, 1998

Environmental and
Monitoring Office

Mr. Al Fenedick
Acting Manager,
Environmental Review Group
office Of strategic Planning Analysis
United states Environmental
Protection Agency
Region V
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

Dear Mr. Fenedick:

I am writing in response to your November 3.1998 letter concerning the Draft Environmental Impact Statement for Pilot (DEIS) Testing Neutralization/Supercritical Water Oxidation of VX Agent stored at Newport Chemical Depot, Indiana. I appreciate the recent opportunity to work with your staff in developing responses to improve the DEIS. I look forward to working with your staff in the future on this program of extreme national importance.

My point Of contact for this action is Mr. Matthew Hurlburt, at 4204367027.

Sincerely,

Charles Shaheen
for William J.B. Pringle
Chief, Environmental and
Monitoring Office

Printed on Recycled Paper

United States Department of the Interior

OFFICE OF THE SECRETARY
Washington, D.C. 20240

SEP 1 1998

ER-98/452

Mr. Matt Hurlburt (SFAE-CD-M)
Program Manager for Chemical
Demilitarization
Department of the Army
Aberdeen Proving Ground, Maryland 21010-5401

Dear Mr Hurlburt:

The Department of the Interior has reviewed the Draft Environmental Impact Statement (DEIS) for the Pilot Testing of Neutralization/Supercritical Water Oxidation of VX Agent at Newport Chemical Depot (NECD), Indiana, dated April 1998, and is providing the following comments for your consideration.

Habitat and Surface Water Quality

Water quality issues are of major concern for Indiana rivers and streams. The DEIS does an adequate job of addressing most of the construction and operational impacts of the proposed project on wildlife habitat and water quality, but some additional information on the existing water quality of surface systems would be useful. Section 3.4.2 (page 3-35 of DEIS) indicates that the
2-1 streams draining the NECD site are polluted by several different types of waste. The general chemical character of streams draining the NECD site should be documented in the DEIS. All the
2-2 streams draining the NECD site should be sampled at least monthly to obtain background information on water quality, Information on how the biological resources (flora and fauna) in this area are monitored for potential health effects should also be provided.

2-3 Some additional clarification of potential construction impacts is also needed. Section 4.1.1.1 (page 4-2 of DEIS) indicates that small quantities of construction-related seepage that discharged into Raccoon Creek would be diluted to acceptable levels during the rainy season, but during drier times of the year seepage would flow undiluted downstream into the Wabash River. This information does not seem to support the concept of no impact to water resources. If "small quantities" are diluted to acceptable levels during the rainy season, does that imply that the impact of quantities discharged during dry seasons are unacceptable or unknown? If this is unknown, a monitoring procedure should be established to assess the risk.

In addition to concerns regarding potential construction runoff and sedimentation, the U.S. Fish

2-1. See discussion of the chemical character of the streams draining the NECD in Sect. 3.3.1.1.

2-2. The Army is committed to monitoring the discharge from the proposed pilot plant. The construction and operation of this facility should not force additional monitoring on streams that are not currently monitored or affected by the proposed action. The storm water run off from the proposed facility will be collected in a detention basin, which will discharge to Little Racoon Creek. Since the agent and disposal operations are multiply contained within the demilitarization buildings, there is virtually no possibility of rainwater coming into contact with the process. Consequently, there should be no requirement for additional monitoring.

2-3. The text in the Draft EIS states that no *permanent* adverse impacts to land or surface water would be expected to occur during construction. Permanent impacts would not occur because flushing by increased flows in Little Racoon Creek during the rainy season in the winter and spring would remove undiluted construction-related contaminants deposited along the streambed during the drier summer and fall months. Impacts would be temporary. The text in Sect. 4.1.1.1 has been revised in the Final EIS to clarify the situation.

No monitoring procedure needs to be established to assess risk associated with deposition of construction-related contaminants in and along Little Racoon Creek. Hazardous chemicals would only impact the creek during an uncontrolled accidental spill. The spill would be cleaned up before the creek was impacted and in accordance with the NECD spill prevention, control, and countermeasures plan. Impacts from a spill that was unattended would be temporary. The contamination would be carried to the Wabash River during the rainy season in the winter and spring and then diluted to acceptable levels.

Mr. Hurlburt 2

and Wildlife Service (FWS) has serious concerns regarding contaminant-related toxicity to the aquatic community of the Wabash River. The Review DEIS (RDEIS), dated December 1997, mentioned in several instances that additional tests would be developed to further determine the
2-4 toxicity of the effluent the facility plans to discharge to the Wabash River. While the results of several additional toxicity tests performed after the release of the RDEIS have been addressed in the present document, those tests appear to only address acute toxicity (with the exception ofthc short-term, '|-day toxicity test for *Ceriodaphnia dubia* survival). and not chronic exposure.

In addition, the RDEIS indicated that a monitoring program would be established in order to determine contaminant concentrations in the effluent, receiving stream, and aquatic biota. This proposed monitoring program for VX, VX breakdown products, and other contaminants has been dropped from further consideration and is not discussed iii the current DEIS. We strongly recommend that monitoring occur, as was discussed in the RDEIS, for contaminants being
2-5 discharged into the Wabash River since all of the estimates of final effluent and instream concentrations, as well as toxicity calculations, are bawd on theoretical values and bench-scale tests. This monitoring should include additional aquatic bioassays using actual effluent grab samples once the plant is in operation. We also recommend that invertebrate complete life-cycle toxicity tests and short-term chronic tests for fathead minnow survival and reproduction be performed. Implementation of the monitoring and chronic toxicity testing would substantially dish our concerns with the contaminant-related aspens of the proposed process. particularly if the facility continues to operate beyond the pilot-test phase. From a public relations perspective, this type of approach may also help to alleviate concerns in surrounding communities. The above recommendations will also be reflected in the comments of the FWS regarding any forthcoming permit applications or modifications.

