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THE MEMPHIS DEPOT
TENNESSEE

ADMINISTRATIVE RECORD COVER SHEET

AR File Number 67

File:
C.G. 541 460.9

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FINAL 67 1

ENVIRONMENTAL ASSESSMENT
REMOVAL ACTION
FOR GROUND WATER

FOR

DEFENSE DISTRIBUTION MEMPHIS, TENNESSEE

Memphis, Tennessee

Contract No. DACA 87-90-D0030

PREPARED FOR

U.S. ARMY CORPS OF ENGINEERS

HUNTSVILLE DIVISION

Huntsville, Alabama

SUBMITTED BY

ENGINEERING-SCIENCE, INC.
St. Louis, Missouri

July 1994

DEFENSE LOGISTICS AGENCY
DEFENSE DISTRIBUTION DEPOT MEMPHIS
2163 AIRWAYS BOULEVARD
MEMPHIS, TENNESSEE 38114-5210

IN REPLY REFER TO DDMT-DE

DEC 0 5 1994

SUBJECT: Transmittal of Environmental Science's *Environmental Assessment Removal Action for Groundwater*, July 1994

TO: Ms. Martha Berry
U.S. Environmental Protection Agency
Federal Facilities Branch
345 Courtland Street N.E.
Atlanta, GA 30365

Dear Ms. Berry:

1. Defense Depot Memphis, Tennessee (DDMT) is pleased to transmit Environmental Science's *Environmental Assessment* for official transfer to the DDMT repositories. This document has now been superseded by the final Proposed Groundwater Action Plan, but is still to be used as a reference document with the following changes:

a. Chapters 2 and 6 of the Environmental Assessment have been superseded by the decisions in the Proposed Plan, and therefore no longer apply.

b. References to the Interim Remedial Measure (IRM) should be replaced with Interim Remedial Action (IRA).

2. Please note that the final Proposed Groundwater Action Plan will also be placed in the repositories, so that the public may have a current understanding of the planned activities by reading the proposed plan and the amended Environmental Assessment.

Sincerely,

Frank Novitzki

FRANK NOVITZKI
DDMT Project Manager

cc:
TDEC (J. English)

FINAL 67 3

ENVIRONMENTAL ASSESSMENT REMOVAL ACTION FOR GROUND WATER

FOR

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July 1994

ENGINEERING-SCIENCE, INC.

400 Woods Mill Road South, Suite 330 • Chesterfield, Missouri 63017-3427 • Telephone (314) 576-7330 • Fax: (314) 576-2702

1 July 1994

Commander
U.S. Army Corps of Engineers
Attn: CEHND-PM-AE (J. Romeo)
106 Wynn Drive
Huntsville, Alabama 35805-1957

RE: Final Environmental Assessment, Removal Action for Ground Water
Defense Distribution Memphis, Tennessee
Contract DACA87-90-D-0030
ES-SL016.23

Dear Mr. Romeo:

Engineering-Science, Inc. (ES) is pleased to submit the Final Environmental Assessment, Removal Action for Ground Water at Defense Distribution Memphis, Tennessee (DDMT) under the above referenced contract.

ES appreciates this opportunity to serve the Huntsville Division. If you have any questions about this work, please give me a call.

Yours truly,

ENGINEERING-SCIENCE, INC.

David E. Mizell

David E. Mizell, P.E.
Project Manager

DISTRIBUTION LIST

Commander U.S. Army Corps of Engineers Attention: CEHND-PM-EP (Dell'Orco) 106 Wynn Drive Huntsville, AL 35805-1957	4 Copies
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1.0 PURPOSE AND NEED

1.1 Introduction

The National Environmental Policy Act (NEPA) of 1969 (PL-190) directs the federal government to assess the environmental impacts associated with its proposed plans, functions, programs and utilization of natural resources. Section 102(2) contains provisions to make sure that federal agencies act according to the letter and spirit of the law. The regulations that implement NEPA for all federal agencies and federal actions are found in 40 CFR Parts 1500-1508.

U.S. Army regulations for protecting the environment are found in AR 200-1, Environmental Protection and Enhancement and AR 200-2, Environmental Effects of Army Actions. Chapter 5 of AR 200-2 specifies that an environmental assessment (EA) is prepared to determine the extent of environmental impacts of a project and decide whether or not those impacts are significant. Listed among the 23 actions normally requiring an EA are installation restoration projects undertaken in response to CERCLA (AR 200-2,5-3-s). Sections 2-2(8)(a) and (b) in AR 200-2 note that very often a Feasibility Study (FS) prepared for a CERCLA project in accordance with 40 CFR 300 contains procedures to ensure full consideration of environmental issues. In most cases when the FS is completed and complies with NEPA that document can meet the needs for an EA and therefore a second NEPA document is not required.

This EA was prepared to investigate and document possible environmental effects resulting from implementation of the proposed Removal Action alternatives that are fully described in the Engineering Report. This EA was prepared to ensure compliance with NEPA and applicable public participation requirements.

1.2 Background

Defense Depot Memphis began operations in 1942 with the mission to inventory and supply materials for the U.S. Army. In 1964, the Depot's mission was expanded to include a complete range of commodities for Department of Defense activities, under the auspices of the Defense Supply Agency, now known as the Defense Logistics Agency (DLA). The Depot became known as Defense Distribution Region Central (DDMT) in 1993.

DDMT warehouses and distributes an extensive inventory of supplies to U.S. military services and federal agencies. These supplies span a broad range of commodities including clothing, food, medical supplies, electronic equipment, petroleum products, and industrial chemicals.

Until 1970, hazardous and nonhazardous materials whose containers were damaged or whose shelf life had expired were occasionally burned and/or buried in a portion of Dunn Field. Wastes disposed of in this manner included: oil and grease, paint and paint thinner, methyl bromide, pesticides, herbicides, and food supplies. Other wastes included minutes quantities of mustard and lewisite gases contained in nine training canisters. Most of the documented hazardous materials which were disposed during this period were buried in the northwest portion of Dunn Field.

During an intital ivestigation and report performed at DDMT , hereinafter referred to as the Law Study (1990 Law), volatile organic compounds were found in the uppermost aquifer beneath Dunn Field. The finding of the Law Study determined that further investigations were necessary to fully define potential sources and extent of contaminated ground water plume. DDMT was placed on the National Priorities List (NPL) in 1992 (see 57 FR 47180, October 14, 1992), and is now regulated under CERCLA.

A ground water "pump and treat" system is being proposed for design, construction and operation in Dunn Field as a non-time critical Removal Aaction (RA) under CERCLA until a permanent solution can be found. Since DDMT is also a RCRA-permitted facility, the same types of actions that are initiated under CERCLA's Removal Authority are equivalent to RCRA Interim Measures. Unfortunately, the term "Interim Remedial Measure" (IRM) is a hybrid of both RCRA and CERCLA terminology. To help ease confusion for all reviewers, whenever the term "IRM" is used in this report, substitute the words "Removal Action". The intention is that this proposed system will be a non-time critical removal action. This Environmental Assessment addresses the potential environmental impacts the RA may pose to Dunn Field, the community of Memphis and the nearby receptors.

1.3 Affected Area

Public water supplies in the Memphis area are drawn from the Memphis Sand Aquifer, which is a confined aquifer that underlies the entire Memphis metropolitan area. The Memphis Sand Aquifer is confined by an overlying deposit of clay soils known as the Jackson-Claiborne Formation. Above this formation is a thin unconfined aquifer that is the upper-most water-bearing zone beneath the Memphis area. This upper-most aquifer is known as the Fluvial Aquifer, after the Fluvial Deposits of sand and silt in which it resides.

The Fluvial Aquifer is not used for public water supply. The Fluvial Aquifer may be hydrologically connected to the underlying Memphis Sand Aquifer. There is a potential for contaminants in the Fluvial Aquifer to migrate from the Dunn Field area into a zone where they could enter the Memphis Sand Aquifer and affect the public water supply for the Memphis metropolitan area.

Past field investigations have revealed that ground water levels in the Fluvial Aquifer are some 80 feet higher than levels in the Memphis Sand Aquifer. This difference in ground water levels creates a downward flow potential for both water and contaminants in the Dunn Field region.

1.4 Nature of Problem

DDMT consists of two sections: Dunn Field, an open storage area about 64 acres in size, and the main installation, which is intensely developed with warehouses and outdoor storage areas for commodities and equipment. DDMT warehouses and distributes a wide variety of supplies including industrial chemicals, petroleum products, electronic equipment, clothing, food and medical supplies. Because of the large volumes handled, some items were spilled, leaked or disposed within the Installation boundaries.

In the past, Dunn Field was periodically used for waste disposal. The west half of Dunn Field has received a wide range of hazardous wastes for disposal by burial in trenches. The burial trenches within Dunn Field are the potential source of contamination in the ground water. Much of the disposed solid waste in Dunn Field is thought to be disposed of either in a dry state or as containerized liquid wastes. Waste constituents can enter the surrounding soil as their containers deteriorate or as water percolates downward through the soil. Water percolating through these soils can then carry waste constituents into the Fluvial Aquifer some 60 feet below the surface.

1.5 Purpose of Proposed Action

An IRM is proposed for the Dunn Field area of DDMT to control ground water contamination in the Fluvial Aquifer. The primary contaminants of concern are volatile organic compounds (VOCs). The VOCs of concern include trichloroethene; tetrachloroethene; 1,1-dichloroethene; 1,2-dichloroethene; and 1,1,2,2-tetrachloroethane. Metals were observed in the Fluvial Aquifer in 1989 and 1990 at levels above action levels, but were found below action levels during a pump test in Dunn Field in 1992 and during follow-up sampling of monitor wells in 1993.

The proposed action will reduce these contaminants from migrating across DDMT boundaries and contributing to future contamination in the Fluvial Aquifer downgradient from DDMT. This action is a partial remedy to ground water contamination in the Dunn Field area, since it does not halt the migration of contaminants from their sources. Future remedial measures will be formulated once more information has been obtained upon the extent and nature of this contamination.

1.6 Intent of Proposed Actions to Satisfy Regulatory Requirements

All work relating to the proposed removal action was initiated by DDMT in 1991. This work included: preparation of a pump test work plan (which was approved by both the U.S. Environmental Protection Agency, Region IV, and the Tennessee Department of Environment and Conservation); performance of an aquifer pump test; a report on the results of the aquifer pump test; and an Engineering Report (also known as an Engineering Evaluation/Cost Analysis (EE/CA)). The next phase of this project will be the design of the preferred alternative followed by the construction of the preferred alternative. The purpose of this removal action is to treat ground water contaminants in the fluvial aquifer and prevent further migration of contaminants to greatly reduce the threat of possible human exposure. This document will be released for public comment in accordance with CERCLA and the National Environmental Policy Act (NEPA). A responsiveness summary/response to comments will be prepared following the public comment period. Comments from the public and the regulatory community will be either incorporated into the documents or a valid reason why the comment cannot be incorporated will be provided. The term "Interim Remedial Measure" (IRM) is used in this report as a descriptor of the preferred alternative. The equivalent CERCLA terminology for "IRM" is "removal action" (RA). Reviewers of this report should be aware that the preferred alternative will be implemented under CERCLA and NCP provisions that permit the facility (DDMT) to perform a removal action. DDMT intends to remain as the lead agency in implementing this preferred alternative and will cooperate with other Federal, State, and local agencies to accomplish this task. This report should be reviewed in conjunction with the Engineering Report for maximum understanding of the issues addressed.

2.0 DESCRIPTION OF PROPOSED ACTION

The proposed action involves installing eight extraction wells along the northwest boundary of Dunn Field and constructing a water treatment facility in the same area. The extracted ground water would be continuously pumped through an air stripping tower for removal of VOCs. Treated water would be discharged to surface drainage along the north boundary of Dunn Field.

When this system is placed in operation, water will be pumped from the extraction wells at the rate of 520 gallons per minute (gpm). The extracted ground water will contain an estimated 908 micrograms per liter (ug/L) of VOCs prior to treatment. The air stripping process will remove about 97 percent of these VOCs creating an effluent that will meet state and federal standards to protect human health and the environment. The treated water will be discharged into surface drainage flowing north from Dunn Field into Cane Creek some 1,600 feet away.

2.1 Ground Water Extraction Method

The proposed ground water extraction system consists of eight wells located on Government property in Dunn Field. The approximate configuration of these eight wells is shown in Figure 2.1. The wells are placed downgradient along the Government property boundary to extract contaminated ground water flowing down gradient from the source and reverse the migration of the contaminants already down gradient.

The average depth of these wells is estimated to be 80 feet, with the bottom 20 feet screened across the aquifer. Each well would be equipped with a submersible pump capable of pumping 75 gpm. Eight wells pumping at rates between 30 and 75 gpm would create a capture zone of approximately 40 acres, including 12 acres outside the

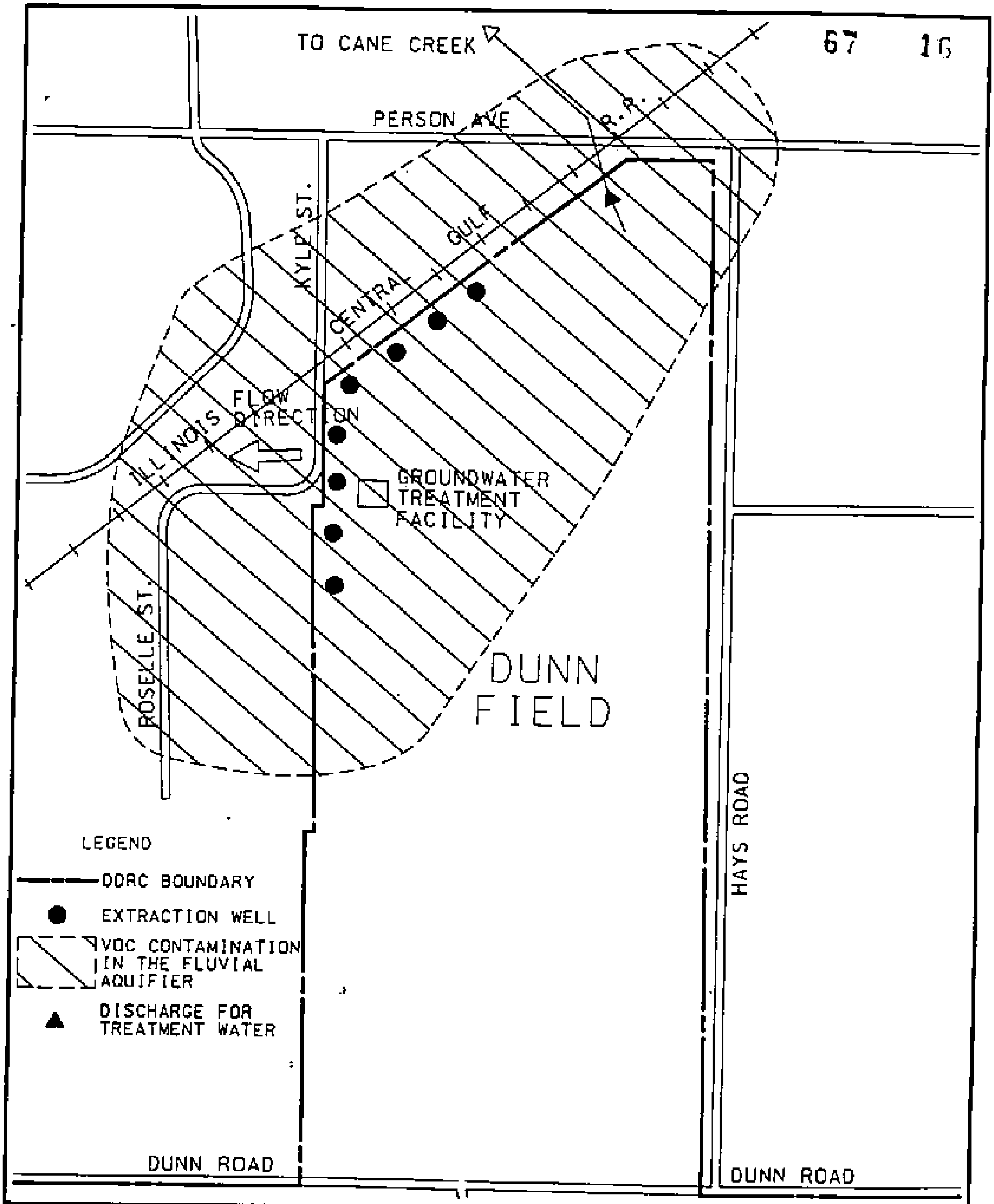

FIGURE 2.1
PROPOSED LOCATION OF GROUNDWATER PUMPING AND TREATMENT SYSTEM

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boundaries of Dunn Field (see the Engineering Report for details). This capture zone will cover the known VOC contamination shown in Figure 2.1.

2.2 Ground Water Treatment

The extracted ground water will be collected in a 70,000 gallon holding tank to equalize flow prior to treatment. Minimizing variations in flow would improve performance and reduce the size of the treatment system. The extracted ground water would then be pumped from the equalization tank to an air stripping tower for removal of volatile organic compounds (VOCs). Air stripping is a physical process of mixing water and air to cause a mass transfer of the volatile organics from the liquid to the gaseous phase.

The air stripping tower would contain ceramic, plastic or glass media. The contaminated water enters at the top of the tower and trickles down across this media while air is forced upward using an air blower. The volatile organics transfer to the gaseous phase and are exhausted with air out the top of the tower. For operations in Dunn Field, the air stripping tower will be about 6 feet in diameter and 15 to 20 feet high.

