

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

**FIRE TRAINING PIT  
IOWA ARMY AMMUNITION PLANT  
MIDDLETOWN, IOWA**

**EXPLANATION OF SIGNIFICANT DIFFERENCE  
AND  
ACTION MEMORANDUM**

Prepared for:

U.S. Department of the Army  
Corps of Engineers, Omaha District  
Omaha, Nebraska

December, 1997

**Environmental Chemical Corporation**  
1240 Bayshore Highway  
Burlingame, California 94010

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# **IOWA ARMY AMMUNITION PLANT - FIRE TRAINING PIT EXPLANATION OF SIGNIFICANT DIFFERENCE**

## **1.0 Introduction**

This document addresses a proposed change in treatment method for contaminated soil at the Fire Training Pit (FTP) located at the Iowa Army Ammunition Plant (IAAAP). The IAAAP facility is located in Middletown (Des Moines County), Iowa, approximately five miles west of Burlington, Iowa. The FTP is part of the IAAAP facility and is located in the southwest portion of the IAAAP Explosives Disposal Area (EDA). The surrounding land is primarily forested or used for agriculture. The IAAAP facility is bordered by U.S. Highway 34 to the north, upland agricultural farms to the east and west, and the Skunk River Valley to the south. The nearest population center is Burlington, with an approximate population of 50,000.

EPA Region VII is providing regulatory oversight for the removal action. Remediation of the FTP site is being addressed under CERCLA removal authority and a Federal Facility Agreement (FFA) between the Army and EPA. CERCLA removal authority is granted to the Army in Executive Order 12580. The purpose of the FFA is to provide a procedural framework for implementing CERCLA and RCRA corrective action and to facilitate cooperation and communications among the FFA signatories. The Iowa Department of Natural Resources was provided with copies of all the reports generated in conjunction with the FTP removal. However, the State has not participated in the review process.

This Explanation of Significant Difference (ESD) is required under CERCLA section 117(c) and is intended to address a proposed change in treatment technology from that originally proposed in the Engineering Evaluation / Cost Analysis (EE/CA) dated May 1996. The proposed change in treatment technology will result in a cost savings of approximately \$200,000. The recommended method of treatment has been changed from ex-situ soil vapor extraction (SVE) proposed in the EE/CA to low temperature thermal desorption (LTTD). This change in treatment technology is based on the results of additional site characterization performed in 1996 that allowed the lateral and vertical extent and level of soil contamination to be accurately determined. In addition to cost savings, LTTD offers numerous technical advantages over ex-situ SVE.

This document will become part of the administrative record file for the FTP. The file is available at the the following locations for public review:

Iowa Army Ammunition Plant  
Visitors Reception Area, Building 100-101  
Middletown, IA 52683-5000  
(319) 753-7710

Burlington Public Library  
501 North 4th Street  
Burlington, IA 52601  
(319) 753-1647

Danville City Hall  
105 West Shepard  
Danville, IA 52623  
(319) 392-4685

## **2.0 Summary of Site History, Contamination Problems, and Selected Remedy**

According to information contained in the Final RI Report (JAYCOR, 1994), fifty-five gallon drums of solvents or fuels were placed in the pit, set ablaze, and extinguished with water by fire fighters. Solvents were used for this purpose from 1982-1984, and fuels were used from 1984 through 1987. Water used for fire extinguishing purposes was directed into the Fire Training Pit.

Since solvents and oils were used as fuels during fire training exercises at the FTP, the soil at the FTP is contaminated with the following materials:

- metals;
- polynuclear aromatic compound (PNAs);
- other semi-volatile organic compounds (SVOC); and
- chlorinated volatile organic compounds and polycyclic aromatic volatile organic compounds (VOCs).

Previous environmental investigations at the FTP site include the following:

- Preliminary Assessment and Site Investigation conducted in 1991 by JAYCOR;
- Phase I of a RI conducted in 1992 by JAYCOR;
- Phase II of a RI conducted in 1993 by JAYCOR;
- Limited Site Investigations for Engineering Evaluations/Cost Analysis (EE/CA) studies conducted in 1995 by Harza; and
- Additional soil characterization performed by Environmental Chemical Corporation (ECC) in 1996.