The RDEIS includes a significant discussion of the potential toxicity of several of the breakdown products of the VX neutralization process, including the compounds ethyl methyl phosphonic acid (EMPA) and methyl phosphonic acid (MPA). Both of these compounds have been described as potentially being harmful to aquatic organisms within the mixing zone area (RDEIS, 1997). Subsequent information indicates, however, that at the detection limits available. these breakdown products of concern are not detected in the final effluent (DEIS, 1998. and personal communication, Greg Zimmerman, Oak Ridge National Laboratory, Oak Ridge, Tennessee, to
2-6 FWS). The FWS encourages further refinement of detection methods for such compounds as EMPA and MPA in order to ensure the protection of aquatic biota near the effluent discharge, especially if this process in to be utilized at additional facilities in the future.

Groundwater Quality

Section 3.3.2.4 (page 3-21 of DEIS) indicates that the site is characterized as one that has several sources of contamination. Consequently, more multi-level monitoring wells should be located
2-7 closer to the boundaries of the NECD site to detect contamination of groundwater leaving the site. The depth of monitoring wells is not shown on Fig. 3.6, and this factor is important in order to know the effectiveness of the monitoring program. The dates of sampling for Fig. 3-6 should

2-4. The exposure times for bioassays directed at fathead minnow survival and growth and *Ceriodaphnia dubia* reproduction were erroneously listed in Table 4.6 as only 48 hrs long, when in fact they were all seven days long. Note also that the algal growth test was 96 hrs long, not 100 hrs as indicated in the table. The exposure durations have been corrected in Table 4.6 of the Final EIS.

2-5. As part of the environmental permitting process, the Army has submitted monitoring plans in permit applications. The NECDF RCRA Part B permit application includes a Preliminary Assessment of Health Impacts (AHI), which uses toxicity data from bench scale tests to assess potential impacts to human health and the environment. A Final AHI will be conducted as part of the Demonstration Test for the operational facility. This analysis will use samples and data collected during the Demonstration Test, which will be overseen by regulatory officials. The specifics of the Demonstration Test are to be negotiated with the Indiana Department of Environmental Management during their review of the Demonstration Test Plan, a document that must be submitted and approved before the Demonstration Test can begin.

See also response to Comment 2-4.

2-6. The Army notes the recommendations regarding enhancements to detection methods. However, at the current detection limits, it is not anticipated that significant adverse impacts to aquatic biota will occur given the extremely low toxicity of the SCWO effluent, particularly after orders of magnitude dilution through the NECD POTW and in the Wabash River.

2-7. No liquid effluent from NECDF will be released to any area with the potential for groundwater contamination. There is, thus, no need for additional groundwater monitoring wells closer to the NECD site associated with this proposed action.

The effectiveness of the groundwater monitoring program for existing contamination at NECD is not relevant to the proposed action. Additional information regarding the depth of monitoring wells, the data collection dates, and sampling frequency for the wells shown in Fig. 3.6 will be provided under separate cover.

Mr. Hurlburt 3

also be provided, along with information on sampling frequency for the wells and whether all aquifers are adequately sampled.

2-8 Table 3.5 (page 3-26 of DEIS) provides some information on groundwater quality of aquifers beneath NECD. However, the overall chemical character of the groundwaters in these aquifers, including information on whether organic pollutants have been detected in water samples, is not provided. Table 3.5 should be expanded in this context

2-9 Page 3-27 of the DEIS indicates that many wells are located in close proximity (2 miles) of the NECD site. Because the surface water and groundwater are interrelated, a hydrogeologic map that shows wetlands and potential groundwater recharge areas is necessary to understand where protection may be needed and should be provided in the EIS.

Federally Listed Species

2-10 The DEIS states that a Biological Assessment (BA) is being prepared to address potential impacts to federally protected species and habitat within 100 km of the NECD. There are two species which are known to occur on or very near (less than 3 miles) the NECD: the Indiana bat (*Myotis sodalis*) and the bald agle (*Haliaeetus leucocephalus*). Our concerns, with regard to the eagle and bat, include impaa s to habitat from construction activities (including tree clearing for the creation of a detention pond [page 2-13 and personal communication of FWS with Kevin Rudduck, Assistant Environmental Engineer for the NECD]), as well as degradation of water quality from construction run-off and effluent discharge. The FWS will perform a separate evaluation of impacts to federally listed species pursuant to section 7 of the Endangered Species Act, as amended. The PWS will provide detailed comments regarding federally listed species after reviewing the BA,

Specific Comment.5

2-11 On the bottom of page xx the text states: "At the proposed site (i.e. adjacent to the Building 144), ..no prime farmland, threatened and endangered species, wetland, or floodplain would be adversely affected by construction." It is our understanding that just south of the proposed fence line around the facility, a number of trees will be removed, and a darn created at the headwaters of a small tributary to Little Raccoon Creek.

2-12 The impacts from this project are not discussed specifically in the DEIS. Then may, in fact, be some adverse effects to the floodplain area of Little Raccoon Creek. In addition, in June 1998, an Indiana bat was captured less than 0.5 miles from the proposed site along Little Raccoon Creek (Phil Cox, personal communication lo FWS). This issue will be discussed in the BA submitted to the FWS (Matt Hurlburt, personal communication to FWS),

2-13 Table 2.11 on page 2-30 indicates that no unique or rare animal species are expected to be affected by construction activities. We would like to point out that the newest bat record (June 1998) and proposed detention pond construction appear to not be considered in this table.

2-8. The comment is not relevant to the proposed action and its potential impacts. See response to Comment 2-7.

2-9. A wetlands delineation for the area of the proposed pilot plant site, including the stormwater detention basin, has recently been completed and has been forwarded to the appropriate authorities for a wetlands determination. That delineation did not find any wetlands within the area of the proposed site.

The presence of the proposed facility would require that the surficial glacial till be disturbed. The resultant unclassified backfill would be very porous and would promote seepage/recharge into the ground. Conversely, the glacial till, where undisturbed, is not very porous; incident precipitation tends to run off rather than seep into the ground. Groundwater bearing sand and gravel lenses have not been mapped in the glacial till beneath the site for the proposed facility. If present, these lenses would be connected hydrologically to the recharge area created by the presence of unclassified backfill.