During the operation of an air stripping tower, volatile organics would be released to the atmosphere. Air emission requirements are therefore a factor in the design and operation of an air stripping tower. Based upon VOC concentrations that have been observed in the ground water, the extraction wells will produce an estimated 2,910 pounds per year (lbs/yr). The air stripping tower will emit about 2,820 lbs/yr (1,280 kg/yr) of VOC's. A schematic diagram of the treatment process is shown in Figure 2.2.

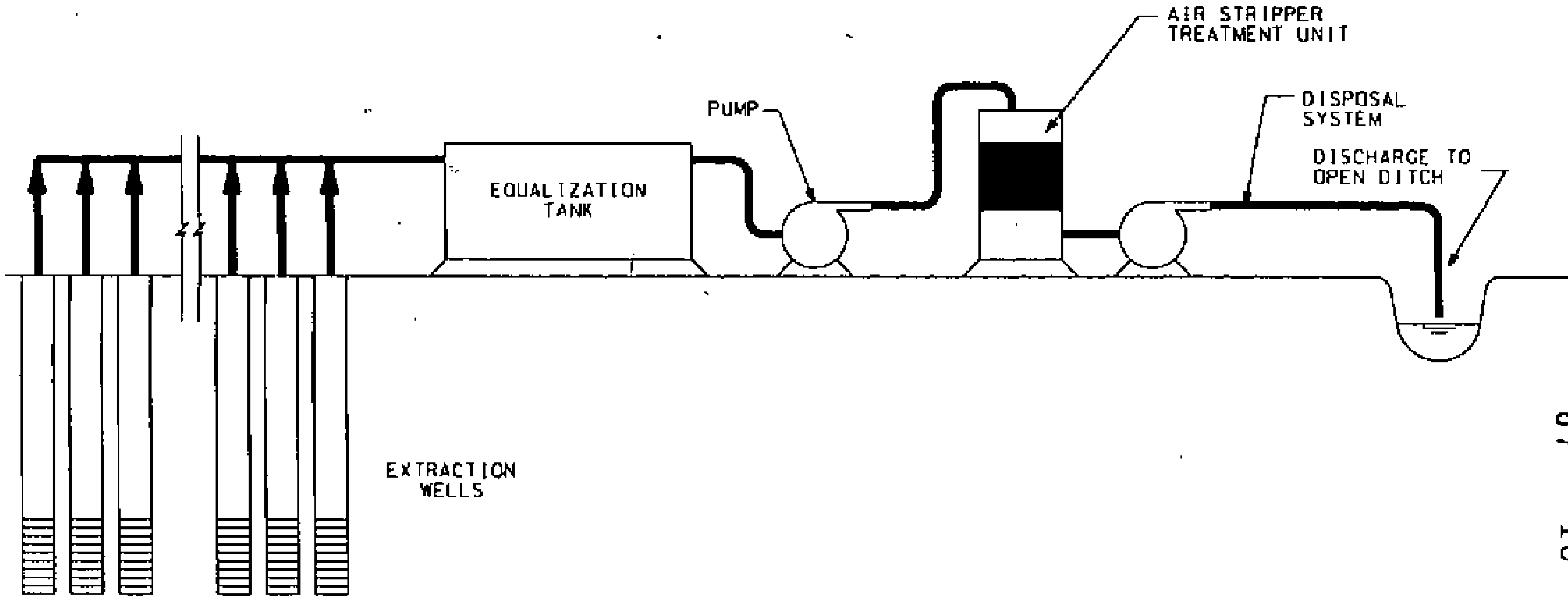

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FIGURE 2.2
FLOW SCHEMATIC OF GROUNDWATER
TREATMENT SYSTEM

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2.3 Disposal of Treated Effluent

The treated water from the air stripping tower would be discharged to a surface water channel in the northeast quadrant of Dunn Field. This water would be pumped to the outfall using 10-inch pipe buried in a shallow trench. This channel conveys runoff to Cane Creek located about 1,600 feet north of Dunn Field. This channel traverses an undeveloped area between Dunn Field and Cane Creek. Cane Creek flows southwestward some 3 miles before its confluence with Nonconnah Creek (Figure 2.3). Nonconnah Creek travels westward another 3 miles where it empties into Lake McKellar, which is an oxbow lake connected to the Mississippi River.

The discharge from the treatment system would be 520 gpm, which is equivalent to about 1.2 cubic feet per second (cfs). The channel at the north property line of Dunn Field is about 1.5 feet wide and 1 foot deep and has a capacity to carry about 20 cfs. Typical summer thunderstorms produce flows in this channel of about 10 cfs at the property line. The treatment system flow would not significantly raise water elevations in the channel during wet weather.

The impact of this continuous flow upon the channel during dry periods will be minimal. Flow will be confined to the floor of the channel, and will hydraulically resemble runoff from light rainfall. Discharge into the surface drainage channel would be considered an on-site, direct discharge and would be required to meet substantive NPDES ARARs. Because this would be considered an on-site, direct discharge, administrative ARARs would not apply in accordance with OSWER Directive 9355.7-03, Permits and Permit Equivalency Processes for CERCLA On-Site Response Actions and the EPA. A copy of this directive is provided in Appendix G of the EE/CA.

FIGURE 2.3
ROUTE OF SURFACE
WATER DISCHARGE

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Other applicabe references that support this finding are: CERCLA Compliance with Other Laws Manual, August, 1988, EPA/540/G-89/006; CERCLA Compliance with Other Laws Manual:Part II, August 1989, EPA/540/G-89/009, and OSWER Directive 9234.1-02.

3.0 ALTERNATIVES TO THE PROPOSED ACTION

3.1 Preliminary Alternatives Considered and Rejected

To develop an interim treatment system to mitigate contaminant migration in ground water at Dunn Field, three functions were evaluated: extraction, treatment and disposal. Potentially viable technologies for each function and their associated process options which were considered and rejected are discussed in the following subsections. Several extraction/treatment/disposal systems were rejected due to their inability to meet one or more of the following objectives:

- control contaminant migration
- proven technology (i.e. applicable to specific contaminants)
- ability to be permitted
- cost effectiveness

The following sections are divided into subsections with respect to their basic functions: extraction, treatment and disposal technologies.

3.1.1 Extraction Methods

3.1.1.1 Interceptor Trenches

Trenches may be used to intercept ground water flow to contain a contaminant plume, primarily in situations involving shallow ground water. Two types of trenches are open trenches and buried trenches. Use of open trenches is confined to very shallow aquifers, while buried trenches may be used for deeper aquifers. Trenches work on the principle of creating a path of least resistance, which allows capture of ground water and contaminants. The depth to the Fluvial Aquifer at Dunn Field is approximately 60 feet. Trenches of this depth are not feasible to construct in a safe manner.

3.1.1.2 Wells

Another means of ground water extraction is from wells, using either well points or pumping wells. Well point systems are generally small in diameter, grouped closely together, and are relatively shallow in depth. The system operates by connecting a suction pump to a common header pipe which connects to all wells. Well points are feasible where ground water is within 25 feet of the surface. The depth to ground water beneath Dunn Field is about 60 feet, thereby eliminating the use of well points to extract contaminated ground water.

Pumping well systems provide greater flexibility than well points sinc
e the wells can be installed at any depth and spacing. Pumping wells are 4 to 12 inches in diameter to accommodate a submersible pump which lifts ground water to the surface. The pump selection is a key component of the pumping well to achieve the desired operating conditions. Installation costs are higher due to the larger size and greater depth of pumping wells. Spacing of the wells is dependent upon the anticipated drawdown and distance-drawdown in the aquifer. Overlapping capture zones can effectively intercept a plume which is wider than the capture zone of one well.

There are techniques that can be used with pumping wells to increase their effectiveness in preventing ground water migration. Reinjection of treated ground water can be used down gradient of the contaminant plume to accelerate ground water flow back toward the extraction wells. Reinjection wells installed up gradient of the plume can assist by accelerating ground water toward the extraction wells.

For the purposes of this IRM, pumping wells will be retained for further consideration as a component of an alternative. At this time there is not sufficient data available to determine the location of the down gradient edge of the plume. Therefore, neither pumping wells nor reinjection wells placed down gradient of the plume will be considered. The use of pumping wells within the plume and reinjection wells up gradient of the plume will be retained for further consideration. Physical barriers will not be considered further since the location of the sources and the extent of the plume is unknown.

3.1.2 Ground Water Treatment

3.1.2.1 *In Situ* Treatment

In-situ treatment of ground water would employ the use of physical, chemical or biological technologies to degrade, immobilize or remove the contaminants. Current technologies for *in situ* treatment of ground water contaminants include bioremediation, chemical immobilization, chemical mobilization, detoxification and vapor extraction.

Bioremediation is a process that uses naturally occurring microorganisms in the soil to decompose toxic or hazardous organic compounds. The suitability for bioremediation must be evaluated through site characterization, laboratory treatability studies, and a bench-scale study. Time would be required to implement these studies. Chlorinated solvents such as those present in the ground water at Dunn Field are not readily biodegradable using *in situ* technologies, and the intermediate products of microbial metabolism of chlorinated solvents may result in compounds which are more hazardous than the original contaminant. This process was rejected because of excessive time to design and implement a suitable treatment system.

Immobilization processes are designed to stabilize or solidify the contaminant, thus reducing the wastes solubility, toxicity or mobility. Most stabilization and solidification technologies are effective on inorganics and metals, but have limited application for organic compounds at Dunn Field. The relatively large size of the potential area of contamination and the relatively dilute concentrations of wastes would result in prohibitive costs to use immobilization technologies.

Chemical mobilization, or "soil flushing", is the process of applying a liquid agent to the contaminated soil which renders specific contaminants soluble. Most applications of chemical mobilization require that the contaminated soil be excavated, which is not desirable at Dunn Field. This technology would not control contaminants already in the Fluvial Aquifer beneath Dunn Field.

Detoxification technologies utilize the chemical reactions of hydrolysis, oxidation/reduction, and neutralization to transform contaminants to a less toxic state. This process is an effective treatment for certain metals; however, it is not effective with organic compounds present in the ground water at Dunn Field and does not warrant further consideration.

Vapor extraction is a proven *in situ* process for removing volatile organic compounds from the unsaturated zone of soil. Vapor extraction indirectly affects the underlying ground water. It is an effective means to remediate a site when the contaminant source and the extent of the plume has been defined. Because vapor extraction will not directly control contaminants in the Fluvial Aquifer, it is not appropriate for Dunn Field.

3.1.2.2 Treatment by Activated Carbon Adsorption

Activated carbon adsorption is a chemical process of collecting soluble substances onto the surface of activated carbon. A typical carbon system uses granular activated carbon in a series of downflow reactor vessels. Periodic monitoring will indicate when the adsorptive capacity has lost its effectiveness and the carbon is considered spent. Economical application of carbon treatment depends on an efficient means of regenerating the carbon after its adsorptive capacity has been reached. Another alternative is disposal of spend carbon as hazardous waste at an off-site landfill. Use of activated carbon as the primary means of ground water treatment was determined to be cost prohibitive due to the expensive operation and maintenance of a carbon adsorption and regeneration/disposal system.

3.1.2.3 Biological Treatment

Extracted ground water containing VOCs may be treated in biological treatment reactors, generally of the aerobic process type. Aerobic biological treatment reactors can be separated into two major categories: suspended growth reactors and fixed-film reactors.

In suspended growth reactors, bacterial growth occurs in the water, which must be mixed to promote oxygen transfer to the microbes for respiration. Oxygen and other macro-nutrients are supplied in these reactors by mechanical means. The major disadvantage to suspended growth reactors is the large reactor vessel size is required due to long hydraulic detention time.

In fixed-film reactors, bacteria are grown on an inert support medium. Oxygen and macro-nutrients are added to the system to support microbial activity. Two primary types of fixed-film reactors are trickling filters and rotating biological contactors.

Rotating Biological Contactors (RBC) are modular in design and adapt easier to flow and contaminant variations, which would be better suited than trickling filters for implementation at Dunn Field. An RBC consists of multiple plastic discs mounted on a horizontal shaft at a right angle to wastewater flow. The bioadsorption and bio-oxidation take place on the surface of the disc. Multiple RBC's may be connected in series to achieve higher degree of contaminant removal. Microbial growth which sloughs off the RBC must be removed by final clarification in a settling tank, and the subsequent sludge will require treatment on disposal in a hazardous water landfill. The potential for gas emission may result and require air monitoring and/or treatment prior to release to the atmosphere. Laboratory treatability studies, bench-scale study and a complete material balance would be necessary to further define fate of contaminants and process in greater detail. The major disadvantage to this alternative is the excessive amount of time prior to implementing the treatment method and subsequent treatment steps for sludges generated and air emissions.

3.1.2.4 Off-Site Treatment

An option to establishing and operating a contaminated ground water treatment facility at Dunn Field would be to transport the water off-site for treatment at an approved, permitted treatment facility. Municipal wastewater treatment systems could not adequately remove VOCs; thus a specialized industrial wastewater facility would be needed. A major concern would be the large amount of manpower and numerous tank trucks to transport water to the treatment facility. The excessive amount of effort and cost to transport water is not cost effective.

3.1.3 Disposal Alternatives

The disposal of treated ground water is a critical factor since the method of disposal may impact the surrounding environment and carry significant costs. Disposal options which were considered and rejected involved the following options: down gradient reinjection, infiltration, and deep well reinjection. Reuse of water in the public drinking water supplies were not considered because of strong possibility of public objection and potential liabilities.

3.1.3.1 Downgradient Reinjection

Treated ground water could be reinjected into the Fluvial Aquifer through wells, in a manner which would control contaminant migration. Reinjection downgradient of the contaminant plume could reverse the gradient in the ground water and send the contaminants back in the direction of the extraction wells. Since the extent of the plume is not fully defined, a location downgradient cannot be selected. If reinjection were done in the middle of the plume, it would accelerate movement of the downgradient contaminants. Therefore, downgradient was rejected as a viable disposal alternative.

3.1.3.2 Infiltration

Upon final treatment of contaminated ground water, it could be released onto the ground surface and allowed to infiltrate through the soil to the Fluvial Aquifer. This method used repeatedly could flush contaminants out of the soils at Dunn Field and toward the extraction wells for treatment. The possibility exists, however, that greater contamination of the ground water would occur as the water passes through the contaminant sources beneath Dunn Field. It is therefore rejected as viable alternative.

3.1.3.3 Deep Well Injection

Deep well injection consists of conveying treated water and reintroducing it through very deep injection wells to deep aquifers beneath Dunn Field. Deeper aquifers beneath Dunn Field are not viable candidates to receive treated water, because the State and Federal agencies would be concerned over the accidental release of contaminants into these aquifers. Therefore, deep well injection was not considered further.

3.2 Viable Alternatives to Proposed Action

Potentially viable technologies which could be used to mitigate ground water contamination at Dunn Field were retained for use in remedial alternatives. Six alternatives, in addition to the proposed action, were identified by combining viable technologies and process options. These alternatives are discussed below, using the same numbering system used in the Engineering Report (EE/CA). Alternative 5 is omitted here because it was ultimately selected as the proposed action (and is described in more detail in Section 2 of this document).

3.2.1 Alternative 1

- No remedial action performed
- Natural processes, including mixing, adsorption absorption and in the case of VOCs, biodegradation, will act to disperse contaminants

- Dispersion may or may not occur before contaminants affect sensitive receptors

This is the No Action Alternative. Selection of the no action Alternative at Dunn Field will be considered as a baseline comparison for the other five alternatives. With no action, the constituents of concern (VOCs) will continue to migrate downward into the Fluvial Aquifer from suspected but currently unidentified sources in Dunn Field. The Fluvial Aquifer will continue to receive these contaminants, and will transport them downgradient to the west. The concentration of these contaminants will diminish at greater distances from Dunn Field as mixing, adsorption and absorption occur. VOCs will be further diminished by chemical breakdown and naturally occurring biodegradation. The rate at which these process would occur in the Fluvial Aquifer is not known and cannot be predicted without further study. Furthermore, the distance and area off-site that would ultimately be affected by the constituents of concern cannot be predicted until further studies are performed.

3.2.2 Alternative 2

- Extraction by Fluvial Aquifer wells located on site
- Treatment using air stripping with the option of carbon filtering.
- Disposal of treated water to publicly owned treatment works

The ground water extraction system would consist of eight wells located on government property in Dunn Field. The wells would be located to extract ground water from those areas beneath Dunn Field found to be most heavily contaminated. The Fluvial Aquifer wells would be 4 to 6 inches in diameter to accommodate a submersible pump capable of pumping 75 gpm. The average depth of the wells is estimated to be 80 feet each. A total of eight wells, with pumping rates between 30 and 75 gpm, would be needed to create a capture zone of approximately 40 acres, including 12 acres outside the boundaries of Dunn Field. The extracted water would be pumped to an air stripping tower to facilitate the removal of volatile organic compounds (VOCs). Air stripping is the physical process of mixing water contaminated with volatile organics with clean air. This contact of water and air causes a mass transfer of the volatile organics from the liquid to the gaseous phase. A liquid-through-air type air stripper would be utilized. The contaminated water enters at the top of the tower and trickles down across the media thus encouraging contact with air. Air is forced upward using an air blower. The volatile organics transfer to the gaseous phase and are exhausted with the air out the top of the tower.