### Selected Treatment Alternative Described in the EE/CA

The action presented in the EE/CA includes excavating highly contaminated soils for placement in Ex-Situ SVE treatment piles. The VOC and SVOCs contaminated soils were to be piled to a height of approximately ten feet on a bermed unlined treatment pad. Since the soil at the FTP is mostly clay, a shredder or a screen would be needed to reduce and segregate the particle size. The lead (metal) contaminated soil would be treated concurrently in an isolated pile.

A total of four treatment piles and a segregated pile for the metal contaminated soil were planned. A network of horizontal, perforated pipes were to be installed at the bottom and in the center of the soil treatment pile. The perforated pipes were to be connected to a vacuum blower to create a suction draft within the soil piles. A venting blower connected to the piles would provide supplemental air for the treatment. In lieu of the installation of the perforated horizontal pipes, a gravel layer could be substituted with single or dual pipes located within the gravel itself. A plastic liner will cover the piles to prevent VOC emissions. A sump downgradient of each pile will capture any leachate generated. The stripped vapors will be passed through a carbon adsorber unit.

### Proposed Change in Treatment Alternative

The soil will be treated utilizing low temperature thermal desorption (LTTD). The contaminated soil will be excavated and stockpiled prior to treatment. Contaminated soil from the stockpile is pre-treated to reduce the clod size to a maximum of 2- to 4-inches. The pre-treatment is accomplished with a soil shredder capable of processing wet clay. The pre-treated soil is fed into the rotary dryer unit where it is heated to approximately 500 degrees Fahrenheit. The heated gases from the dryer chamber are forced through a high temperature baghouse to remove soil fines and dust particles. The particle free gases are forced through a secondary treatment unit (STU) consisting of a thermal oxidizer operating at approximately 1800 degrees Fahrenheit, evaporative cooling chamber, and acid gas scrubber. The STU removes over 99% of the hydrocarbons that are oxidized to carbon dioxide and water. The scrubber neutralizes the inorganic acids prior to discharge to the atmosphere. Dust from the baghouse is mixed with the soil exiting the rotary dryer. As the soil is discharged, it is re-hydrated to minimize dust production. Treated soil is placed in stockpiles that are sampled and analyzed to ensure treatment standards are achieved. Soil failing TCLP for metals will be placed in a separate stockpile and stabilized after LTTD treatment. After treatment, the soil will be placed in the IAAAP's Trench 6 Soil Repository (Trench 6). Trench 6 was constructed adjacent to the Inert Landfill as part of another non-time-critical removal action. Construction consisted of low permeability liners and leachate collection systems which meet RCRA requirements of 40 CFR 264, Subpart N.

### **3.0 Description of Significant Differences and the Basis for the Differences**

Both ex-situ SVE and LTTD treatment alternatives were evaluated in the EE/CA. The recommended treatment alternative in the EE/CA was ex-situ SVE although the cost comparison showed that treatment utilizing LTTD was most cost effective. LTTD was not selected for the following reasons:

- More extensive bench scale testing would be required
- Assumed higher implementation costs due to initial pilot testing
- High cost risk in relation to increase in soil quantities

Due to the limited chemical data available during preparation of the EE/CA, the extent and nature of contamination could not be accurately determined. As a result, it was assumed that pilot testing would be required. Additionally, the quantity of soil requiring treatment could not

be accurately estimated. Therefore, there was a high risk associated with LTTD if additional soil required treatment. The costs associated with ex-situ SVE are primarily capital costs that are incurred prior to treatment. These costs are for equipment and materials required for treatment, and O&M costs. The costs for LTTD treatment are primarily for the actual treatment of the contaminated soil. Therefore, if more soil required treatment than anticipated, it would have less impact on the cost of treatment if SVE was utilized.

After the EE/CA was prepared, additional sampling was performed that defined the nature and extent of contamination. Based on the results of the sampling, it was determined that the contaminants present at the FTP could be effectively treated utilizing LTTD. Since LTTD treatment of the FTP contaminants has been documented at numerous other sites, bench scale or pilot testing is not required. The additional sampling determined the quantity of soil that will require treatment, thereby eliminating the risk of additional soil requiring treatment.