The sand and gravel aquifers within the glacial till would only be impacted if an accidental spill occurred. This is discussed in Sect. 4. 1.4.2. The system of curbs, berms, sumps, and concrete slabs would contain an accidental spill within the facility. The impacts of a spill outside the facility are also discussed in Sect. 4. I .4.2. Clearly, a spill outside of the proposed facility that went unattended would seep into the ground because of the presence of unclassified backfill. Additional discussion of potential impacts to the sand and gravel aquifers has been added to Sect. 4.1.4.2 of this Final EIS.

2-10. The comment is noted. These concerns are addressed in the Biological Assessment (BA) (see Appendix D in this Final EIS). Also see text changes in this Final EIS discussing tree clearing and the detention pond in Sect. 2.2.2.4 and the impacts of these actions on the Indiana bat and the bald eagle in Sects.4.1.1.4and4.1.2.4.

2-1 1. Additional text has been added to Sect. 4. 1.1 and the Executive Summary of the Final EIS discussing the environmental impacts attributable to construction of the stormwater detention basin, including tree clearing. This discussion includes consideration of hydrology, floodplains, and aquatic and terrestrial resources. No significant impacts to these resources are expected as a result of construction and operation of the stormwater detention basin.

2-12. The comment is noted. Section 4.1.1.4 has been updated accordingly.

2-13. Although no significant impacts to unique or rare animal species are expected, Table 2.11 has been revised in this Final EIS to incorporate this information.

Mr. Hurlburt 4

2-14 On pages 4-6 and 4-7, the section on terrestrial resources indicates that no rare or unique plant or animal resources occur within the proposed pilot test facility or support facility construction areas. Furthermore, the report states: 'Due to the distances of the proposed site from sensitive ecological resources, impacts to them from construction are considered unlikely.' This section should be revised to include the new bat data, as well as information regarding the construction activities for the proposed detention pond.

2-15 The section on threatened and endangered species (page 4-7) states that the closest roost and suitable foraging area for Indiana bats is 1.5 km (0.9 miles) from the pilot-tea facility. New information indicates that Indiana bats are foraging along Little Raccoon Creek, less than 0.5 miles from the facility. In addition, construction of the detention pond. which will remove suitable foraging habitat for the bats, is proposed to occur at the headwaters of the creek. This section of the EIS should be revised to include this new information

The FWS, on behalf of the Department, has a continuing interest in working with the Department of the Army to ensure that impacts to fish and wildlife resources are adequately addressed. for further consultation and coordination on threatened and endangered species and fish and wildlife resources, please contact the Acting Field Supervisor, U.S. Fish and Wildlife Service, 620 South Walker Street, Bloomington, Indiana 47403-2121, Telephone: (812) 334-4261, or Ms. Robin McWilliams, project biologist. at (812) 334-4261 at. 207.

Thank you for the opportunity to provide these comments.

Sincerely,

Willie R. Taylor
Director. Office of Environmental
Policy and Compliance

2-14. The comment is noted. Pages 4-6 and 4-7 have been updated accordingly.

2-15. See response to Comments 2-10, 2-11, 2-12, and 2-13.

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Control and Prevention (CDC)
Atlanta GA 30341-3724

20 July 98

July 15, 1998

William J. B. Pringle, Chief
Environmental and Monitoring Office
Department of the Army SFAE-CD-ME (50q)
Program Manager for Chemical Demilitarization
Aberdeen Proving Ground. MD 21010

Dear Mr. Pringle:

Thank you for providing us with the opportunity to review the latest Draft Environmental Impact Statement (DEIS) for the "Pilot Testing of Neutralization/Supercritical Water Oxidation of VX Agent at Newport Chemical Depot, Indiana", dated April 1998. As you m&y be aware wc reviewed and commented upon an earlier draft of the same document dated December 1997. These comments were transmitted to LTC Joseph Pecoraro, Program Manager for Alternative Technologies and Approaches, in early January 1998. and a copy is enclosed for your information.

3-1 As noted in our previous comments, we generally concurred with discus.400 and analysis of the potential human exposure pathways as described in that document. Also our specific comments were addressed in the updated draft. However, our generic questions regarding the air exposure

3-2 pathway and non-agent, potentially toxic compound emissions are only vaguely addressed. There is some discussion of modeling results showing increases to some of the common criteria-type pollutants that seems to demonstrate no significant impact on background levels of these pollutants. There is also indication of agent monitoring between the beds of the charcoal filters, which is clearly appropriate. This leads us to our two pertinent questions:

3-3 1. How will the source terms used to model increments to the criteria pollutants be verified? Will there be initial or periodic sampling for these emittents? Are any CEMS. other than for agent, planned or needed?

3-4 2. How can it be verified that non-agent organics are not passing through the filter banks? Will there be any sampling for THCs or VOCs, initially or routinely? Will there be any attempt to characterize gaseous emissions against the battery of known "hazardous air pollutants (HAPS)?

Intuitively, we would not anticipate significant releases of organic compounds given the redundancy of the carbon filters; however, it is not clear that this expectation will be verified.

3-1. The comment is noted.

3-2. All gaseous emissions produced within the CDB will be passed through the filtration system. This includes redundant activated carbon beds. As noted in Sect. 2.2.3.4, if breakthrough of a hazardous air pollutant is detected in the first of a series of charcoal beds, vent gas would be redirected to one of the two backup beds, and the spent bed replaced. From another perspective, Table 2.8 in the Final (and Draft) EIS presents calculations of gaseous emissions to total organic compounds at a daily rate of 0.003 lb. This suggests and approximate 5 ppb total organic emission given an air discharge of about 600,000 lb/day. Out of the 50 different organic materials looked for in a study of volatile organic compounds (VOCs) production, only S were detected, and these were between 9 and 41 ppb. A conservative (i.e., maximum) estimate of the maximum VOCs might be 40 ppb x 5, or 200 ppb of total VOCs. Assuming the average dilution in air going from the source to the receptor [assumed to be a resident 1 km (0.6 mile) from the source] is a minimum of 1: 1,000, this results combined VOC exposure of 0.2 ppb. If one further assumes that the VOCs are made up of some of the most hazardous VOCs (represented by chlorinated solvents), an upper limit of cancer risk could be estimated to be very much smaller than 1×10^{-6}.