With air stripping, volatile organics would be released to the atmosphere. These emissions could be controlled if airborne concentrations were high enough to impact the surrounding environment. Carbon adsorption is an effective means of capturing the volatile organics from an air stream, and would satisfy regulatory air emission concerns. Regeneration of spent carbon, or disposal at a hazardous waste landfill, would be necessary. Disposal of treated water would be to publicly owned treatment works (POTW) via a sanitary sewer that is capable of handling an additional 520 gpm discharge from the treatment system. Sewer line upgrades would be necessary due to the insufficient size of sewers in the vicinity of Kyle Street, just west of Dunn Field.

Sanitary sewage at Kyle Street is conveyed to the City of Memphis-South Wastewater Treatment Facility also known as T.E. Maxon Facility. The plant has sufficient capacity to handle the additional flow of treated ground water. A sewer charge would be assessed by the City of Memphis and would be based on the water quality.

3.2.3 Alternative 3

- Extraction by Fluvial Aquifer wells on- and off-site
- Treatment using air stripping with the option for carbon filtering.
- Disposal of treated water to POTW

The extraction methods, treatment and disposal systems would be identical to Alternative 2 except for the placement of extraction wells. Alternative 3 provides for greater capture of contaminated ground water off-site by placing two of the eight extraction wells west of Dunn Field outside of DDMT boundaries. This configuration is designed to intercept the contaminant plume as it migrates off government property as well as collect contaminated ground water that has already migrated off-site.

Extraction wells operating off government property would require easements, rights-of-way or property transaction from land holders. Security problems, and additional ground water conveyance piping would be needed due to increased distances off-site.

3.2.4 Alternative 4

- Extraction by Fluvial Aquifer wells on-site
- Treatment by using ultraviolet (UV)/oxidation.
- Disposal of treated water to POTW

The extraction methods, and disposal configuration described for Alternative 2 in Section 3.2.2 would be used in Alternative 4. Ground water extracted on government property would be treated using UV/oxidation prior to disposal to the POTW.

Extracted ground water would be conveyed to a UV/oxidation treatment system. UV/oxidation is a process which can be used to destroy organic contaminants. Contaminated ground water is mixed with hydrogen peroxide in a reactor vessel and exposed to ultraviolet light. Ozone is transferred to the contaminated water forming hydroxyl radicals which are powerful chemical oxidants capable of breaking down a wide variety of organic contaminants. The end products of such a process are carbon dioxide, water and chlorine. Fugitive ozone is captured in an ozone decomposition unit, so that no harmful ozone is released to the atmosphere.

The major benefit of this system over other alternatives is that it provides destruction of organic contaminants. Primary concerns are the safe handling of ozone, and susceptibility of UV lamps to fouling which diminishes their effectiveness. Treatability studies would be necessary prior to implementation, and the need for greater technical expertise necessary for oversight of operation all add to the higher cost compared with other viable treatment systems.

3.2.5 Alternative 6

- Extraction by Fluvial Aquifer wells on-site
- Treatment using ultraviolet (UV)/oxidation with the option for carbon filtering
- Disposal of treated water into storm water drainage systems

The extraction method described for Alternative 2 would be identical for Alternative 6. Treatment would use UV/oxidation as described in Alternative 4. Water would be disposed by release to nearby surface drainage, as in the Proposed Action.

3.2.6 Alternative 7

- Extraction by Fluvial Aquifer wells located on-site
- Treatment using air stripping with the option for carbon filtering
- Disposal of treated water by reinjection into Fluvial Aquifer

Alternative 7 would extract ground water from six pumping wells on government property, and the extracted water would be treated using air stripping as described in Section 3.2.2 for Alternative 2. The treated water from the air stripping tower would be reinjected directly into the Fluvial Aquifer through four wells on the east side of Dunn Field. The reinjection wells would be placed upgradient from the extraction wells so that injected water could be re-treated if a treatment system failure allowed contaminants to be reinjected. The capture zone would be reduced in size under this alternative, becoming more localized beneath Dunn Field and having less effect off-site. Chemically altered water is not normally allowed to be reinjected into the ground by the Memphis/Shelby County Ground Water Quality Control Board. It would be necessary to obtain a waiver to this regulation before this Alternative is acceptable.

4.0 AFFECTED ENVIRONMENT

4.1 Site Location and Description

4.1.1 Site Location

Defense Distribution Memphis, Tennessee (DDMT) is located in the city of Memphis, Tennessee, situated on 642 acres of Federal land in Shelby County, Tennessee. The Installation lies in the south central section of Memphis, and just northeast of the Interstate 240, Interstate 55 junction.

DDMT is approximately four miles southeast of the Central Business District and one mile northwest of Memphis International Airport. Airways Boulevard bounds the site on the east, and provides primary access to the installation (Figure 4.1). Dunn Road, Ball Road and Perry Road serve as the northern, southern and the western boundaries, respectively. DDMT consists of two sections: Dunn Field, an open storage area located on the north end of the site about 64 acres in size, and the main installation which is highly developed and occupies the remaining 578 acres.

4.1.2 Facility Description

DDMT is a major field installation of the Defense Logistics Agency (DLA), whose primary mission is to warehouse and distribute supplies common to all U.S. Military Services and some civil agencies, primarily in the southeastern United States, Puerto Rico and Panama area. DDMT's mission is to receive, store, maintain and ship items which are centrally managed by the Defense Logistics Agency (DLA), and supplied to the United States military. Stocked items include food, clothing, electronic equipment, petroleum products, construction materials, industrial, medical and general supplies.

The installation consists of 118 buildings, 24 miles of railroad tracks, and 36 miles of paved streets. The site has approximately 6.0 million square feet of open storage, and

67 34

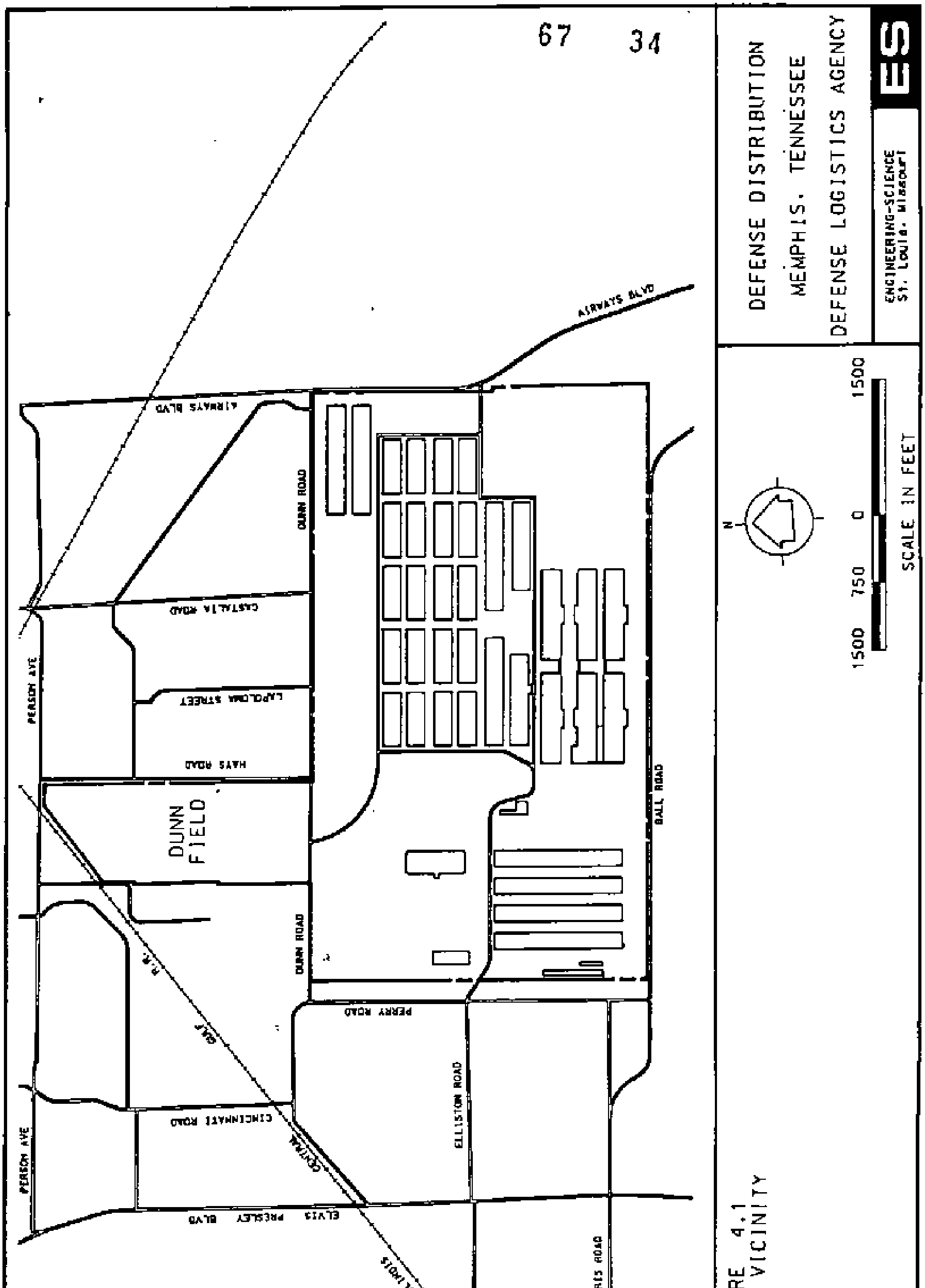

FIGURE 4.1
DDMT VICINITY

5.5 million square feet of covered storage. The land and buildings are owned by the U.S. Army and leased by DLA.

Defense Depot Memphis Tennessee began operations in 1942 with the mission to inventory and supply materials for the U.S. Army Engineer, Chemical and Quartermaster Corps. In 1964, the Depot's mission was expanded to include a complete range of commodities for Department of Defense activities, under the auspices of the Defense Supply Agency, now known as the Defense Logistics Agency (DLA). In 1993, the Depot became known as Defense Distribution Memphis, Tennessee (DDMT).

4.1.3 Facility Surroundings

Defense Distribution Memphis, Tennessee (DDMT) is set in a mixed residential, commercial and industrial land use area, within the south central Memphis city limits. Most of the land in the proximity of the installation is intensely developed. To the north of the site are tracks for the Illinois Central Railroad and the Burlington Northern Railroad, with numerous warehousing facilities along these lines. A triangular shaped area immediately to the north of DDMT along Dunn Road contains several industrial firms with a few single family residences nearby.

Airways Boulevard, to the east of DDMT is lined with a wide range of businesses including: convenience stores, liquor stores, restaurants, used car dealers and service stations. Remaining commercial establishments to the north, south and west of the site consist of small grocery or convenience stores.

DDMT is surrounded by residential development, including single family homes and multi-family apartment buildings. There are several large multi-family developments in the area, with the older units to the north of the site and the newer units to the south along Ball Road.

Institutional uses include many small church buildings within the residential neighborhoods, as well as several schools and five cemeteries. Memphis Light, Gas and Water Division (MLGWD) operates a large substation along Person Avenue. Approximately one mile to the west of the site, MLGWD operates a number of public water supply wells at the Allen Well Field (primarily west of Elvis Presley Boulevard).

4.2 Topography and Geology

4.2.1 Topography

Dunn Field lies just north of the main installation and Dunn Road, and consists of almost 64 acres of undeveloped land. Dunn Field is unpaved, with approximately one-half the area covered by grass. An arc shaped ridgeline separates the northeast quadrant from the rest of Dunn Field.

The northeast quadrant of the field is gently rolling with a grass cover and numerous mature trees. The northwest quadrant is grass covered and is level to gently sloping westward. The southwest quadrant of the field is grassed and gently sloping to the west. The southeast quadrant is a level area that is utilized for storage of covered and uncovered bulk materials (Figure 4.2).

The lowest surface elevation is 273 feet, National Geodetic Vertical Datum of 1929 (NGVD). The storage piles of bauxite ore at the southeast quadrant, average 10 feet in height, peaking at about 315 feet (NGVD).

4.2.2 Geology

4.2.2.1 General

The Memphis, Tennessee area straddles two major subdivisions of the Atlantic Coastal Plain Physiographic Province (Figure 4.3). The western Memphis urban area lies within the Mississippi Alluvial Plain Subdivision. DDMT and eastern Memphis are situated with the Gulf Coastal Plain Subdivision.