Treatment utilizing LTTD will result in a cost savings of approximately \$200,000 based on the current quantity of soil that will require treatment (900 cubic yards [CY]). The cost savings from utilizing LTTD is also documented in the EE/CA. The cost comparison in the EE/CA was performed assuming that 1600 CY of soil would require treatment for ex-situ SVE and LTTD. As stated previously, the costs associated with ex-situ SVE are primarily capital. The costs for LTTD treatment are primarily for the actual treatment of the contaminated soil. The additional sampling performed after the EE/CA was prepared demonstrated that approximately 900 CY will require treatment. Therefore, the decrease in soil volume will result in more savings for the LTTD alternative than for ex-situ SVE.

In addition to cost savings, treatment utilizing LTTD offers several advantages over ex-situ SVE. These advantages are *italicized* in the following sections:

#### Treatment Effectiveness

The waste stream consists of wet clay with very high concentrations of volatile organic compounds. Ex-situ SVE is likely to be ineffective treating this waste stream to below Land Disposal Restrictions. The wet clay at the FTP has a very low primary permeability. The majority of the permeability after excavation will result from void space between the clay clods. The pre-treated clay will compact in the SVE pile reducing the permeability through time and decreasing the treatment effectiveness. Additionally, due to the lack of primary permeability within the clay clods, SVE treatment will result in removal of volatile organic compounds (VOCs) on the outer edge of the clay clods without significant removal of VOCs within the clod.

*LTTD is very effective treating contaminated soil with high levels of VOCs. This is documented in numerous case histories<sup>1</sup>. Land Disposal Restrictions (LDRs), which are required to place the soil in a landfill, can easily be obtained with mobile LTTD units. Additionally, LTTD is effective in treating soil with a high clay content because VOCs are removed at elevated temperatures and the soil is heated evenly.*

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<sup>1</sup> i.e. 14,000 cubic yards of TCE and DCE contaminated soil was remediated using LTTD at Letterkenny Army Depot, Chambersburg, Pa.

### Treatment Time

Due to the low permeability of the clay and high VOC concentrations, SVE will require very long treatment times. It is unlikely that LDRs can be achieved prior to the scheduled capping of Trench 6 where the material is to be disposed. As a result, it may be necessary to dispose of treated FTP material off-site, resulting in significant transportation and disposal costs.

*The 900 cubic yards (CY) of contaminated FTP material can be treated to below LDRs in less than two weeks using an on-site thermal desorption unit.*

### Off-gas Treatment

Based on the high contaminant levels at the FTP, SVE gas concentrations will be much higher than anticipated due to the high concentrations of contaminants. This will result in very short breakthrough times, frequent carbon changeout periods, and carbon costs that are higher than originally anticipated.

*Off-gas from the LTTD system can be treated with a thermal oxidizer which is very effective in treating off-gas with high VOC levels.*

### Operation & Maintenance (O&M)

An O&M period of one to two years may be required to treat the waste stream to below LDRs utilizing SVE.

*The O&M period will be approximately 10 to 15 days utilizing LTTD.*

### Soil Disposal

Due to the long treatment times potentially required using SVE, Trench 6 may be capped before LDRs are achieved using SVE. Therefore, transportation and disposal off-site disposal site may be required.

*Due to the short treatment times utilizing LTTD, the treated material can be placed in Trench 6 before it is capped.*

## **4.0 Support Agency Comments**

The change in treatment technology is supported by the EPA Region VII. For more information contact:

Scott Marquess  
Project Manager  
USEPA Region VII  
Federal Facilities and Special Emphasis Branch - Superfund Division  
726 Minnesota Avenue  
Kansas City, Kansas 66101  
(913) 551-7131



## **5.0 Statutory Determinations**

Considering the new information that has been developed and the changes that have been made to the selected remedy, the Army and EPA believe that the remedy remains protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to this removal action, and is cost-effective. In addition, the revised remedy utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable for this site.