3-3. Periodic monitoring is anticipated to be part of the RCRA and NPDES permits to be issued by the Indiana Department of Environmental Management. Likewise, the proposed NECDF will use monitoring of some parameters (e.g., total organic compounds, pH, and carbon monoxide) to monitor the operational efficiency of tbe facility.

3-4. Agent and THC analyzers will be placed at multiple sampling locations along the carbon filter beds. Data will be collected during the Demonstration Test for emissions to be used in the Assessment of Health Impacts.

Page 2 - Mr. Pringle

Again, we appreciate the opportunity to review this DEIS, and we hope that you find our brief comments helpful. If you have any questions, please feel free to contact me at 770 488-7092.

Sincerely,

Harvey W. Rogers

Harvey W. Rogers, M.S.
Special Programs Group, NCEH

cc: Michelle Timmerman, IDEM
Ken Holt, SPG, NCEH

INDIANA DEPARTMENT OF NATURAL RESOURCES — LARRY D. MACKLIN, DIRECTOR

Division of Historic Preservation
and Archaeology
401 W. Washington St., Room W274
Indianapolis, Indiana 46204
E-mail: dhpa_at_dnrlan@ima.isd.state.in.us
(317) 232-1646
(317)232-0693 FAX

April 14, 1998

Joseph E. Pecoraro, LTC, CM
Project Manager for Alternative
Technologies and Approaches
Department of the Army
Program Manager for Chemical Demilitarization
Aberdeen Proving Ground, Maryland 21010.5401

Dear Mr. Pecoraro:

We have reviewed the draft environmental impact statement for the chemical depot agent disposal facility pilot plant at the Newport Chemical Depot in Vermillion County, Indiana [Project #SFAE-CD-A(50Q; DNR #6766]. This review is being conducted pursuant to Section 106 of the National Historic Preservation Act (16 U.S.C. Section 470f) and implementing regulations found at 36 C.F.R. Part 800.

4-1 No known historic buildings, structures, objects or districts listed in or eligible for inclusion in the National Register of Historic Places will be affected by this project.

4-2 Our records indicate that any undisturbed portions of the proposed project area have a potential to contain archaeological resources. As such, a reconnaissance level archaeological survey will be required of all portions of the project area that have not been disturbed by previous construction. The survey must be done in accordance with the Secretary of the Interior's "Standards and Guidelines for Archaeology and Historic Preservation" (48 FR 44716). A description of the survey methods and results must be submitted to the Division of Historic Preservation and Archaeology for review before we can comment further. Please refer to the enclosed list of qualified archaeologists.

4-3 In the event that sites which are eligible for the National Register are discovered, the applicant must follow the rules and regulations established by the Advisory Council on Historic Preservation (found at 36 CFR Part 800) to implement federal Public Laws 89-665, 94-422, and 96-515, and Executive Order 11593. If you have any questions regarding the archaeological aspects of this project please call Dr. Rick Jones or Jim Mohow at (317) 232-1646. Thank you for your cooperation.

Very truly yours,

Larry D. Macklin
State Historic Preservation Officer

LDM:JAM:MMD:RSW:smg

Enclosure (I)

cc: Steve Jose, IDNR, Division

"EQUAL OPPORTUNITY EMPLOYER"

PRINTED ON RECYCLED PAPER

4-1. The comment is noted.

4-2. The Army and NECD have arranged for a reconnaissance level survey of the undisturbed portion of the footprint of the proposed facility. The survey will be conducted by qualified archaeological professionals,

4-3. The Army and NECD will follow and implement the referenced rules and regulations in the event that eligible sites are discovered by the reconnaissance level survey.

STATE OF INDIANA
FRANK O'BANNON, Governor
PATRICK R. RALSTON. Executive Director

STATE EMERGENCY MANAGEMENT AGENCY
DEPARTMENT GF FIRE AND BUILDING SERVICES
PUBLIC SAFETY TRAINING INSTITUTE
INDIANA GOVERNMENT CENTER SOUTH
302 W. WASHINGTON ST., ROOM E208
INDIANAPOLIS, IN 46204

July 23, 1998

Program Manager for Chemical Demilitarization
Attn: Mr. Matt Hurlburt (SFAE-CD-ME)
Aberdeen Proving Ground, MD 21010-5401

Dear Mr. Hurlburt:

5-1 We have reviewed the Draft Environmental Impact Statement for Pilot Testing of Neutralization/SuperCritical Water Oxidation of VX Agent at Newport Chemical Depot, Indiana and have no suggested changes.

If you have any questions or need further assistance, please feel free to contact Mr. Robert Brown, Director, CSEPP Operations at 317/232-4681.

Sincerely,

PATRICK R. RALSTON, EXECUTIVE DIRECTOR
STATE EMERGENCY MANAGEMENT AGENCY AND
DEPARTMENT OF FIRE & BUILDING SERVICES

PRR/kdr

cc: Phil Roberts, Deputy Director, SEMA
Dave Crose, Director. Technological Hazards Division
Robert Brown, Director, CSEPP Operations
File

5-l. The comment is noted.

Earle Chorbagian
2085 Lone Wolf Lane
Canton, Michigan 48188
June 27, 1998

Mr. Matt Hurlburt,

I have received the "Environmental Impact Statement for the Newport Chemical Agent Disposal Facility Pilot Plant" to the best of my ability.

6-1 I feel you are proceeding in a steady but cautious manner and therefore I approve of your plans.

It will be a blessing when the day arrives that all nerve agents will be destroyed.

Sincerely,
Earle Chorbagian
Citizen

6-1. The Army appreciates the comment.