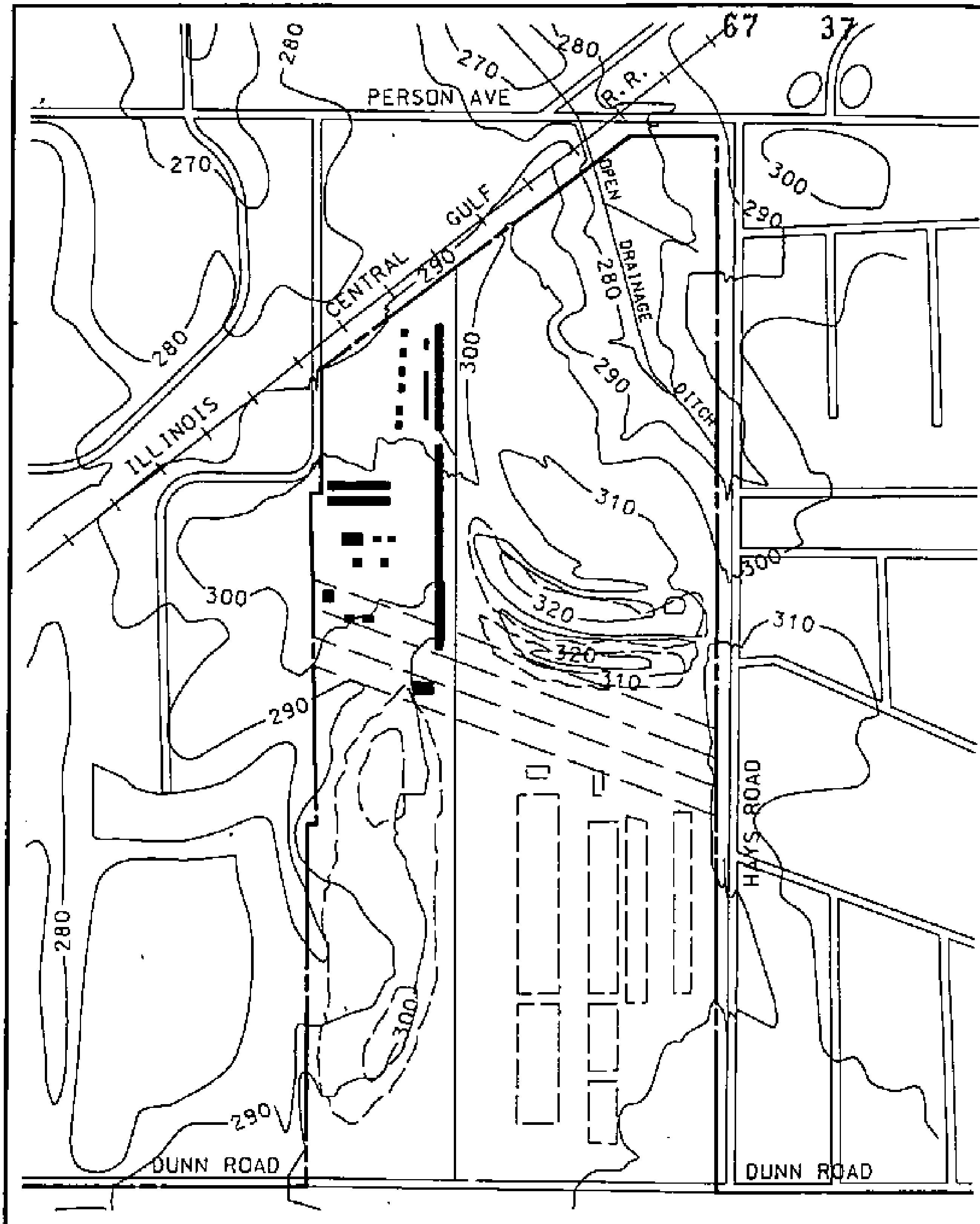

FIGURE 4.2
TOPOGRAPHY AND LAND USE
OF DUNN FIELD

BURIAL AREA
MATERIAL STORAGE

400 200 0 400
SCALE IN FEET

N

DEFENSE DISTRIBUTION

MEMPHIS, TENNESSEE

DEFENSE LOGISTICS AGENCY

ENGINEERING-SCIENCE
St. Louis, Missouri

ES

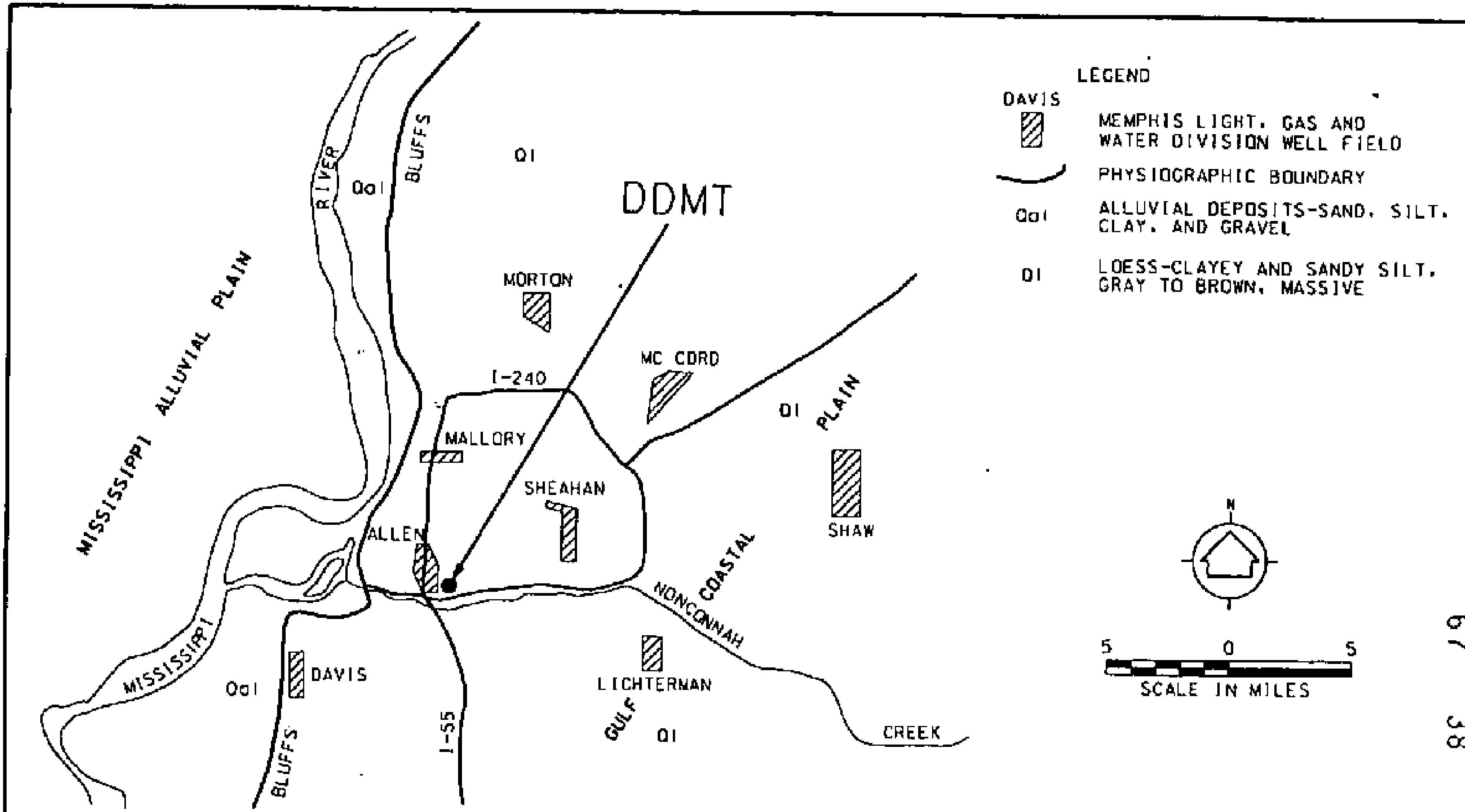

FIGURE 4.3
GEOLOGIC MAP OF MEMPHIS AREA

DEFENSE DISTRIBUTION
MEMPHIS, TENNESSEE
DEFENSE LOGISTICS AGENCY

ENGINEERING-SCIENCE
St. Louis, Missouri

ES

67 38

The generalized geologic setting for the Memphis area is situated within a major structural feature termed the Mississippi Embayment. The embayment is a wedge shaped, southward dipping structure composed of stratified sediments which have accumulated since late Cretaceous Period and have undergone a period of subsidence and subsequent uplift. This area is described as a youthful to mature, belted coastal plain. The principal river in the area is the Mississippi River; the major tributaries are the Wolf River, the Loosachatchie River, and Nonconnah Creek (1986 Graham and Parks).

4.2.2.2 Geologic Units

The Geologic Units that comprise the Quaternary and Tertiary strata in the Memphis area are composed of loosely consolidated deposits of marine, fluvial, fluivalglacial and deltaic sediments (Late Cretaceous through Quaternary). These sediments reach their maximum thickness at Memphis where they range from 2700 to 3000 feet in thickness. Periods of Pleistocene glaciation are responsible for the origin, distribution, and character of all of the Quaternary deposits in the Mississippi Embayment.

The following geologic units have been identified in the study area (1990 Law), and are important in that many of these units contain substantial quantities of ground water of local and regional importance:

1) Alluvium (Note: not present at DDMT)
2) Loess
3) Fluvial (Terrace) Deposits
4) Jackson Formation and Upper Claiborne Group
5) Memphis Sand
6) Flour Island Formation
7) Fort Pillow Sand
8) Old Breastworks Formation

Descriptions of these units are presented in Table 4.1.

Table 4-1
Geologic Strata
DDMT Study Area

67 40

(Alluvium is shown here in the conventional position at the yougest stratigraphic unit. Actually, almost nowhere does it overlie the Loess but may over lie any of the older stratigraphic units)

SYSTEM	SERIES	GROUP	STRATIGRAPHIC UNIT	THICKNESS (feet))	LITHOLOGY AND HYDROLOGIC SIGNIFICANCE
Quaternary	Holocene and Pleistocene		Alluvium	0-175	Sand, gravel, silt, and clay. Underlies the Mississippi alluvial plain and alluvial plains of streams in the Gulf coastal plain. Thickest beneath the alluvial plain, where commonly between 100 and 150 feet thick; generally less than 50 feet thick elsewhere. Provides water to domestic, farm, industrial, and irrigation wells in the Mississippi alluvial plan
	Pleistocene		Loess	0-65	Silt, silty clay, and minor sand. Principal unit at the surface in upland areas of the gulf coastal plain. Thickest on the bluffs that border the Mississippi alluvial plain; thinner eastward from the bluffs. Tends to retard downward movement of water providing recharge to the fluvial deposits.
Quaternary and Tertiary (?)	Pleistocene and Pliocene (?)		Fluvial Deposits (terrace deposits)	0-100	Sand, gravel, minor clay and ferruginous sandstone. Generally underlie the loess in upland areas, but are locally absent. Thickness varies greatly because of erosional surfaces at top and base. Provides water to many domestic and farm wells in rural areas.
Tertiary	Eocene	? Claiborne	Jackson Formation and upper part of Claiborne Group, includes Cockfield and Cook Mountain formations (capping clay)	0-380	Clay, silt, sand, and lignite. Because of similarities in lithology, the Jackson formation and upper part of the Claiborne group cannot be reliably subdivided based on available information. Most of the preserved sequence is the Cockfield and Cook Mountain formations undivided, but locally the Cockfield may be overlain by the Jackson formation. Serves as the upper confining bed for the Memphis sand.
			Memphis Sand ("500-foot" Sand)	500-890	Sand, clay, and minor lignite. Thick body of sand with lenses of clay at various stratigraphic horizons and minor lignite. Thickest in the southwestern part of the Memphis area; thinnest in the northeastern part. Principal aquifer providing water for municipal and industrial supplies east of the Mississippi River; sole source of water for the city of Memphis.
	?	Wilcox	Flour Island Formation	180-310	Clay, silt, sand, and lignite. Consists primarily of silty clays and sandy silts with lenses and interbeds of fine sand and lignites. Serves as the lower confining bed for the Memphis sand and the upper confining bed for the Fort Pillow sand.
			Fort Pillow Sand ("1400-foot" Sand)	125-305	Sand with minor clay and lignite. Sand is fine to medium. Thickest in the southwestern part of the Memphis area; thinnest in the northern and northeastern parts. Once the second principal aquifer supplying the city of Memphis; still used by an industry. Principal aquifer providing water for municipal and industrial supplies west of the Mississippi River.
	Paleocene		Old Breastworks Formation	180-350	Clay, silt, sand lignite. Consists primarily of silty clays and clayey silts with lenses and interbeds of fine sands and lignite. Serves as the lower confining bed for the Fort Pillow sand, along with underlying Porters Creek clay and Clayton formation of the Midway group.

Source: Modified from Grahm and Parks, 1986

4.3 Soils

Five soil types were mapped and described in the study area, based on information furnished by the U.S. Department of Agriculture Service (1970). Four of these soil types are found in the Dunn Field area (Figure 4.4). A brief description of these four units is as follows:

- Falava Silt Loam (Fm). This soil unit may have developed as a narrow strip of alluvium on a bench above a stream channel. The unit has been mapped on a small portion of northern Dunn Field, and is described as a silt loam, poorly to moderately drained, and possesses a shallow water table and typically low to moderate permeabilities.

- Graded land (Gr). This soil unit has been artificially developed from silty native upland materials as a result of numerous site modifications and consists of silty sandy clay or clayey sandy silt. This unit may include coarser materials such as construction materials and demolition debris. The permeability is reported as highly variable. This soil unit occupies over 90 percent of the land area at DDMT.

- Memphis silt loam (MeB). This soil unit developed in silty native upland materials on low hilltops, benches, and nearby gradual slopes. It is described as a silt loam or silty clay loam, and is well drained and possesses low to moderate permeabilities. This unit is significant because wastes buried in Dunn Field lie within this unit.

- Memphis silt loam (MeD2). This unit developed in silty native upland material on intermediate slope benches. It is described as a silt loam or a silty clay loam. It is deep, well drained and possesses low to moderate permeabilities.

In summary, the surface soils at Dunn Field are predominantly of the Graded Land (Gr) unit, where the permeability is considered highly variable, due to past disturbances and possible mixing of debris and other units nearby. This condition is significant in that infiltration from precipitation is likely.

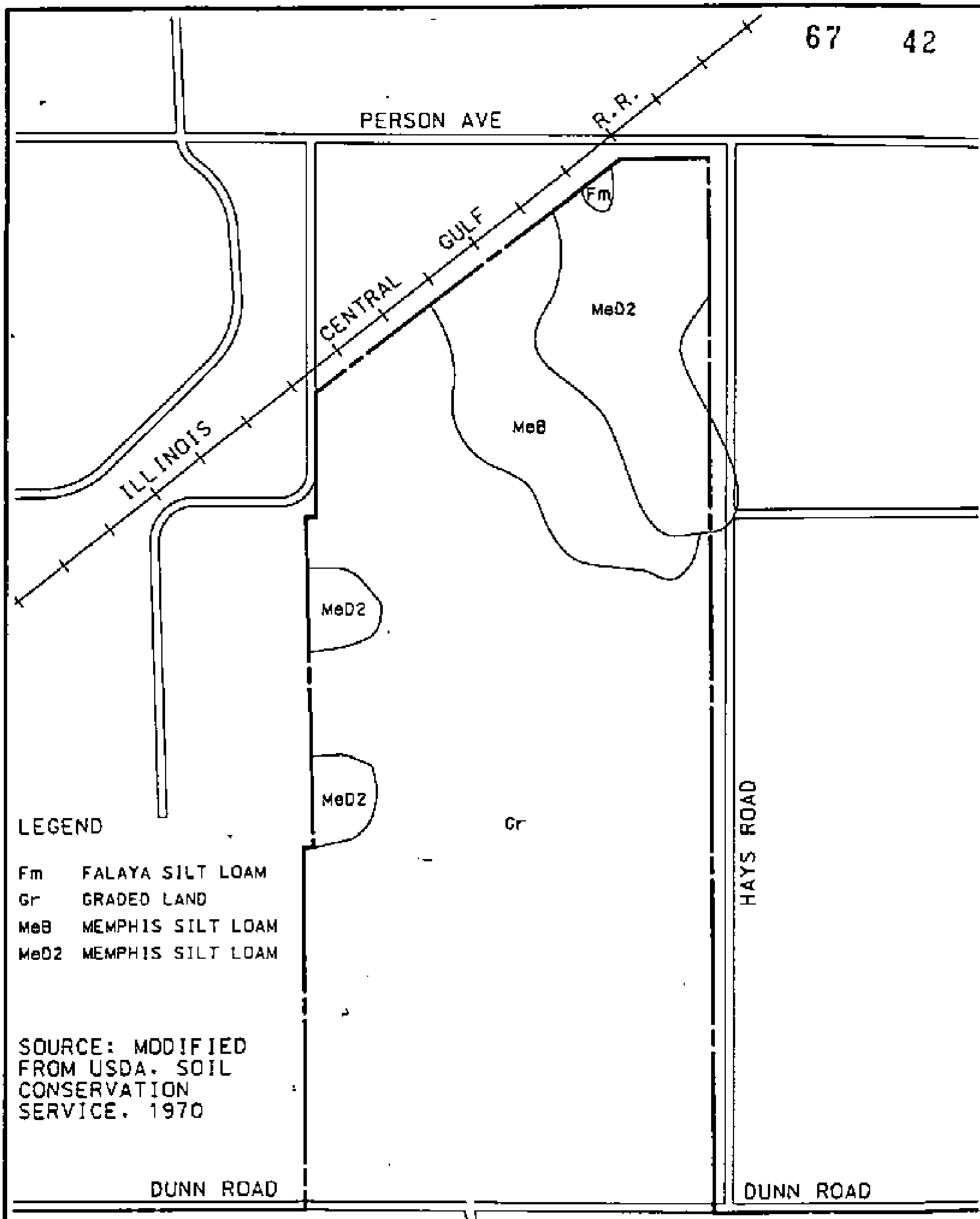

FIGURE 4.4
SOIL TYPES IN DUNN FIELD

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MEMPHIS, TENNESSEE
DEFENSE LOGISTICS AGENCY

ENGINEERING-SCIENCE
St. Louis, Missouri

ES

The area of Dunn Field at the northeast quadrant is overlain by Memphis silt loams (MeB, MeD2) which are well drained and exhibit low to moderate permeabilities. These units may reduce rainfall infiltration while the Graded Land unit may encourage infiltration.

4.4 Water Resources

4.4.1 Introduction

Water resources at Dunn Field include surface water (in the form of runoff), and ground water from the Fluvial Aquifer, the Memphis Sand Aquifer and to a lessor degree, the Fort Pillow Sand aquifer. This section summarizes the major characteristics, their relationship and use.

4.4.2 Surface Waters

No permanent surface water bodies exist at Dunn Field. Because of its relative elevation, Dunn Field receives little or no runoff from surrounding areas (Figure 4.5).

Runoff from Dunn Field flows off DDMT to the north and west. The northeast quadrant drains to a concrete lined channel, and then proceeds north via an open drainage ditch into Cane Creek. The northwest quadrant of Dunn Field flows overland to a drainage ditch along Kyle Street. The southern half of the Dunn Field runoff flows to the west into drainage ditches which convey the stormwater offsite to surrounding property.

Dunn Field lies within the Cane Creek watershed which has a drainage area of about 7.7 square miles, all of which lies within the city of Memphis. Flow in Cane Creek is intermittent, and discharge subsides after periods of rainfall. Cane Creek empties into Nonconnah Creek, which drains approximately 180 square miles of southern Shelby County and southwestern Tennessee.

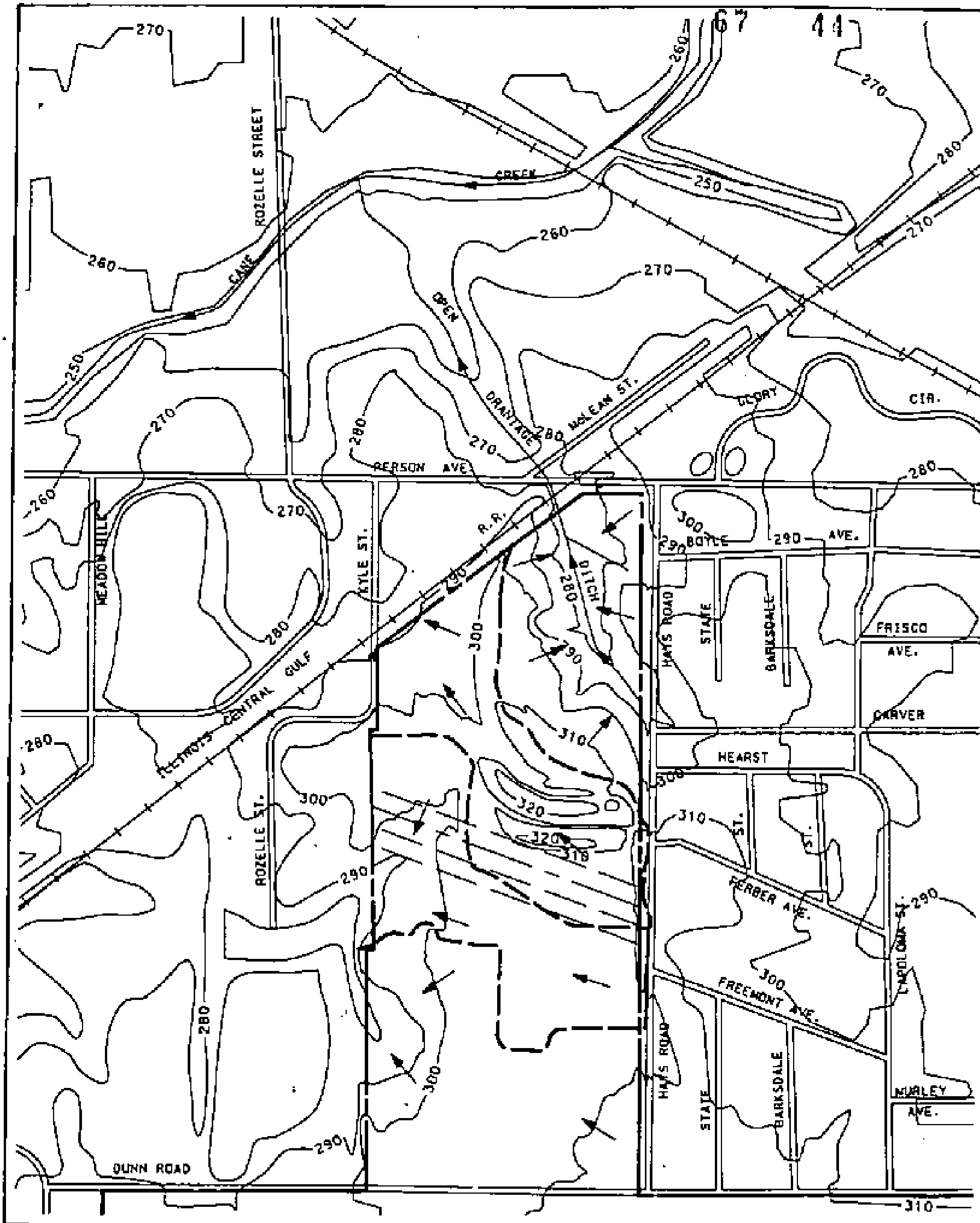

FIGURE 4.5
SURFACE DRAINAGE
OFF DUNN FIELD

600 300 0 600

SCALE IN FEET

DEFENSE DISTRIBUTION

MEMPHIS, TENNESSEE

DEFENSE LOGISTICS AGENCY

ENGINEERING-SCIENCE
St. Louis, Missouri

ES

4.4.3 Ground Water Hydrology

4.4.3.1 Regional Hydrology

Water supply systems in the Memphis area depend heavily upon ground water resources. The uppermost aquifer beneath Dunn Field is the Fluvial Aquifer. The Fluvial Aquifer is not utilized as a drinking water source due to its variable water quality, high hardness and elevated iron concentrations. Due to the properties of the overlying loess deposits, which allow infiltration and recharge to Fluvial Aquifer, this unit is susceptible to contamination from the surface. The fluvial deposits have a limited saturated thickness that tends to fluctuate, and may not be a dependable source of water.

The Memphis Sand Aquifer lies beneath the Fluvial Aquifer, and is the shallowest artesian (confined) aquifer in the area. The Memphis Sand Aquifer receives most of its recharge from areas where it crops out. The out crop area forms a wide northeast trending belt several miles east of the Memphis metropolitan area. This aquifer is locally and regionally important, in that it supplies about 200 million gallons per day (MGD) to the city of Memphis and the surrounding unincorporated areas. The Memphis Light Gas and Water Division operates ten well fields in Shelby County, Tennessee, extensively using the Memphis Sand Aquifer (Figure 4.2). The Allen Well Field is nearest to Dunn Field, only 1 to 1.5 miles west of DDMT.

The Fort Pillow Sand Aquifer lies beneath the Memphis Sand, and supplies over 10 MGD to the City of Memphis. However, it is not significant with respect to this study, because its hydraulic head is higher than the Memphis Sand Aquifer.

4.4.3.2 Site Hydrogeology

Refer to subsection 4.2.2.2 of this report for lithological description(s) of the following strata encountered beneath Dunn Field. The following describes the aquifers and respective confining bed present at Dunn Field.

- Loess - The loess is not typically a water bearing zone. There is no evidence that it produces water to wells in the DDMT vicinity. The loess deposits permit recharge into underlying fluvial deposit during rainfall event. Seasonal perched ground water may occur within the loess.

- Fluvial Deposit - The fluvial deposit forms the water table aquifer in the Dunn Field vicinity. In this area, the Fluvial Aquifer is about 20 feet thick and receives recharge from rainfall infiltration through overlying loess and lateral ground water inflow from the east. Discharge is toward the Mississippi River to the west and possibly by leakage into the underlying Memphis Sand through the Jackson/Upper Claiborne confining bed. Based on data collected during the Law Study (1990 Law), ground water flow in the Dunn Field vicinity is generally toward the west.

- Jackson Clay/Upper Claiborne Formation - The Jackson Clay/Upper Claiborne unit is a regional confining bed which separates the Fluvial Aquifer from the Memphis Sand Aquifer. Through erosion, this unit is thinned at DDMT immediately south of Dunn Field. It is documented (1989 Smith and Ishak/Muhamad) that some areas of the Memphis Sand are directly overlain by the fluvial deposit.

- Memphis Sand - The top of Memphis Sand is approximately 125 to 150 feet above MSL in the vicinity of DDMT. The base of this unit is about -750 feet below MSL. Thus, the aquifer is about 900 feet thick and is under confined conditions. Recharge to the aquifer occurs from rainfall infiltration on the outcrop located to the east of Memphis and possibly from leakage from the overlying Fluvial Aquifer. Pumpage for municipal water supplies (see well fields shown in Figure 4.2) is the primary discharge from the aquifer.

4.5 Air Quality

The Memphis/Shelby County Health Department has adopted the State of Tennessee Air Code, which conforms to the provisions of the Clean Air Act (CAA) of 1990. Under the provisions of the CAA, the Memphis/Shelby County area has been designated a nonattainment area by EPA Region IV for ozone, carbon monoxide and lead. The

*** MODELING OPTIONS USED: CONC RURAL FLAT FLGPOL

67 47

*** MODEL SETUP OPTIONS SUMMARY ***

- -

**Model Is Setup For Calculation of Average CONCentration Values.

**Model Uses RURAL Dispersion.

**Model Uses User-Specified Options:
1. Final Plume Rise.
2. Stack-tip Downwash.
3. Buoyancy-induced Dispersion.
4. Calms Processing Routine.
5. Not Use Missing Data Processing Routine.
6. Default Wind Profile Exponents.
7. Default Vertical Potential Temperature Gradients.

**Model Assumes Receptors on FLAT Terrain.

**Model Accepts FLAGPOLE Receptor Heights.

**Model Calculates 1 Short Term Average(s) of: 1-HR

**This Run Includes: 1 Source(s); 1 Source Group(s); and 15 Receptor(s)

**The Model Assumes A Pollutant Type of: TCE

**Model Set To Continue RUNning After the Setup Testing.

**Output Options Selected:
Model Outputs Tables of Highest Short Term Values by Receptor (RECTABLE Keyword)

**NOTE: The Following Flags May Appear Following CONC Values: c for Calm Hours
m for Missing Hours
b for Both Calm and Missing Hours

**Misc. Inputs: Anem. Hgt. (m) = 10.00 ; Decay Coef. = .0000 ; Rot. Angle = .0
Emission Units = GRAMS/SEC ; Emission Rate Unit Factor = .10000E+07
Output Units = MICROGRAMS/M**3

**Input Runstream File: DORC8.INP ; **Output Print File: DORC8.OUT

*** MODELING OPTIONS USED: CONC RURAL FLAT FLGPOL

67 48

*** POINT SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC)	X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE SCALAR VARY BY
STRIPPER	0	.16200E-01	.0	.0	.0	7.63	293.00	.00	1.20	NO	

*** MODELING OPTIONS USED: CONC RURAL FLAT FLGPOL

67 49

*** SOURCE IDs DEFINING SOURCE GROUPS ***

GROUP ID	SOURCE IDs
ALL	STRIPPER,

67 50

*** MODELING OPTIONS USED: CONC RURAL FLAT FLGPOL

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZFLAG)
(METERS)

(-67.0,	.0,	.0,	1.5);	(-61.0,	70.0,	.0,	1.5);
(101.0,	174.0,	.0,	1.5);	(281.0,	238.0,	.0,	1.5);
(262.0,	.0,	.0,	1.5);	(250.0,	-122.0,	.0,	1.5);
(232.0,	-366.0,	.0,	1.5);	(214.0,	-653.0,	.0,	1.5);
(-122.0,	-616.0,	.0,	1.5);	(-107.0,	-366.0,	.0,	1.5);
(-85.0,	-122.0,	.0,	1.5);	(-430.0,	-702.0,	.0,	1.5);
(1549.0,	-702.0,	.0,	1.5);	(1546.0,	-1821.0,	.0,	1.5);
(-476.0,	-1821.0,	.0,	1.5);				

*** MODELING OPTIONS USED: CONC RURAL FLAT FLGPOL

67 51

*** METEOROLOGICAL DAYS SELECTED FOR PROCESSING ***
(1=YES; 0=NO)

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1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1
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METEOROLOGICAL DATA PROCESSED BETWEEN START DATE: 93 1 1 1
AND END DATE: 93 1 1 15

NOTE: METEOROLOGICAL DATA ACTUALLY PROCESSED WILL ALSO DEPEND ON WHAT IS INCLUDED IN THE DATA FILE.

*** UPPER BOUND OF FIRST THROUGH FIFTH WIND SPEED CATEGORIES ***
(METERS/SEC)

1.54, 3.09, 5.14, 8.23, 10.80,

*** WIND PROFILE EXPONENTS ***

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B	.70000E-01	.70000E-01	.70000E-01	.70000E-01	.70000E-01	.70000E-01
C	.10000E+00	.10000E+00	.10000E+00	.10000E+00	.10000E+00	.10000E+00
D	.15000E+00	.15000E+00	.15000E+00	.15000E+00	.15000E+00	.15000E+00
E	.35000E+00	.35000E+00	.35000E+00	.35000E+00	.35000E+00	.35000E+00
F	.55000E+00	.55000E+00	.55000E+00	.55000E+00	.55000E+00	.55000E+00

*** VERTICAL POTENTIAL TEMPERATURE GRADIENTS ***
(DEGREES KELVIN PER METER)

STABILITY	WIND SPEED CATEGORY					
CATEGORY	1	2	3	4	5	6
A	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
B	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
C	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
D	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
E	.20000E-01	.20000E-01	.20000E-01	.20000E-01	.20000E-01	.20000E-01
F	.35000E-01	.35000E-01	.35000E-01	.35000E-01	.35000E-01	.35000E-01

*** MODELING OPTIONS USED: CONC RURAL FLAT FLGPOL

67 52

*** THE FIRST 15 HOURS OF METEOROLOGICAL DATA ***

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NAME: NONAME
YEAR: 1993

FORMAT: (4I2,2F9.4,F6.1,I2,2F7.1)
UPPER AIR STATION NO.: 99999
NAME: NOPLACE
YEAR: 1993

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93	1	1	1	270.0	8.50	293.0	4	500.0	600.0
93	1	1	2	319.0	8.50	293.0	4	500.0	600.0
93	1	1	3	30.1	8.50	293.0	4	500.0	600.0
93	1	1	4	49.7	8.50	293.0	4	500.0	600.0
93	1	1	5	90.0	8.50	293.0	4	500.0	600.0
93	1	1	6	116.0	8.50	293.0	4	500.0	600.0
93	1	1	7	147.6	8.50	293.0	4	500.0	600.0
93	1	1	8	161.9	8.50	293.0	4	500.0	600.0
93	1	1	9	191.2	8.50	293.0	4	500.0	600.0
93	1	1	10	196.7	8.50	293.0	4	500.0	600.0
93	1	1	11	235.0	8.50	293.0	4	500.0	600.0
93	1	1	12	211.5	8.50	293.0	4	500.0	600.0
93	1	1	13	114.4	8.50	293.0	6	500.0	600.0
93	1	1	14	139.7	8.50	293.0	6	500.0	600.0
93	1	1	15	194.6	8.50	293.0	6	500.0	600.0

*** NOTES: STABILITY CLASS 1=A, 2=B, 3=C, 4=D, 5=E AND 6=F.
FLOW VECTOR IS DIRECTION TOWARD WHICH WIND IS BLOWING.

*** THE 1ST HIGHEST 1-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): STRIPPER,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF TCE IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
-67.00	.00	16.11327	(93010101)	-61.00	70.00	11.75345	(93010102)
101.00	174.00	4.01262	(93010103)	281.00	238.00	1.48805	(93010104)
262.00	.00	2.61402	(93010105)	250.00	-122.00	6.09006	(93010113)
232.00	-366.00	1.13474	(93010107)	214.00	-653.00	.52114	(93010108)
-122.00	-616.00	.60728	(93010109)	-107.00	-366.00	3.80840	(93010115)
-85.00	-122.00	4.85582	(93010112)	-430.00	-702.00	.38325	(93010112)
1549.00	-702.00	.55201	(93010113)	1546.00	-1821.00	.33489	(93010114)
-476.00	-1821.00	.47339	(93010115)				

67 54

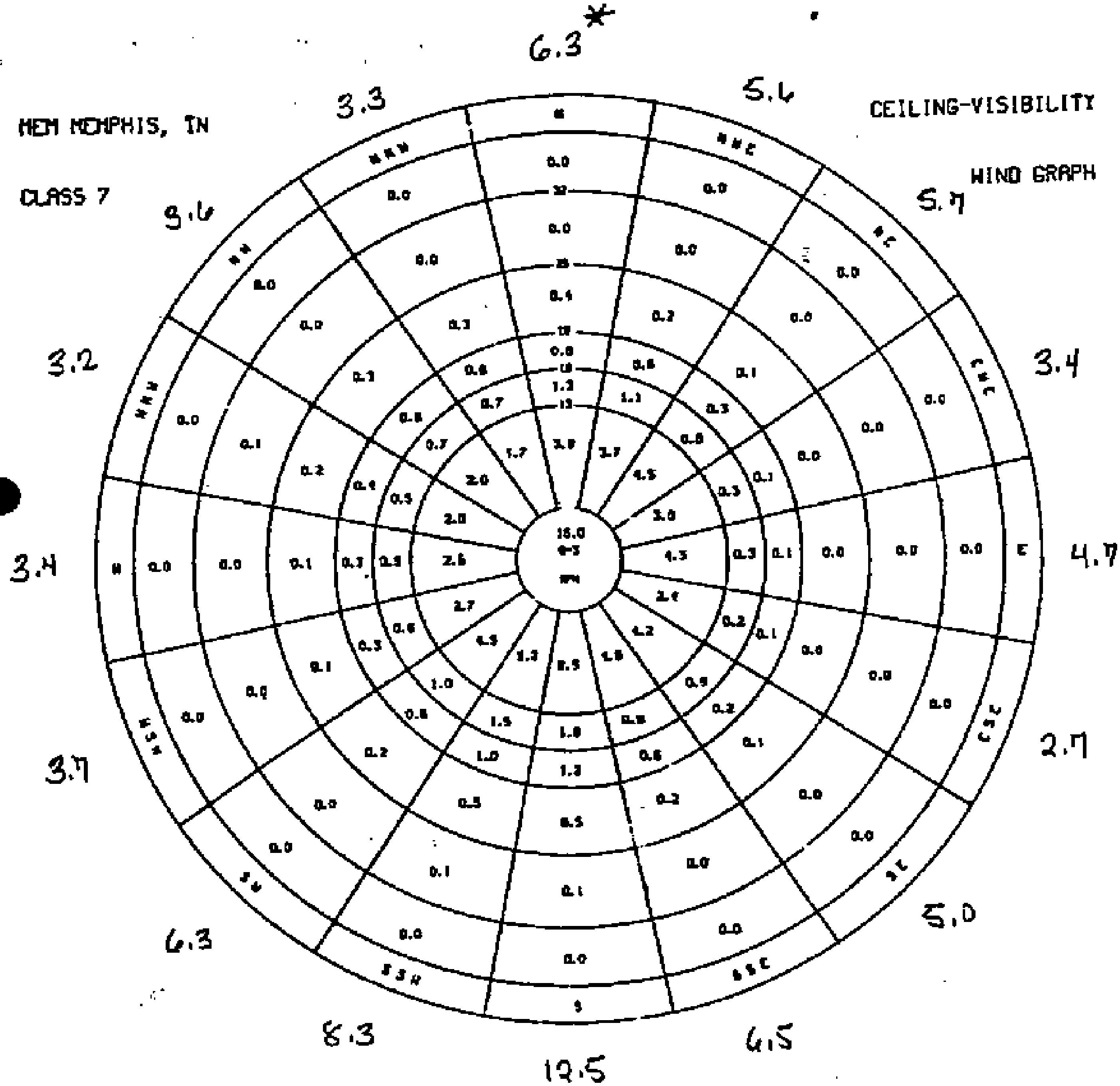
```
**ISCST2 FILE FOR DEFENSE DEPOT REGION CENTRAL (DDRC)
* LING OF TCE EMISSIONS FROM AIR STRIPPER TO OBTAIN
* CENTRATIONS AT FENCELINE
**8/20/93 CLAIRE CHAPIN
**
**
CO STARTING
   TITLEONE TCE CONCENTRATIONS FOR AIR STRIPPER AT DDRC
   TITLETWO WIND SPEED 8.5 M/S
   MODELOPT CONC RURAL
   AVERTIME 1
   POLLUTID TCE
   FLAGPOLE 1.5
   RUNORNOT RUN
CO FINISHED
**
SO STARTING
**
** SOURCE IS SINGLE AIR STRIPPER LOCATED AT ORIGIN OF COORDINATES
** STACK VELOCITY ZERO SINCE EMISSION IS HORIZONTAL FROM RADIAL ORIFICES
** AND RAPIDLY ATTAINS AMBIENT AIR SPEED
**
   LOCATION STRIPPER POINT 0.0 0.0
   SRCPARAM STRIPPER 0.0162 7.625 293.0 0.0 1.2
   SRCGROUP ALL
SO FINISHED
**
   RTING
**
** RECEPTORS ARE ALL ON FENCELINE
** ORIGIN IS AT STRIPPER
**
   DISCCART -67. 0.
   DISCCART -61. 70.
   DISCCART 101. 174.
   DISCCART 281. 238.
   DISCCART 262. 0.
   DISCCART 250. -122.
   DISCCART 232. -366.
   DISCCART 214. -653.
   DISCCART -122. -616.
   DISCCART -107. -366.
   DISCCART -85. -122.
   DISCCART -430. -702.
   DISCCART 1549. -702.
   DISCCART 1546. -1821
   DISCCART -476. -1821
**
RE FINISHED
**
ME STARTING
**
   FILES ARE FABRICATED FILES GIVING PROPER WIND SPEED
   VARYING WIND DIRECTION EACH HOUR
**
   INPUTFILE WIND8.MET
   ANEMHGHT 10.
```

There is more dispersion of pollutants at greater wind speeds, and, consequently, smaller concentrations. At a wind speed of 5.8 m/s the largest concentration at the fenceline is 29 $\mu g/m^3$, and at 8.5 m/s the greatest concentration at the fenceline is 16 $\mu g/m^3$. The fenceline concentrations diminish from these maximum values with distance from the air stripper.