Program Manager For Chemical Demilitarization
ATTN: SFAE-CD-M
Aberdeen Pr oving Ground. Maryland 21010--5401

July,26-1998

Re: Comments om the Draft Environmental Impact Statement of construction and operation of a pilot test chemical neutralization of VX followed by supercritical water oxidation at Newport Chemical Depot.

7-1 As members of C.A.I.N. we are delighted with the fact that the Army is proposing to pilot the destruction of VX by neutralization and SCWO.

W e still have some concerns as follows:

7-2 1. Emission of agent into the air from possible inadequate filtering of exhaust gases.
A. that monitors provide short term information on emissions.

7-3 B. T hat all filtering processes be redundant.

7-4 2. now is the reactivation of contaminated carbon filters contemplated ?
There should be no incineration of carbon filters.

7-5 3. Final disposition of the solid waste (salts) from the SCWO, if contemplated on-site should require the drilling and analysis of the present fill content to determine possible reactions with the new material.

7-6 4. Monitoring and disposition of the waste water after leaving the NECD plant. We hope that the disposal of all wastes would be monitored during the process.

7-7 5. That the Army keeps the entire community up to date during the construction and operation of the facility.

7-8 We appreciate the efforts of all those who have helped make sure that the concerns of the local community were and are being heard.

Mark Hudson and Rainer Zangerl on behalf
of C A I N

7-1. The Army appreciates the comment.

7-2. Equipment specification requires the vendor of the carbon filters to meet a performance level of 99 percent removal of volatile organic compounds (VOCs) or an undetectable level (<5 ppbw), whichever is more restrictive, for emissions from the gas/liquid separators. Additional equipment specifications call for a performance level of 99.9999 percent for VX constituents for each carbon filter unit, for emissions from the Chemical Demilitarization Building. Calculations have been performed to describe the adequacy of the carbon filter to remove toxic vapors during a bounding case (release of agent). The calculation indicates that two of the six carbon filters are sufficient to remove 50 times the calculated release. These requirements are considerably more stringent than the regulatory requirement.

7-3. See response to Comment 7-2.

7-4. The Army does not plan to reactivate carbon filters.

7-5. Current plans are to transport the solid waste (salts) off-site to a permitted treatment, storage and disposal facility (TSDF). In the unlikely event of on-site disposal of the salts, the Army would be required to comply with RCRA regulations which include the avoidance of future reactivity problems.

7-6. The Army is required to comply with numerous permit requirements (see Sect. 4.9 of this EIS) specified by the Indiana Department of Environmental Management and the U.S. Environmental Protection Agency to protect human health, The monitoring requirements mentioned in the comment have yet to be determined by these agencies.

7-7. The Army will continue to keep Newport and other nearby communities, as well as the State of Indiana, informed on a regular basis if a decision is made to proceed with construction and operation of the proposed facility.

7-8. The comment is noted.

Comment Form

PMCD

Type of Event ________ Date ________

Name and Mailing Address (optional)

Carolyn Jeffers & Husband
John Jeffers
RR 3 Box 265
Rockville, In 47872-9368

How did you hear about the Program?

Would you like to be added to our mailing list to receive Program updates?

☐ Yes ☐ No

General Suggestions and/or Requests for Program Literature

Comments for the Record

8-1 We have lived with this nerve agent just a few miles east of the plant, this means the predominate westerly breezes we have would certainly drift our way in a very short time. So we are so hopeful this Supercritical Water Oxidation process will be able to destroy this horrible health risk nerves. I was not one who was sad when this plant closed! We do not want this incinerated as the vapor could cause problems in the air - it has not been found otherwise

Thank You. We value your input.
Please Fold and Mail or Fax to (410) 671-3435

8-1. The Army appreciates the comment. It should be noted, however, that the baseline incinerations process (which is not an alternative considered in this EIS) does not result in the release of atmospheric emissions (Le., vapors) harmful to human health or the environment.

Comment Form

PMCD

Type of Event ____________ Date ____________

Name and Mailing Address (optional)

How did you hear about the Program?

Would you like to be added to our mailing list to receive Program updates?

☐ Yes ☐ No *I am.*

General Suggestions and/or Requests for Program Literature

Comments for the Record *7-25-98*

9-1 *I am fully in favor of the neutralization process; not burning the VX at the Newport, Indiana site. My greatest concern is that the Army will not approve the method and proceed with the burning. I am more hopeful now since I have attended some meetings and have seen the plans and heard discussion.*

Thank You. We value your Input.
Please Fold and Mail or Fax to (410) 671-3435

9-1. The Army appreciates the comment.

MIF, INC

MEDICAL IMAGING FACILITIES, INC.

July 27, 1998

Mr. James L. Bacon
Program Manager for Chemical Demilitarization
ATTN.: SFAE-CD-M
Aberdeen Proving Ground, MD 21010-5401
FAX: (410) 671-3435

Re: Review -- "Draft Copy of the Environmental Impact Statement" dated April 1998.

Dear Mr. Bacon:

10-1 It was noted in my study and in my review of the "Draft Copy of the Environmental Impact Statement, April, 1998", there are forty-nine (49) pages which are thought to be in need of corrective action due to questionable and/or misleading statements. There was information which appeared to verify noncompliance when weighed with the Indiana Law 13-7-8.5-13, 1993. The "Report" provided no statistically reliable, valid, nor reproducible data to support the human safety requirements.

An explanation of this information in written form was brought to the attention of the Project Manager on January 27, 1998. A copy of the list of page numbers is submitted as Attachment #1.

Your comments are solicited.

Louis F. Wally, Ph.D. -- Active in VX Project since 1958
1345 Linwood Court
Terre Haute, IN 47802

Copies to: 1. Jo Lynn Ewing
Indiana Department of Environmental Management
2. Senator Dan Coats
3. Senator Ed Pease

Attachment: Page numbers for further review

1345 Linwood Court, Terre Haute, Indiana 47802
Telephone and Telefax: (812) 299-1062.

10-I. Without further details, the Army is unable to respond to this comment. The Army has reviewed the pages listed in the comment and can find no instances of questionable or misleading statements. The Army has previously supplied a written response to the letter of January 27, 1998, referenced in the comment.

June 25, 1998

NEEDS FOR CLARIFICATION CORRECTION

Following are referenced pages for various sections of the Draft: Environmental Impact Statement, dated April 1998, and released June 12, 1998, which is the commencement date for a 45 day reply period which ends midnight July 27, 1998, at which time remarks are to be submitted to:

US Army Program Manager for Chemical Demilitarization
Attn: Matt Hurlburt, Environmental and Monitoring Office
Building E4517
Aberdeen Proving Ground, Maryland 21010-5401

	PAGES
EXECUTIVE SUMMARY:	
– xxi, xxii	2
SECTION 2:	
2, 5, 7, 10, 12, 13, 14, 16, 18, 19, 28, 29, 33, 34	14
SECTION 3:	
3	1
SECTION 4:	
10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22, 25, 27, 30, 31, 32, 33, 34, 35, 38, 40, 41, 42, 43, 47, 50, 57	28
APPENDIX A:	
A-26	1
APPENDIX C:	
C-4	1
APPENDIX D:	
D-6, D-7	2
TOTAL	49

[signature]

The following comments were received by FAX on July 28, 1998, by Matt Hurlburt of PMCD. The commentor was Mr. Kevin Rudduck of NECD. They have been retyped for legibility.

Pilot testing of Neutralization/Supercritical Water Oxidation of VX Agent at Newport Chemical Depot, Indiana (April 1998)

11-1 **Page 2-4, Table 2-2, VX Nominal Fill WT/TC should be 682 Kg11500 lb. Remainder of metric/standard conversions in chart should be checked.**

11-2 **Page 2-5, para 4, Temperatures - 650%C is not 1110% F.**

11-3 **Page 2-9, Fig. 2.3, "Existing lagoons" do not exist.**

11-4 **Page 2-16, Para 2.2.3.3, adequately describes SCWO but Fig 2.5 is less clear -- into which stream is O_2 fed on entry to SCWO reactor?**

11-5 **Page 3-3, para 2. Chemical Plant constructed 1959 - 1961 Not 1962.**

11-6 **Page 3-15, para 3. This paragraph, as written, would seem to indicate that LRC water is still being degraded by past discharge practices even though LRC has not been used to discharge industrial/sanitary wastes since the early 1970's. (Is there any recovery in LRC?) Industrial/ sanitary wastes have been discharged to the Wabash River (via forced main) since 1973.**

11-7 **Page 3-15, para 4. Use of retention basins 30007, 30008, and 30009 should be further qualified in the narrative. It should be stated that the retention basins were not used to process industrial waste from the Chemical (VX) Plant.**

11-1. Table 2.2 has been revised to indicate the proper fill weight as indicated in the comment.

11-2. The correct metric unit for the temperature has been inserted into this final version of the EIS.

11-3. **Figure 2.3 has been revised to delete the lagoons.**

11-4. **Figure 2.5 has been revised to clarify the process stream.**

11-5. The language in this final EIS has been revised to reflect the construction dates provided in the comment.

11-6. The language in Sect. 3.3.1.1 of this Final EIS has been revised to reflect the historical nature (i.e., prior to 1973) of these discharges.

11-7. **The language in Section 3.3.1.1. of this final EIS has been revised to clarify** historical usage of the retention basins mentioned in the comment. The retention basins were not used to process industrial chemical waste from the manufacture of VX agent; only water from boiler drains and heat exchangers was pumped to these basins.

DEPARTMENT OF THE ARMY
HUNTSVILLE CENTER, CORPS OF ENGINEERS
P.O. BOX 1600
HUNTSVILLE, ALABAMA 35807-4301

REPLY TO
ATTENTION OF:

CEHNC-CH-AQ

MEMORANDUM FOR Program Manager for Chemical Demilitarization, ATTN: SFAE-CD-ME (Mr. Matt Hurlburt), Aberdeen Proving Ground, MD 21010-5401

SUBJECT: Draft Environmental Impact Statement (DEIS) Review for NECDF

12-1 1. Enclosed are our review comments for the DEIS for NECDF, as requested by your memorandum, dated 4 Jun 98. These comments were telecopied to you on 17 Jul 98.

2. If you have questions, please contact Mr. Philip D. Brown, (256) 895-1368.

FOR THE COMMANDER:

Encls

JERRY MULLINIX, P.E.
Director of Chemical Demilitarization

12-1. The Army acknowledges and appreciates the coordination of review from the Huntsville Center, Corps of Engineers.

U.S. ARMY ENGINEER DIVISION HUNTSVILLE — CORPS OF ENGINEERS

DESIGN REVIEW COMMENTS

PROJECT: Alt Tech Newport IN (7-5-98, 17 July 1998)

☐ SITE DEV ☐ ENVIR PROT& UTIL ☐ ARCHITECTURAL ☐ STRUCTURAL ☐ MECHANICAL ☐ MFG TECHNOLOGY ☐ ELECTRICAL ☐ INST & CONTROLS ☐ SAFETY ☐ ADV TECH ☐ ESTIMATING ☐ SPECIFICATIONS ☐ SYSTEMS ENG ☐ VALUE ENG ☒ GEOTECH

REVIEW: Draft EIS
DATE: 07/10/98
NAME: Art Dohrman 256-895-1623

ITEM	DRAWING NO. OR REFERENCE	COMMENT	ACTION
1.	Page 2-9, Figure 2.3	13-1. a. Recommend that this sketch be updated to incorporate the latest design from Stone and Webster.	
		13-2. b. The "existing lagoons" shown in the southeast part of the site are in fact *abandoned; the berms/dikes were bulldozed and the entire area graded to* drain in the late 1970's. Revise this figure accordingly.	
2.	Page 3-56, para 3.7	13-3. The statement about the most likely contributor to seismic ground motions is irrelevant. Revise to discuss the design earthquake motion recommended by the Weston report for design of the facility.	
3.	Page G-12, para G.3	13-4. The last two sentences refer to uncertainties in overburden thickness and earthquake motions, and the additional site characterization planned by the Army. The report on the additional site characterization and revised recommendations on ground motion has been prepared by Weston and should be available from PMATA.	