Complete output files from the ISCST2 code are included in Appendix A.

67 56

Figure 1. Wind Rose for Memphis International Airport.



* Numbers indicate percent of time that winds of any speed blow from indicated direction.

*** MODELING OPTIONS USED: CONC RURAL FLAT FLGPOL

*** Message Summary For ISC2 Model Execution ***

--------- Summary of Total Messages --------

```
A Total of          0 Fatal Error Message(s)
A Total of         15 Warning Message(s)
A Total of          0 Informational Message(s)

   ******** FATAL ERROR MESSAGES ********
            ***  NONE  ***

   ********   WARNING MESSAGES   ********
RE W228    33 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    34 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    35 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    36 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    37 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    38 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    39 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    40 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    41 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    42 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    43 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    44 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    45 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    46 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    47 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART

   ***********************************
   *** ISCST2 Finishes Successfully ***
   ***********************************
```

```
**ISCST2 FILE FOR DEFENSE DEPOT REGION CENTRAL (DDRC)
**MODELING OF TCE EMISSIONS FROM AIR STRIPPER TO OBTAIN
**CONCENTRATIONS AT FENCELINE
**8/20/93 CLAIRE CHAPIN
**
**
CO STARTING
   TITLEONE TCE CONCENTRATIONS FOR AIR STRIPPER AT DDRC
   TITLETWO WIND SPEED 1.5 M/S
   MODELOPT CONC RURAL
   AVERTIME 1
   POLLUTID TCE
   FLAGPOLE 1.5
   RUNORNOT RUN
CO FINISHED
**
SO STARTING
**
** SOURCE IS SINGLE AIR STRIPPER LOCATED AT ORIGIN OF COORDINATES
** STACK VELOCITY ZERO SINCE EMISSION IS HORIZONTAL FROM RADIAL ORIFICES
** AND RAPIDLY ATTAINS AMBIENT AIR SPEED
```

```
**
   LOCATION STRIPPER POINT 0.0 0.0
   SRCPARAM STRIPPER 0.0162 7.625 293.0 0.0 1.2
   SRCGROUP ALL
SO FINISHED
**
RE STARTING
**
** RECEPTORS ARE ALL ON FENCELINE
** ORIGIN IS AT STRIPPER
**
   DISCCART -67. 0.
   DISCCART -61. 70.
   DISCCART 101. 174.
   DISCCART 281. 238.
   DISCCART 262. 0.
   DISCCART 250. -122.
   DISCCART 232. -366.
   DISCCART 214. -653.
   DISCCART -122. -616.
   DISCCART -107. -366.
   DISCCART -85. -122.
   DISCCART -430. -702.
   DISCCART 1549. -702.
   DISCCART 1546. -1821
   DISCCART -476. -1821
**
RE FINISHED
**
ME STARTING
**
** METFILES ARE FABRICATED FILES GIVING PROPER WIND SPEED
** AND VARYING WIND DIRECTION EACH HOUR
**
   INPUTFILE WIND1.MET
   ANEMHGHT 10.
   SURFDATA 50000 1993 NONAME
   UAIRDATA 99999 1993 NOPLACE
   STARTEND 93 1 1 1 93 1 1 15
**
ME FINISHED
**
**
OU STARTING
**
** OUTPUT IS TABLE OF RECEPTOR VALUES EACH HOUR IN 30 DEG
** WIND INCREMENTS STARTING WITH WIND BLOWING FROM NORTH
**
   RECTABLE 1 FIRST
**
OU FINISHED


 *** Message Summary For ISC2 Model Setup ***

 --------- Summary of Total Messages --------

A Total of          0 Fatal Error Message(s)
A Total of         15 Warning Message(s)
A Total of          0 Informational Message(s)
```

```
******** FATAL ERROR MESSAGES ********
         ***  NONE  ***

********   WARNING MESSAGES   ********
RE W228    33 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    34 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    35 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    36 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    37 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    38 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    39 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    40 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    41 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    42 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    43 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    44 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    45 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    46 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    47 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART

*************************************
*** SETUP Finishes Successfully ***
*************************************
```

*** MODELING OPTIONS USED: CONC RURAL FLAT FLGPOL

67 60

*** MODEL SETUP OPTIONS SUMMARY ***

**Model Is Setup For Calculation of Average CONCentration Values.

**Model Uses RURAL Dispersion.

**Model Uses User-Specified Options:
1. Final Plume Rise.
2. Stack-tip Downwash.
3. Buoyancy-induced Dispersion.
4. Calms Processing Routine.
5. Not Use Missing Data Processing Routine.
6. Default Wind Profile Exponents.
7. Default Vertical Potential Temperature Gradients.

**Model Assumes Receptors on FLAT Terrain.

**Model Accepts FLAGPOLE Receptor Heights.

**Model Calculates 1 Short Term Average(s) of: 1-HR

**This Run Includes: 1 Source(s); 1 Source Group(s); and 15 Receptor(s)

**The Model Assumes A Pollutant Type of: TCE

**Model Set To Continue RUNning After the Setup Testing.

**Output Options Selected:
Model Outputs Tables of Highest Short Term Values by Receptor (RECTABLE Keyword)

**NOTE: The Following Flags May Appear Following CONC Values: c for Calm Hours
m for Missing Hours
b for Both Calm and Missing Hours

**Misc. Inputs: Anem. Hgt. (m) = 10.00 ; Decay Coef. = .0000 ; Rot. Angle = .0
Emission Units = GRAMS/SEC ; Emission Rate Unit Factor = .10000E+07
Output Units = MICROGRAMS/M**3

**Input Runstream File: DDRC1.INP ; **Output Print File: DDRC1.OUT

*** MODELING OPTIONS USED: CONC RURAL FLAT FLGPOL

67 61

*** POINT SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC)	X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE SCALAR VARY BY
STRIPPER	0	.16200E-01	.0	.0	.0	7.63	293.00	.00	1.20	NO	

*** MODELING OPTIONS USED: CONC RURAL FLAT FLGPOL

67 62

*** SOURCE IDs DEFINING SOURCE GROUPS ***

GROUP ID	SOURCE IDs
ALL	STRIPPER,

*** MODELING OPTIONS USED: CONC RURAL FLAT FLGPOL

67 63

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZFLAG)
(METERS)

(	-67.0,	.0,	.0,	1.5);	(	-61.0,	70.0,	.0, 1.5);
(	101.0,	174.0,	.0,	1.5);	(	281.0,	238.0,	.0, 1.5);
(	262.0,	.0,	.0,	1.5);	(	250.0,	-122.0,	.0, 1.5);
(	232.0,	-366.0,	.0,	1.5);	(	214.0,	-653.0,	.0, 1.5);
(	-122.0,	-616.0,	.0,	1.5);	(	-107.0,	-366.0,	.0, 1.5);
(	-85.0,	-122.0,	.0,	1.5);	(	-430.0,	-702.0,	.0, 1.5);
(	1549.0,	-702.0,	.0,	1.5);	(	1546.0,	-1821.0,	.0, 1.5);
(	-476.0,	-1821.0,	.0,	1.5);				

MODELING OPTIONS USED: CONC RURAL FLAT FLGPOL

67 61

*** METEOROLOGICAL DAYS SELECTED FOR PROCESSING ***
(1=YES; 0=NO)

```
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1
```

METEOROLOGICAL DATA PROCESSED BETWEEN START DATE: 93 1 1 1
AND END DATE: 93 1 1 15

NOTE: METEOROLOGICAL DATA ACTUALLY PROCESSED WILL ALSO DEPEND ON WHAT IS INCLUDED IN THE DATA FILE.

*** UPPER BOUND OF FIRST THROUGH FIFTH WIND SPEED CATEGORIES ***
(METERS/SEC)

1.54, 3.09, 5.14, 8.23, 10.80,

*** WIND PROFILE EXPONENTS ***

STABILITY	WIND SPEED CATEGORY					
CATEGORY	1	2	3	4	5	6
A	.70000E-01	.70000E-01	.70000E-01	.70000E-01	.70000E-01	.70000E-01
B	.70000E-01	.70000E-01	.70000E-01	.70000E-01	.70000E-01	.70000E-01
C	.10000E+00	.10000E+00	.10000E+00	.10000E+00	.10000E+00	.10000E+00
D	.15000E+00	.15000E+00	.15000E+00	.15000E+00	.15000E+00	.15000E+00
E	.35000E+00	.35000E+00	.35000E+00	.35000E+00	.35000E+00	.35000E+00
F	.55000E+00	.55000E+00	.55000E+00	.55000E+00	.55000E+00	.55000E+00

*** VERTICAL POTENTIAL TEMPERATURE GRADIENTS ***
(DEGREES KELVIN PER METER)

STABILITY	WIND SPEED CATEGORY					
CATEGORY	1	2	3	4	5	6
A	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
B	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
C	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
D	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
E	.20000E-01	.20000E-01	.20000E-01	.20000E-01	.20000E-01	.20000E-01
F	.35000E-01	.35000E-01	.35000E-01	.35000E-01	.35000E-01	.35000E-01

**MODELING OPTIONS USED: CONC RURAL FLAT FLGPOL

67 65

*** THE FIRST 15 HOURS OF METEOROLOGICAL DATA ***

FILE: WIND1.MET   FORMAT: (4I2,2F9.4,F6.1,I2,2F7.1)
SURFACE STATION NO.: 50000   UPPER AIR STATION NO.: 99999
NAME: NONAME   NAME: NOPLACE
YEAR: 1993   YEAR: 1993

YEAR	MONTH	DAY	HOUR	FLOW VECTOR	SPEED (M/S)	TEMP (K)	STAB CLASS	MIXING HEIGHT (M) RURAL	URBAN
93	1	1	1	270.0	1.50	293.0	6	500.0	600.0
93	1	1	2	319.0	1.50	293.0	6	500.0	600.0
93	1	1	3	30.1	1.50	293.0	6	500.0	600.0
93	1	1	4	49.7	1.50	293.0	6	500.0	600.0
93	1	1	5	90.0	1.50	293.0	6	500.0	600.0
93	1	1	6	116.0	1.50	293.0	6	500.0	600.0
93	1	1	7	147.6	1.50	293.0	6	500.0	600.0
93	1	1	8	161.9	1.50	293.0	6	500.0	600.0
93	1	1	9	191.2	1.50	293.0	6	500.0	600.0
93	1	1	10	196.7	1.50	293.0	6	500.0	600.0
93	1	1	11	235.0	1.50	293.0	6	500.0	600.0
93	1	1	12	211.5	1.50	293.0	6	500.0	600.0
93	1	1	13	114.4	1.50	293.0	6	500.0	600.0
93	1	1	14	139.7	1.50	293.0	6	500.0	600.0
93	1	1	15	194.6	1.50	293.0	6	500.0	600.0

*** NOTES: STABILITY CLASS 1=A, 2=B, 3=C, 4=D, 5=E AND 6=F.
FLOW VECTOR IS DIRECTION TOWARD WHICH WIND IS BLOWING.

*** MODELING OPTIONS USED: CONC RURAL FLAT FLGPOL

*** THE 1ST HIGHEST 1-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): STRIPPER,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF TCE IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
-67.00	.00	119.24270	(93010101)	-61.00	70.00	114.77420	(93010102)
101.00	174.00	66.35485	(93010103)	281.00	238.00	31.34834	(93010104)
262.00	.00	49.13413	(93010105)	250.00	-122.00	45.60301	(93010106)
232.00	-366.00	24.82357	(93010107)	214.00	-653.00	12.27051	(93010108)
-122.00	-616.00	14.13976	(93010109)	-107.00	-366.00	29.30556	(93010110)
-85.00	-122.00	28.99841	(93010112)	-430.00	-702.00	9.33498	(93010112)
1549.00	-702.00	3.12805	(93010113)	1546.00	-1821.00	1.89768	(93010114)
-476.00	-1821.00	2.68252	(93010115)				

*** MODELING OPTIONS USED: CONC RURAL FLAT FLGPOL

*** THE SUMMARY OF HIGHEST 1-HR RESULTS ***

** CONC OF TCE IN MICROGRAMS/M**3 **

GROUP ID		AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR (XR, YR, ZELEV, ZFLAG)				OF TYPE	NETWORK GRID-ID
ALL	HIGH 1ST HIGH VALUE IS	119.24270	ON 93010101: AT (	-67.00,	.00,	.00,	1.50)	DC	

*** RECEPTOR TYPES: GC = GRIDCART
GP = GRIDPOLR
DC = DISCCART
DP = DISCPOLR
BD = BOUNDARY

*** MODELING OPTIONS USED: CONC RURAL FLAT FLGPOL

67 68

*** Message Summary For ISC2 Model Execution ***

--------- Summary of Total Messages --------

A Total of 0 Fatal Error Message(s)
A Total of 15 Warning Message(s)
A Total of 0 Informational Message(s)

******** FATAL ERROR MESSAGES ********
*** NONE ***

******** WARNING MESSAGES ********

```
RE W228   33 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   34 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   35 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   36 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   37 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   38 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   39 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   40 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   41 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
   W228   42 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
    228   43 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   44 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   45 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   46 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   47 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
```

****
*** ISCST2 Finishes Successfully ***
****

```
*** MODELING OPTIONS USED:  CONC   RURAL  FLAT   FLGPOL
```

67   69

```
*** Message Summary For ISC2 Model Execution ***

 --------- Summary of Total Messages --------

A Total of           0 Fatal Error Message(s)
A Total of          15 Warning Message(s)
A Total of           0 Informational Message(s)

   ******** FATAL ERROR MESSAGES ********
              ***  NONE  ***

   ********   WARNING MESSAGES   ********
RE W228    33 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    34 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    35 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    36 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    37 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    38 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    39 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    40 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    41 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
[illegible]228    42 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
[illegible]W228    43 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    44 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    45 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    46 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    47 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART

   ***********************************
   *** ISCST2 Finishes Successfully ***
   ***********************************
```

```
**ISCST2 FILE FOR DEFENSE DEPOT REGION CENTRAL (DDRC)
**MODELING OF TCE EMISSIONS FROM AIR STRIPPER TO OBTAIN
**CONCENTRATIONS AT FENCELINE
**8/20/93 CLAIRE CHAPIN
**
**
CO STARTING
   TITLEONE TCE CONCENTRATIONS FOR AIR STRIPPER AT DDRC
   TITLETWO WIND SPEED 5.8 M/S
   MODELOPT CONC RURAL
   AVERTIME 1
   POLLUTID TCE
   FLAGPOLE 1.5
   RUNORNOT RUN
CO FINISHED

[illegible]TARTING

** SOURCE IS SINGLE AIR STRIPPER LOCATED AT ORIGIN OF COORDINATES
** STACK VELOCITY ZERO SINCE EMISSION IS HORIZONTAL FROM RADIAL ORIFICES
** AND RAPIDLY ATTAINS AMBIENT AIR SPEED
```

```
**
   LOCATION STRIPPER POINT 0.0 0.0
   SRCPARAM STRIPPER 0.0162 7.625 293.0 0.0 1.2
   SRCGROUP ALL
  INISHED

RE STARTING
**
** RECEPTORS ARE ALL ON FENCELINE
** ORIGIN IS AT STRIPPER
**
   DISCCART -67. 0.
   DISCCART -61.-70.
   DISCCART 101. 174.
   DISCCART 281. 238.
   DISCCART 262. 0.
   DISCCART 250. -122.
   DISCCART 232. -366.
   DISCCART 214. -653.
   DISCCART -122. -616.
   DISCCART -107. -366.
   DISCCART -85. -122.
   DISCCART -430. -702.
   DISCCART 1549. -702.
   DISCCART 1546. -1821
   DISCCART -476. -1821

RE FINISHED
**
  TARTING

** METFILES ARE FABRICATED FILES GIVING PROPER WIND SPEED
** AND VARYING WIND DIRECTION EACH HOUR
**
   INPUTFILE WIND6.MET
   ANEMHGHT 10.
   SURFDATA 50000 1993 NONAME
   UAIRDATA 99999 1993 NOPLACE
   STARTEND 93 1 1 1 93 1 1 15
**
ME FINISHED
**
**
OU STARTING
**
** OUTPUT IS TABLE OF RECEPTOR VALUES EACH HOUR IN 30 DEG
** WIND INCREMENTS STARTING WITH WIND BLOWING FROM NORTH
**
   RECTABLE 1 FIRST
**
OU FINISHED


*** Message Summary For ISC2 Model Setup ***

 ------ Summary of Total Messages --------

A Total of          0 Fatal Error Message(s)
A Total of         15 Warning Message(s)
A Total of          0 Informational Message(s)
```

67   70

67 71

```
******** FATAL ERROR MESSAGES ********
         ***  NONE  ***

********   WARNING MESSAGES   ********
RE W228   33 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   34 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   35 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   36 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   37 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   38 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   39 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   40 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   41 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   42 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   43 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   44 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   45 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   46 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228   47 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART

************************************
*** SETUP Finishes Successfully ***
************************************
```

*** MODELING OPTIONS USED: CONC RURAL FLAT FLGPOL

*** MODEL SETUP OPTIONS SUMMARY ***

- -

**Model Is Setup For Calculation of Average CONCentration Values.

**Model Uses RURAL Dispersion.

**Model Uses User-Specified Options:
1. Final Plume Rise.
2. Stack-tip Downwash.
3. Buoyancy-induced Dispersion.
4. Calms Processing Routine.
5. Not Use Missing Data Processing Routine.
6. Default Wind Profile Exponents.
7. Default Vertical Potential Temperature Gradients.