ACTION CODES
A - ACCEPTED/CONCUR
D - ACTION DEFERRED
W - WITHDRAWN
N - NON-CONCUR
VE - VE POTENTIAL/VEP ATTACHED

CEHND FORM 7 (Revised) 15 Apr 89 — PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE — PAGE 3 OF 3

13-1. Figure 2.3 has been revised to incorporate the latest design available.

13-2. See response to Comment 11-3

13-3. The statements about contributors to seismic ground motion are not completely irrelevant, since they were intended to support the validity of considering seismically-initiated accidents as being credible events. As stated in Sect. 1.5 in this EIS, the specific design of the facility (including seismic considerations) is beyond the scope of this EIS; hence, the seismic design of the facility need not be discussed in detail in this document.

13-4. The text in Sect. G.3 in appendix G of this Final EIS has been changed to include the information offered in the comment.

U.S. ARMY ENGINEER DIVISION HUNTSVILLE — CORPS OF ENGINEERS

DESIGN REVIEW COMMENTS — PROJECT: CSDP ALT TECH Newport, IN (CN: 7-5-98, S: 17 July 98)

☐ SITE DEV & GEO ☐ MECHANICAL ☐ SAFETY ☐ SYSTEMS ENG
☐ ENVIR PROT & UTIL ☐ MFG TECHNOLOGY ☐ ADV TECH ☐ VALUE ENG
☐ ARCHITECTURAL ☐ ELECTRICAL ☐ ESTIMATING ☐ OTHER
☐ STRUCTURAL ☐ INST & CONTROLS ☐ SPECIFICATIONS

REVIEW: Draft EIS
DATE: 9 July 98
NAME: Mr. Sang / ED-CS-P / 895-1641

	ITEM	DRAWING NO. OR REFERENCE	COMMENT	ACTION
14-1, 14-2	1.	Para. 2.2.3.3, Page 2-16	Water treatment plant sludge should be changed to wastewater treatment plant sludge. In addition, Page 2-19 stated that sludge from FOTW would be handled in a manner consistent with current NECA FOTW practice. Please confirm that sludge from FOTW is currently being handled as hazardous waste. Disposal of hazardous waste is costly.	
14-3	2.	Para. 3.6.5, Page 3-54	Please clarify the statement: "More recently, the Indiana ...that there are no know historical or archaeological sites... any projects at NECA(See Appendix F)." Appendix F only states that there are no historical or architectural significance at NECA . This exemption does not include the archaeological concerns.	
14-4	3.	Para. 4.9.1, Page 4-55	Technically, only RCRA require that permit must be obtained prior to construction. Other two permits must be obtained prior to operation of the facilities.	

ACTION CODES
A - ACCEPTED/CONCUR
a - ACTION DEFERRED
W - WITHDRAWN
N - NON-CONCUR
VE - VE POTENTIAL/VEP ATTACHED

CEHND FORM 7 (Revised) 15 Apr 89 — PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE — PAGE 1 OF 3

14-1. The language in this final EIS has been revised to reflect information provided in the comment.

14-2. A toxic chemical leaching procedure (TCLP) is done to confirm whether the sludge is hazardous. The last time this was done the sludge was found to be non-hazardous and was sent to a RCRA Subtitle D landfill.

14-3. See response to comment 4-2.

14-4. The comment is noted. The language in Sect. 4.9.1 in this final EIS has been revised to reflect regulatory requirements more clearly.

U. S. ARMY ENGINEER DIVISION HUNTSVILLE — CORPS OF ENGINEERS

DESIGN REVIEW COMMENTS — PROJECT Draft Environmental Impact Statement (DEIS)

☐ SITE DEV ☐ ENVIR PROT&UTIL ☐ ARCHITECTURAL ☐ STRUCTURAL ☐ MECHANICAL ☐ MFG TECHNOLOGY ☐ ELECTRICAL ☐ INST & CONTROLS ☒ SAFETY ☐ ADV TECH ☐ ESTIMATING ☐ SPECIFICATIONS ☐ SYSTEMS ENG ☐ VALUE ENG ☐ PM-OT

REVIEW Draft
DATE 7 July 1998/7-5-98
NAME R. Waits/ED-SY-S/895-1583/rw-176

	ITEM	DRAWING NO. OR REFERENCE	COMMENT	ACTION
15-1	1.	Section 2, Para 2.1.4 Pg 2-4	Change the 2nd sentence in the 2nd paragraph to read, "If that action did not stop the leak, **the container would be placed in a specially design piece of equipment (APE 1982)**, where the valve or plug would be replaced while the container remained full of agent". Reason: To give a more accurate description of the response procedures used to stop a leak around plugs or valves.	
15-2	2.	Section 2, Para 2.2.3.1, Pg 2-14	Change the last three words of the 1st paragraph from "melting to scrap" to read "smelting". Reason: Clarification.	

ACTION CODES:
A - ACCEPTED/CONCUR
D - ACTION DEFERRED
W - WITHDRAWN
N - NON-CONCUR
VE - VE POTENTIAL/VEP ATTACHED

CEHND FORM 7 (Revised)*
15 Apr 89

PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE

PAGE 2 OF 3

15-1. The language in this final EIS has been revised as suggested in the comment to provide a more accurate description of how a leak around plugs or valves could be stopped.

15-2. The comment is noted. The language in this final EIS has been revised as suggested in the comment to clarify the information.

STATE OF INDIANA

VERMILLION COUNTY

TRANSCRIPT OF NEWPORT CHEMICAL AGENT
DISPOSAL FACILITY

DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)
PUBLIC INFORMATION SESSION

JULY 7, 1998

NEWPORT LIONS COMMUNITY BUILDING

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The Army appreciates the remarks offered in this transcript. No specific comments on the Draft EIS are contained in the transcript.