**Model Assumes Receptors on FLAT Terrain.

**Model Accepts FLAGPOLE Receptor Heights.

**Model Calculates 1 Short Term Average(s) of: 1-HR

**This Run Includes: 1 Source(s); 1 Source Group(s); and 15 Receptor(s)

**Model Assumes A Pollutant Type of: TCE

**Model Set To Continue RUNning After the Setup Testing.

**Output Options Selected:
Model Outputs Tables of Highest Short Term Values by Receptor (RECTABLE Keyword)

**NOTE: The Following Flags May Appear Following CONC Values: c for Calm Hours
m for Missing Hours
b for Both Calm and Missing Hours

**Misc. Inputs: Anem. Hgt. (m) = 10.00 ; Decay Coef. = .0000 ; Rot. Angle = .0
Emission Units = GRAMS/SEC ; Emission Rate Unit Factor = .10000E+07
Output Units = MICROGRAMS/M**3

**Input Runstream File: DDRC6.INP ; **Output Print File: DDRC6.OUT

*** MODELING OPTIONS USED: CONC RURAL FLAT FLGPOL

67 73

*** POINT SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (GRAMS/SEC)	X (METERS)	Y (METERS)	BASE ELEV. (METERS)	STACK HEIGHT (METERS)	STACK TEMP. (DEG.K)	STACK EXIT VEL. (M/SEC)	STACK DIAMETER (METERS)	BUILDING EXISTS	EMISSION RATE SCALAR VARY BY
STRIPPER	0	.16200E-01	.0	.0	.0	7.63	293.00	.00	1.20	NO	

**MODELING OPTIONS USED: CONC RURAL FLAT FLGPOL

67 74

*** SOURCE IDs DEFINING SOURCE GROUPS ***

GROUP ID	SOURCE IDs
ALL	STRIPPER,

*** MODELING OPTIONS USED: CONC RURAL FLAT FLGPOL

67 75

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZFLAG)
(METERS)

(	-67.0,	.0,	.0,	1.5);	(	-61.0,	70.0,	.0,	1.5);
(	101.0,	174.0,	.0,	1.5);	(	281.0,	238.0,	.0,	1.5);
(	262.0,	.0,	.0,	1.5);	(	250.0,	-122.0,	.0,	1.5);
(	232.0,	-366.0,	.0,	1.5);	(	214.0,	-653.0,	.0,	1.5);
(	-122.0,	-616.0,	.0,	1.5);	(	-107.0,	-366.0,	.0,	1.5);
(	-85.0,	-122.0,	.0,	1.5);	(	-430.0,	-702.0,	.0,	1.5);
(	1549.0,	-702.0,	.0,	1.5);	(	1546.0,	-1821.0,	.0,	1.5);
(	-476.0,	-1821.0,	.0,	1.5);					

**MODELING OPTIONS USED: CONC RURAL FLAT FLGPOL

67 76

*** METEOROLOGICAL DAYS SELECTED FOR PROCESSING ***
(1=YES; 0=NO)

```
1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1
```

METEOROLOGICAL DATA PROCESSED BETWEEN START DATE: 93 1 1 1
AND END DATE: 93 1 1 15

NOTE: METEOROLOGICAL DATA ACTUALLY PROCESSED WILL ALSO DEPEND ON WHAT IS INCLUDED IN THE DATA FILE.

*** UPPER BOUND OF FIRST THROUGH FIFTH WIND SPEED CATEGORIES ***
(METERS/SEC)

1.54, 3.09, 5.14, 8.23, 10.80,

*** WIND PROFILE EXPONENTS ***

STABILITY CATEGORY	WIND SPEED CATEGORY 1	2	3	4	5	6
A	.70000E-01	.70000E-01	.70000E-01	.70000E-01	.70000E-01	.70000E-01
B	.70000E-01	.70000E-01	.70000E-01	.70000E-01	.70000E-01	.70000E-01
C	.10000E+00	.10000E+00	.10000E+00	.10000E+00	.10000E+00	.10000E+00
D	.15000E+00	.15000E+00	.15000E+00	.15000E+00	.15000E+00	.15000E+00
E	.35000E+00	.35000E+00	.35000E+00	.35000E+00	.35000E+00	.35000E+00
F	.55000E+00	.55000E+00	.55000E+00	.55000E+00	.55000E+00	.55000E+00

*** VERTICAL POTENTIAL TEMPERATURE GRADIENTS ***
(DEGREES KELVIN PER METER)

STABILITY CATEGORY	WIND SPEED CATEGORY 1	2	3	4	5	6
A	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
B	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
C	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
D	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
E	.20000E-01	.20000E-01	.20000E-01	.20000E-01	.20000E-01	.20000E-01
F	.35000E-01	.35000E-01	.35000E-01	.35000E-01	.35000E-01	.35000E-01

**MODELING OPTIONS USED: CONC RURAL FLAT FLGPOL

*** THE FIRST 15 HOURS OF METEOROLOGICAL DATA ***

FILE: WIND6.MET   FORMAT: (4I2,2F9.4,F6.1,I2,2F7.1)
SURFACE STATION NO.: 50000   UPPER AIR STATION NO.: 99999
NAME: NONAME   NAME: NOPLACE
YEAR: 1993   YEAR: 1993

YEAR	MONTH	DAY	HOUR	FLOW VECTOR	SPEED (M/S)	TEMP (K)	STAB CLASS	MIXING HEIGHT (M) RURAL	URBAN
93	1	1	1	270.0	5.80	293.0	5	500.0	600.0
93	1	1	2	319.0	5.80	293.0	5	500.0	600.0
93	1	1	3	30.1	5.80	293.0	5	500.0	600.0
93	1	1	4	49.7	5.80	293.0	5	500.0	600.0
93	1	1	5	90.0	5.80	293.0	5	500.0	600.0
93	1	1	6	116.0	5.80	293.0	5	500.0	600.0
93	1	1	7	147.6	5.80	293.0	5	500.0	600.0
93	1	1	8	161.9	5.80	293.0	5	500.0	600.0
93	1	1	9	191.2	5.80	293.0	5	500.0	600.0
93	1	1	10	196.7	5.80	293.0	5	500.0	600.0
93	1	1	11	235.0	5.80	293.0	5	500.0	600.0
93	1	1	12	211.5	5.80	293.0	5	500.0	600.0
93	1	1	13	114.4	5.80	293.0	6	500.0	600.0
93	1	1	14	139.7	5.80	293.0	6	500.0	600.0
93	1	1	15	194.6	5.80	293.0	6	500.0	600.0

*** NOTES: STABILITY CLASS 1=A, 2=B, 3=C, 4=D, 5=E AND 6=F.
FLOW VECTOR IS DIRECTION TOWARD WHICH WIND IS BLOWING.

*** MODELING OPTIONS USED: CONC RURAL FLAT FLGPOL

*** THE 1ST HIGHEST 1-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): STRIPPER,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF TCE IN MICROGRAMS/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
-67.00	.00	29.10793	(93010101)	-61.00	70.00	23.40234	(93010102)
101.00	174.00	9.70689	(93010103)	281.00	238.00	3.93026	(93010104)
262.00	.00	6.60992	(93010105)	250.00	-122.00	8.92509	(93010113)
232.00	-366.00	3.04923	(93010107)	214.00	-653.00	1.45881	(93010108)
-122.00	-616.00	1.68773	(93010109)	-107.00	-366.00	5.58128	(93010115)
-85.00	-122.00	8.86553	(93010112)	-430.00	-702.00	1.08768	(93010112)
1549.00	-702.00	.80898	(93010113)	1546.00	-1821.00	.49078	(93010114)
-476.00	-1821.00	.69375	(93010115)				

*** MODELING OPTIONS USED: CONC RURAL FLAT FLGPOL

*** THE SUMMARY OF HIGHEST 1-HR RESULTS ***

** CONC OF TCE IN MICROGRAMS/M**3 **

GROUP ID	AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR (XR, YR, ZELEV, ZFLAG)	OF TYPE	NETWORK GRID-ID
ALL HIGH 1ST HIGH VALUE IS	29.10793	ON 93010101:	AT (-67.00, .00, .00, 1.50)	DC	

*** RECEPTOR TYPES: GC = GRIDCART
GP = GRIDPOLR
DC = DISCCART
DP = DISCPOLR
BD = BOUNDARY

nonattainment designation means that ambient air quality exceeds federal standards for these pollutants at least part of the time. At present, the nonattainment status of ozone and carbon monoxide is being reevaluated by EPA Region IV of improved air quality. Regardless of the outcome for ozone and carbon monoxide, Memphis/Shelby County will remain a nonattainment area for lead until the state and local officials can demonstrate improved air quality.

4.6 Ecological Resources

4.6.1 Surface Water

DDMT has two main surface water features: Lake Danielson and the golf course pond. Both are located in the southeastern quadrant of the facility. They accept no surface runoff from Dunn Field, and therefore are not affected by the proposed action. Surface water on Dunn Field empties into Cane Creek to the north of the site, in turn empties into Nonconnah Creek to the south of DDMT. In turn it empties into Lake McKellar which is a backwater zone of the Mississippi River.

The Tennessee Water Quality Standards define uses of waters which are in the public interest. The uses for waters include:

1) Sources of water supply for domestic/industrial purposes;
2) propagation and maintenance of fish and other desirable aquatic life;
3) recreation in and on the waters;
4) stock watering and irrigation;
5) navigation;
6) generation of power; and
7) the enjoyment of scenic and aesthetic qualities of water.

The Tennessee Water Quality Control Act states that when waters are classified for multiple uses, the most stringent criteria will apply. Also, waterways that are considered as wet weather conveyances shall be protective of wildlife and humans that may come into contact with them, and maintain standards that are applicable to all downstream waters.

Both Cane and Nonconnah Creeks have been classified for propagation and maintenance of fish and other desirable wildlife, livestock and wildlife watering and irrigation. Furthermore, the section of Cane Creek near Dunn Field is classified for recreation. The propagation and maintenance of fish and aquatic life is the most stringent criteria. Specifically, it states that the waters shall not contain toxic substances which cause death or serious illness to aquatic biota and refers to criteria put into effect under the Clean Water Act and Safe Drinking Water Act (SDWA) (1987 Tennessee Water Quality Board).

4.6.2 Flora

DDMT has been developed for urban use, and does not support vegetative or a rural life. Dunn Field is predominantly an underdeveloped area, however, past activities have altered the surface and probably removed many native species which may account for the limited vegetation. Some areas of the field have native Bermuda grass and a few mature, deciduous black oak trees (Quercus velutina).

4.6.3 Fauna

According to the Law Study (1990 Law), no threatened or endangered species associated with the Memphis area have been sighted on the DDMT facility. The most prevalent forms of animal life was reported to be pests such as roaches, rats and mosquitos. Additional species noted at Dunn Field include squirrels (Sciurus niger), the red fox (Vulpes vulpes fulva), mourning doves (Zanaidura macroura), quail (Colinuus virgianianus) and land turtles (Terrpaene carolina) (1987 DDMT).

4.7 Contamination

4.7.1 Background

The RCRA Facility Assessment (RFA) performed in 1989 identified Solid Waste Management Units (SWMUs) and Areas of Concern (1990 A.T. Kearney). The purpose of the RFA was to assess the release potential of hazardous constituents from these units. Further investigatory sampling and analysis were recommended for the SWMU's identified in Dunn Field.

Because it was suspected that the upper aquifer may have been adversely impacted by past waste disposal activities, DLA initiated a more detailed investigation in 1989 and 1990, which culminated in a report (1990a and 1990b Law).

4.7.2 Soils

4.7.2.1 Surface Soils

During the Law Study, a total of five surface soil samples were collected at Dunn Field. The purpose of these sampling events was to determine if past or present activities at Dunn Field were contributing hazardous material to the environment. Elevated levels of volatile organic compounds (VOCs), semi-volatile organic compounds, pesticides, and metals were detected in the surface soils of Dunn Field. Several compounds were detected in excess of State of Tennessee guidelines for soil criteria. The surface soils are not affected by the proposed action.

4.7.2.2 Subsurface Soils

During the Law Study, a total of four soil borings were advanced at Dunn Field. The purpose of these soil borings was similar to the surface soil sample rationale, however, additional information as to the extent, and proximity of contaminant concentration with respect to ground water were obtained. Generally, soil samples were obtained at each soil boring from three zones 1) vadose zone, 2) the top of saturated zone and 3) from within the saturated zone. Elevated levels of volatile organic compounds (VOCs), semi-volatile organic compounds, pesticides and metals were detected in the subsurface soils. Several compounds were in excess of State of Tennessee guidelines for soil criteria. The subsurface soils will not be affected by the proposed IRM, in that the remedial measure will involve removal of contaminated ground water for treatment at the surface.

4.7.3 Surface Water

The Law Study at DDMT in 1989/1990 (1990 Law) conducted sampling and analysis of surface waters draining off Dunn Field. Samples were taken on two occasions from the channel draining north off Dunn Field, and no elevated levels of constituents were found in either sample.

4.7.4 Ground Water

During previous investigation at DDMT, the ground water beneath Dunn Field was found to be contaminated with volatile organic compounds (VOCs) and metals at levels exceeding the federal primary drinking water standards. The contaminants of concern included the VOCs tetachloroethene, trichloroethene, 1,1,2,2-tetrachloroethane, 1,1-dichloroethene, and 1,2-dichloroethene. Metals included arsenic, barium, chromium, lead, and nickel. The Law Study (1990 Law) concluded that the plume of contaminated ground water had migrated toward the west. The source was believed to be waste material buried in trenches in the northwest quadrant to Dunn Field. Additional investigations were recommended to define the extent of ground water contamination.

A pumping test to aid in the design of the IRM was performed in Dunn Field in September 1992 (1992 ES). Ground water was pumped at a constant rate while draw-down in the surrounding aquifer was monitored. Water samples were taken at the beginning, mid point and end of the 42-hour test, and analyzed for organic and inorganic chemicals. VOCs found during the Law Study were present in the pump test water at generally the same levels, while metals were below levels requiring corrective action. Follow-up sampling and analysis of monitor welss in 1993 confirmed that metals are below action levels.

5.0 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION

This section describes the short and long term impacts associated with implementing the proposed action to control the migration of contaminated ground water beneath Dunn Field. Impacts of the alternatives are also discussed. Where appropriate, a discussion of the effects of the construction phase as well as the operational phase of the interim remedial measure are included.

5.1 Facility and Surroundings

The construction and operation of extraction wells and an air stripping tower will not impact any usage of Dunn Field. The extraction wells will be located along the northwest property boundary of Dunn Field and the air stripping tower will be built adjacent to the existing 70,000 gallon above-ground storage tank. The presence of a 20 to 25 foot high air stripping tower will not be a visual intrusion to the DDMT vicinity, due to the mixed light industrial activities which occur in the vicinity north and west of Dunn Field.

Several single family residential structures are located some 400 to 1,000 feet from the proposed location of the air stripping tower. The line of sight from most of these residences is obscured by vegetation and foliage of numerous trees and therefore, minimizes any visual impacts resulting from the proposed action. The UV/oxidation treatment system in Alternatives 4 and 6 would be similar in character to the air stripping tower and supporting facilities.

5.2 Soils

<u>Surface</u>

For the Proposed Action and all alternatives, surface soils will be disturbed by vehicles and excavation equipment during installation of extraction wells, laying subsurface piping, and construction of the treatment system. For Alternative 3, there will be short-term disturbance of soils off-site during the construction of extraction wells and associated piping and controls. The impacts will be temporary and can be mitigated by erosion control measures. In order to minimize any runoff from the project area, measures will be employed to contain sediment runoff via plastic sheeting and/or hay bales. This will be done wherever surface disturbance occurs.

During operation of the pumping and treatment system, soils in Dunn Field will not be disturbed. Soils along the surface water channel leading to Cane Creek will not be adversely affected because the flow will be confined to the very bottom of the channel. At the conclusion of the IRM when the project facilities are dismantled, ground cover compatible with the surrounding landscape elements shall be reestablished.

Subsurface

The subsurface deep soils will experience partial dewatering due to extraction of ground water from the Fluvial Aquifer. Since the saturated zone of the Fluvial Aquifer is about 20 feet thick, the chance of subsidence due to dewatering is remote. The proposed action is not a source control measure, therefore additional contaminants will possibly continue to reach deep soils through surface water infiltration and percolation.

5.3 Water Quality and Quantity

Surface

For the Proposed Action and Alternative 6, the water treatment process will produce an effluent meeting state and federal standards in compliance with substantive NPDES requirements for surface water discharge. The continuous discharge to surface drainage leading to Cane Creek will be 520 gallons per minute (gpm) or about 1.2 cubic feet per second (cfs). The surface drainage channel at the north boundary of Dunn Field is approximately 1.5 feet wide and 1 foot deep, and has a capacity to carry over 20 cfs. The hydraulic impact of this discharge will be negligible along down stream channels where the hydraulic capacity is higher. A typical summer thunderstorm would produce a discharge of 10 cfs in this channel at the north boundary, so the added flow from the treatment system is not significant.

Alternatives 2, 3 and 4 would require enlarging the sanitary sewer lines in the vicinity of Kyle Street and nearby roads. The 520 gpm discharged to the sewer system wouild flow to the South Treatment Plant operated by the City of Memphis, which has adequate hydraulic capacity of accommodate this flow.

Cane Creek is a local watershed within the city of Memphis with a drainage area of about 7.7 square miles. The drainage area upstream of the Dunn Field discharge is about 2.5 square miles. Flow in Cane Creek is intermittent, and discharge subsides after periods of rainfall. Cane Creek empties into Nonconnah Creek, which drains approximately 180 square miles of southern Shelby County and southwestern Tennessee. Neither Cane Creek nor Nonconnah Creek will be affected by the proposed discharge from Dunn Field.

The ground water extraction system will be designed to automatically shut down if the blower system on the air stripping tower should fail. Other key components, such as intermediate pumps in the treatment process, will have a similar over-ride feature, so that water will stop flowing if the treatment system fails. These measures will prevent the discharge of untreated water into surface drainage.

<u>Subsurface</u>

For the Proposed Action and Alternatives 2-4 and 6, the Fluvial Aquifer will experience a drawdown effect of up to 13 feet below prevailing water levels in the vicinity of each extraction well. This drawdown will diminish to less than one foot at distances greater than 400 feet away from the extraction wells. There are no users of the Fluvial Aquifer that will be affected by this drawdown. For Alternative 7, the drawdown effect would be off-set by the reinjection of water upgradient.

Water quality in the Fluvial Aquifer will be improved as a result of the proposed action. Operation of the extraction wells will alter flow patterns of contaminated ground water beneath Dunn Field, causing ground water that is currently contaminated to move toward these wells. This system will capture contaminants beneath Dunn Field within a few years after start up, but continued operation would be needed until a permanent solution is found to halt or intercept the contaminants migrating downward from the burial areas into the Fluvial Aquifer.

5.4 Air Quality

For the Proposed Action and Alternatives 2,3 and 7, the ground water treatment system will use an air stripping process to remove VOCs from the extracted water. VOC emissions from the treatment process are expected to be about 2,820 pounds per year (1.4 tons/year). The treatment process will use a blower supplying about 1,000 cubic feet of air per minute. The concentration of VOCs in this emission is estimated to be about 86 micrograms per cubic meter (ug/m^3) The greatest single constituent in the emission will be trichloroethene at 34 ug/m^3. The air emissions from this process will be in an extremely dilute concentration (estimated to be 119 micrograms per cubic meter at the closest (west) fenceline under the worst case conditions; see Appendix A) that will not exceed risk limits to human health.

Alternatives 4 and 6 would employ UV/oxidation to destroy VOCs in the ground water flow, and would emit harmless carbon dioxide and water vapor into the atmosphere.

5.5 Noise

For the Proposed Action and Alternatives 2,3 and 7, the chief source of noise will be the ground water treatment system. The operation at the blower fan on the air stripper tower will emit an estimated 85-100 dBA sound level in the immediate vicinity of the unit. The blower fan will operate continuously 24 hours per day. As the distance increases from the unit, perceived sound pressure levels will decrease measurably. The nearest residential units are 400 feet west of the proposed location. Given that the area to the north of Dunn Field is heavily industrialized, the close proximity of the Burlington Northern Railroad tracks, and the position of Dunn Field along flight approach path to Memphis International Airport (1 mile south), the sound emitted from the unit would not affect any sensitive receptor in this particular setting.

Noise levels associated with the other alternatives will not be significant because the treatment systems will operate within enclosed structures.

5.6 Ecological Resources

Flora

For the Proposed Action and all Alternatives, minor disturbances of grass covered areas will occur during drilling, piping installation and treatment system construction. The construction phase will be relatively short in duration and the vegetation will be replaced at the end of the project. Vegetation along the drainage channel to Cane Creek will be stimulated by additional water in the channel. Vegetation along Cane Creek itself is not expected to be significantly impacted by the additional flow.

Fauna

For the Proposed Action and all Alternatives, the construction of the treatment system will have no significant impact on any wildlife. Wildlife may be temporarily displaced during construction activities; but will return to the area after construction is completed. No threatened or endangered species are known to occur on the installation or adjacent lands.

5.7 Hazardous Waste/Solid Waste

For the Proposed Action and all Alternatives, the extraction wells and subsurface piping are to be located away from known disposal areas at Dunn Field. This will minimize the possibility of encountering contaminated soils while drilling wells or digging during construction. Excavated soils will be sampled and analyzed for contaminants, and if contaminants are found, the material will be disposed in accordance with federal and state requirements.

During drilling and excavating operations, proper health and safety procedures will be enforced to minimize contact with potentially contaminated soils, fluids and air emissions.

5.8 Utilities

For the Proposed Action and all Alternatives, utility impacts will consist primarily of electrical power requirements for the extraction/treatment system. Alternatives 2, 3 and 4 would involve the discharge of 520 gpm (about 0.75 million gallons per day) into the municipal sewer system. Sanitary sewer lines serving the Dunn Field area would have to be enlarged to accommodate this additional flow. The South Treatment Plant has adequate capacity to receive this additional flow.

5.9 Short Term Impacts

Several short term impacts will occur due to the construction and operation of the proposed action.

Adverse impacts during construction include short-term disturbance of surface soils and the creation of noise on-site. Adverse impacts during operation include VOC emissions to the atmosphere, noise on-site, and consumption of electric power. If activated carbon treatment is required by state and local authorities to reduce VOC emissions, then contaminated carbon residues will be generated periodically and will require transportation off-site for re-generation. Short term beneficial impacts include effective treatment of contaminated ground water beneath Dunn Field, including capture of 40 acres of contaminated zone beneath Dunn Field and off-site and the prevention of further dispersion of contaminants downgradient. The short term effectivenesss of ground water pumping alternatives cannot be determined and verified without downgradient monitoring wells and definition of the groundwater plume.

5.10 Long Term Impacts

Ground water pumping and treatment to mitigate contaminant migration at Dunn Field is a partial solution to achieving long term effectiveness and improvement of ground water quality benéath DDMT. The successful treatment of the Fluvial Aquifer through this IRM process will minimize any contaminants entering Memphis Sand Aquifer and therefore reduce the chance for degradation of the drinking water supply from the contaminants in the Fluvial Aquifer. The long term effectivenesss of ground water pumping alternatives cannot be determined and verified without downgradient monitoring wells and definition of the groundwater plume. A summary of the environmental consequences is presented in Table 5-1.

Table 5-1
IMPACT EVALUATION MATRIX

POTENTIAL IMPACT CATEGORY	CONSTRUCTION PHASE			OPERATING PHASE		
	ADVERSE EFFECT	NO EFFECT	BENEFICIAL EFFECT	ADVERSE EFFECT	NO EFFECT	BENEFICIAL EFFECT
1. FACILITY SURROUNDINGS						
USE						
COMPATIBILITY						
2. SOILS						
SURFACE						
SUBSURFACE						
3. WATER QUALITY						
SURFACE						
FLUVIAL AQUIFER						
MEMPHIS SAND AQUIFER						
4. AIR QUALITY						
VOC EMISSIONS						
5. NOISE						
ON SITE						
OFF SITE						
6. ECOLOGICAL RESOURCES						
FLORA						
FAUNA						
7. HAZARDOUS WASTE/SOLID WASTE						
DRILL CUTTINGS						
OPT. CARBON TREATMENT						
8. UTILITIES						
ELECTRIC USE						
9. PROTECTION HUMAN HEALTH						

6.0 CONCLUSION

A ground water pumping and treatment system is being proposed for the northwest corner of the Dunn Field area of DDMT. This system will control ground water contaminants in the Fluvial Aquifer that have apparently originated from burial of various wastes into trenches in this area of Dunn Field. The proposed system will be implemented as a non-time critical removal action under CERCLA and is intended to stop further migration of contaminants off-site and help prevent possible contamination of the Memphis Sand Aquifer. This action is not intended as a final remedial action at this site, but will hopefully supplement the final remedial action. A decision on the final remedial action will be made at the conclusion of the study phase (RI/FS) by the community, the State of Tennessee, the USEPA, and DDMT.

Several negative impacts will occur from the construction and operation of this system. Short-term negative impacts will arise from increased noise levels emitted by the ground water treatment system and the emission of low levels of volatile organic compounds (VOCs) into the atmosphere. All of these impacts will cease when the system is shut down. Short term negative impacts during construction will include disturbing surface soils and noise due to operation of construction equipment.

The positive impacts of this action include the control of ground water contaminants beneath Dunn Field. This action will reduce contaminant migration away from Dunn Field, thereby reducing future volumes of contaminated ground water in the Fluvial Aquifer. This action indirectly protects the Memphis Sand Aquifer which serves as the public water supply in the Memphis metropolitan area.

This environmental assessment finds no significant impact upon the environment as a result of the construction and operation of the proposed action.

7.0 LISTING OF AGENCIES AND PERSONS CONTACTED

Name and Title	Affiliation and Phone Number
Jordan English Supervisor of Superfund Programs	Tennessee Division of Superfund Field Office, Memphis 901/543-6695
John Leonard Water Pollution Control	Tennessee Division of Superfund Field Office, Memphis, Tennessee 901/543-6695
Greg Parker Supervisor of Water Quality Control	Memphis-Shelby County Health Department Water Quality Control 901/576-7741
Mac Parker Air Pollution Control	Memphis-Shelby County Health Department 901/576-7741
Barry Moore Water Pollution Control	Memphis-Shelby County Health Department 901/576-7741
John Yeganeh Air Pollution Control	Memphis-Shelby County Health Department 901/576-7653
Robert Foster Assistant Director of Water Supply	Tennessee Division of Water Supply, Nashville 615/532-0155
Ed O'Neil Manager of Water Supply	Tennessee Division of Water Supply, Memphis 901/423-6600
Clure Winfrey Administrator of Wastewater	City of Memphis, Environmental Maintenance Collection Facilities 901/528-2917
Al Chokhachi Environmental Engineer	Dept. of Public Works, Memphis, Tennessee 901/353-2392
Rodney Thomas	South Treatment Plant, Memphis, Tennessee 901/353-2392
Randy Niccolli	Met-Pro Corporation, Dual Division Owosso, Michigan 517/725-8184
Jim Widlak	United States Department of the Interior Fish and Wildlife Service Cookeville, Tennessee 615/528-6481

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APPENDIX A

AIR DISPERSION MODELLING

AIR STRIPPING TOWER EMISSIONS

The latest version of the EPA-approved short-term version of the Industrial Source Complex air pollutant dispersion model, ISCST2, was used to estimate concentrations of TCE resulting from the 24-hour operation of and air stripper at DDRC. This memo summarizes the modeling methodology and results obtained.

Methodology

Meteorology

Since general worst-case estimates of TCE concentrations at the fenceline of the DDRC are desired, detailed meteorological data for the area is not needed. Meteorological parameters needed for the modeling are based on the wind rose for the Memphis International Airport obtained from the National Oceanic and Atmospheric Administration (NOAA), attached as Figure 1. The numbers in the wind rose give the average percent of time that winds of a specified direction and speed will occur, based on a thirty-year average of wind data in the area. The diagram shows that winds from the south are the most probable (they occur 12.5% of the time), and that calm winds, which are those having speeds from 0 to 3 MPH, occur 16% of the time. Wind speed are generally moderate. The most probable range of wind speeds is from 3 to 13 MPH, which occurs 59.9% of the time. Wind speeds greater than 13 MPH occur less frequently. Wind speeds in the range of 13-19 MPH occur 20.6% of the time, and wind speeds greater than 19 MPH occur only 2.5% of the time.

The ISCST2 model becomes increasingly inaccurate at slow wind speeds. The model does not calculate concentrations for wind speeds less than 1.0 meter per second (m/s) because the model produces inaccurate concentration estimates under these conditions. The wind speeds chosen for the modeling were 1.5 m/s, (3.3 MPH) which is near this accuracy limit, and corresponds approximately to the high end of the calm winds category, 5.8 m/s, (13 MPH), which corresponds to the upper end of the most probable wind range, and 8.5 m/s (19 MPH), which corresponds to the upper limit of wind speeds in the area.

Atmospheric stability categories used by the model characterize the ability of the atmosphere to disperse air pollutants through vertical mixing. Stability category A is the most unstable and dispersive. Category F is the most stable and stagnant. Since the air stripper would operate 24 hours a day, the worst dispersion would occur under nighttime conditions when the atmosphere is more stable, and less dispersive. The stability categories were chosen according to the wind speed for nighttime conditions, as F for speed 1.5 m/s, E for speed 5.8 m/s, and D for speed 8.5 m/s.

Receptors

Receptor locations, which are the locations where concentrations are calculated, were chosen to be on the fenceline of the DDRC as shown in Figures 2 and 3. Fifteen locations were selected. The coordinates of these receptors, in a Cartesian coordinate system centered on the air stripper, with the y-axis pointing north and x-axis pointing east are given in Table 1. The height at which concentrations are calculated at each receptor is 1.5 m (about 5 feet) in all cases.

The worst case concentrations will occur when the wind is blowing the plume from the air stripper directly toward each receptor. At each wind speed used in the modeling, 15 different wind directions were chosen so as to direct the plume from the air stripper toward each of the fenceline receptors. In this way, the maximum concentration that would occur at each receptor was calculated.

Emissions

The air stripper was specified as emitting TCE at the rate of 0.162 grams per second (g/s) from a height of 25 feet (7.625 m) from a tower with diameter 1.2 m (approximately 4 feet). The emission actually occurs from horizontal jets on the circumference of the air stripper. The speed of the jet is assumed to rapidly mix with the atmosphere, and acquire the ambient wind speed. The emission is assumed to be equivalent to a stack emitting TCE with a zero vertical speed, and at ambient temperature. Consequently there is no plume rise.

Results

The results of the modeling are shown in figures 4-9, where that modeled concentrations are given next to each fenceline receptor. The greatest concentration determined from the dispersion modeling was 119 $\mu g/m^3$ at receptor number 1 (which is the receptor closest to the air stripper) at a wind speed of 1.5 MPH. Concentrations diminish with distance from the stripper. At the 1.5 m/s wind speed, the concentrations drop to 49 $\mu g/m^3$ for receptor 6 (which is just opposite of the air stripper on the east side), to about 12-14 $\mu g/m^3$ at Dunn Road, and to 1.9 $\mu g/m^3$ at the point on the boundary of the DDRC farthest from the air stripper (receptor 14).

67 98

```
   SURFDATA 50000 1993 NONAME
   UAIRDATA 99999 1993 NOPLACE
   STARTEND 93 1 1 1 93 1 1 15
**
[illegible]INISHED

**
OU STARTING
**
** OUTPUT IS TABLE OF RECEPTOR VALUES EACH HOUR IN 30 DEG
** WIND INCREMENTS STARTING WITH WIND BLOWING FROM NORTH
**
   RECTABLE 1 FIRST
**
OU FINISHED


 *** Message Summary For ISC2 Model Setup ***

 --------- Summary of Total Messages --------

A Total of          0 Fatal Error Message(s)
A Total of         15 Warning Message(s)
A Total of          0 Informational Message(s)


   ******** FATAL ERROR MESSAGES ********
              ***  NONE  ***


[illegible]*******   WARNING MESSAGES    ********
[illegible]228    33 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    34 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    35 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    36 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    37 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    38 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    39 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    40 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    41 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    42 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    43 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    44 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    45 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    46 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART
RE W228    47 DISCAR: Default(s) Used for Missing Parameters on Keyword  DISCCART

************************************
*** SETUP Finishes Successfully ***
************************************
```

*** THE SUMMARY OF HIGHEST 1-HR RESULTS ***

** CONC OF TCE IN MICROGRAMS/M**3 **

GROUP ID		AVERAGE CONC	DATE (YYMMDDHH)	RECEPTOR (XR, YR, ZELEV, ZFLAG)	OF TYPE	NETWORK GRID-ID
ALL	HIGH 1ST HIGH VALUE IS	16.11327	ON 93010101:	AT (-67.00, .00, .00, 1.50)	DC	

*** RECEPTOR TYPES: GC = GRIDCART
GP = GRIDPOLR
DC = DISCCART
DP = DISCPOLR
BD = BOUNDARY

FINAL PAGE

ADMINISTRATIVE RECORD

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