COMMENTS:

My name is Lane Ralph and I am representing United States Senators Richard G. Lugar and Dan Coats. since 1985, destruction of the nation's chemical weapons stockpile has been a major commitment by the United States government. Throughout this process, it has been the objective of the Congress and others to ensure the U. S.Army and the Department of Defense determine the best and safest method of destruction of the nation's chemical agent and munitions stockpile. With the release of the Draft Environmental Impact Statement by the Department of the Army concerning the pilot testing of the neutralization/supercritical water oxidation of VX agent at Newport Chemical Depot, Indiana, Senators Lugar and Coats are pleased to have this opportunity to submit a statement for the record during this public comment period for this Draft EIS.

Since 1965 we have closely monitored the Army's Chemical Demilitarization Program. Through the annual Congressional defense authorization and appropriation legislation for the Army and Department of Defense, we supported efforts to provide funding and oversight recommendations relating to the destruction process and review of alternative technology disposal methods. Determining a safe and cost effective method for disposal of our nation's chemical weapons stockpile is an issue of concern to many communities and citizens in Indiana and in other states that have one of the Army's seven other storage sites for chemical agents and munitions.

We have also provided oversight comments to the Army and to the Newport Chemical Depot concerning installation of a number of improvements at the facility that help ensure continued safety of the various aspects of the chemical weapons disposal program. We continue to work with the State of Indiana and with the local communities in Newport and surrounding areas to ensure public safety by encouraging emergency preparedness programs emphasizing public involvement, and providing many oversight comments to the Army in an effort to improve storage conditions and safeguards at Newport and at other U. S. sites.

Public participation in this process has been a critical factor in the federal government's effort to determine the best and safest method of disposing of the chemical weapons stockpile. Responding to significant public interest in stockpile disposal issues, Congress amended the original statutes several times on a number of issues, including the creation of public advisory commissions and prohibition of transportation of active chemical weapons material.

Throughout this period, we have worked to shape the Army's review and assessment process so that real alternatives Were considered - and resources provided - to carry out these evaluations in a complete and thorough manner. P.L. 102-484 required the Army to consider using a technology other than incineration.

Publication of this EIS follows many years of work and evaluation by the Army, the National Research Council, other Federal agencies, state government agencies, local citizen advisory committees and the general public, over the feasibility of alternatives for destruction of the bulk VX stockpile and VX manufacturing facilities located at the Newport Chemical Depot.

Neutralization followed by supercritical water oxidation was selected by the Army as the preferred technology for this pilot test. This process may eliminate many of the public concerns about risks associated with other technologies. The purpose of the pilot test facility is to demonstrate the validity of the research and policy guidance which developed this process as a potentially viable alternative.

We understand the full-scale pilot testing facility may destroy about one-third of the existing stockpile located at the Newport Chemical Depot if pilot testing proves successful (page 2-27 indicates this equates to about 36 percent - or 615 - of the 1,690 tons containers stored at Newport). We also understand construction of the pilot facility is planned over a two-year period from December 1999 through March 2002 with a one-year period of systemization.

In the draft EIS, the Army notes that additional National Environmental Policy Act documentation - along with and public involvement and comment - may be available to occur prior to further authorization to dispose of the remaining balance of the stockpile at Newport. We believe it is important for inclusion of as much public participation as possible, and we encourage the Army to ensure that this will occur at each stage of the process.

We have offered our support for, and have participated in, efforts to ensure that the Chemical Stockpile Emergency Preparedness Program (CSEPP) established by the Army in conjunction with the Federal Emergency Management Agency, the Governor of Indiana, and the State Emergency Management Agency, receive the physical resources and technical assistance needed to implement cooperative agreements. These agreements are intended to enhance stite and local emergency preparedness in the unlikely event of a stockpile accident.

We would like to take this opportunity to reiterate that full and complete communication, training and participation among the CSEPP program, the Army, and among relevant state and local entities and organizations is essential for elimination of unnecessary risks associated with hypothetical or "real" accidents which could occur. We continue to offer our support and encouragement for the processes established under the CSEPP program and from other appropriate sources that help reduce risks to public health and safety. Ongoing communications are essential for successful and safe implementation of neutralization pilot testing that will occur during the construction, systemization and eventual VX destruction processes.

We hope a careful scrutiny of existing federal and state environmental requiremants will occur to ensure that the permit requirements for pilot testing meet all objectives and parameters of the processes relating to neutralization. This will require a thorough effort by the U. S. Environmental Protection Agency and by the Indiana Department of Environmental Management to ensure compliance with the Clean Air Act, the Clean Water Act, and the Resource Conservation and Recovery Act. The Department of the Army should expect increased attention will strengthen the overall pilot testing process. Unforeseen adverse impacts or even potential improvements in the process of VX destruction and treatment of waste waters and hazardous wastes could be discovered if appropriate verification and analysis of compliance is a priority for all federal and state agencies.

We look forward to the results of the pilot testing of VX using the neutralization and supercritical water oxidation process. We appreciate this opportunity to comment on this Draft EIS.

STATE OF INDIANA
SS;
COUNTY OF VERMILLION

I, Mary Alice Bemis, a Notary Public, in and for the State of Indiana, do hereby certify that a public information session was held on July 7, 1998, between the hours of 9:00 a.m. and 11:OO a.m. and 5:00 p.m. and 7:00 p.m. at the Newport Lions Community Building, Newport, Indiana, whereby the public was invited to attend the Newport Chemical Agent Disposal Facility Draft Environmental Impact Statement (DEIS) Public Information Session. That a poster display was held between the hours of 9:00 a.m. and 11:00 a.m. and 5:00 p.m. and 7:00 p.m. That formal comments whereby the public could voice their concerns or give statements relating to said display were held. That said public comments was taken down by means of recording and afterwards reduced to typewriting by me.

I do further certify that I am a disinterested person in this cause of action: that I am not a relative or attorney of any party, or otherwise interested in the event of this action.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my notarial seal this 7th day of August, 1998.

Mary Alice Bemis

Mary Alice Bemis, Notary Public
co. of Res: Vermillion

My commission expires:
Y-22-2001