## **6.0 Public Participation Activities**

The administrative record for the FTP is available for comment at the locations presented in Section 1 of this document. The comment period for the removal action presented in this document and the Action Memo will take place in January and February, 1998. The point of contact for public inquiries is:

Rodger Allison  
SIOIA-PPE  
Iowa Army Ammunition Plant  
17575 State Highway 79  
Army Mail Room  
Middletown, Iowa 52638-9701  
(319) 753-7130

A public meeting to address this removal action is not currently planned. However, a meeting will be scheduled upon public request.

**FIRE TRAINING PIT  
IOWA ARMY AMMUNITION PLANT  
MIDDLETOWN, IOWA**

**ACTION MEMORANDUM**

Prepared for:

U.S. Department of the Army  
Corps of Engineers, Omaha District  
Omaha, Nebraska

December, 1997

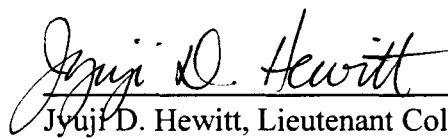
**Environmental Chemical Corporation**  
1240 Bayshore Highway  
Burlingame, California 94010

The Removal Action at the Fire Training Pit  
at the Iowa Army Ammunition Plant is supported by:

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Jyuji D. Hewitt, Lieutenant Colonel,  
U.S. Army Commander,  
Iowa Army Ammunition Plant

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Jyuj D. Hewitt, Lieutenant Colonel,  
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## LIST OF ACRONYMS

APC	Air Pollution Control
AOC	Area of Contamination
ARAR	Applicable, Relevant and Appropriate Requirements
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CFM	Cubic Feet per Minute
COC	Chemicals of Concern
CY	Cubic Yards
DCE	Dichloroethene
DERA	Defense Environmental Restoration Account
DOT	Department of Transportation
EE/CA	Engineering Evaluation/Cost Analysis
FTP	Fire Training Pit
FS	Feasibility Study
HDPE	High-Density Polyethylene
IAAAP	Iowa Army Ammunition Plant
IAPCR	Iowa Air Pollution Control Regulations
LTTD	Low-Temperature Thermal Desorption
MC	Methylene Chloride
MCL	Maximum Contaminant Level
NAPL	Non-Aqueous Phase Liquid
NCP	National Contingency Plan
NTCRA	Non-Time-Critical Removal Action
O&M	Operation and Maintenance
PCE	Tetrachloroethene
PCB	Polychlorinated Biphenyls
PPM	Parts Per Million
PRG	Preliminary Remediation Goal
RBC	Risk-Based Concentration
RCRA	Resource Conservation and Recovery Act
RGs	Remediation Goals
RI	Remedial Investigation
ROD	Record of Decision
SI	Site Investigation
SVE	Soil Vapor Extraction
SVOC	Semi-Volatile Organic Compound
SARA	Superfund Amendments and Reauthorization Act
TBC	To Be Considered (where ARARs not applicable)
TCE	Trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
TPH	Total Petroleum Hydrocarbons
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VOC	Volatile Organic Compound



**ACTION MEMORANDUM  
FIRE TRAINING PIT  
IOWA ARMY AMMUNITION PLANT  
MIDDLETOWN, IOWA.**

**I. PURPOSE**

This Action Memorandum presents the Non-time Critical (NTC) Removal Action for contaminated soil at the Fire Training Pit (FTP) at the Iowa Army Ammunition Plant (IAAAP), Middletown, Iowa. The objective of the removal is the reduction of potential human health risks from hazardous substances in the soil that constitute a contaminant source to the groundwater. The removal of the contaminated soil will prevent future leaching of the soil contaminants to the groundwater.

This NTC Removal Action will be performed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). Section 300.415 of the NCP defines a mechanism to accomplish early actions to promptly reduce risk to human health and the environment. All actions will be performed in accordance with the terms of the IAAAP Federal Facility Agreement (FFA) and pursuant to Executive Order 12580. The action will be funded by the Defense Environmental Restoration Account (DERA) through the Installation Restoration Program (IRP).

**II. SITE CONDITIONS AND BACKGROUND**

**A. Site Description**

**1. Removal Site Evaluation**

**1.1 History of Release**

The Fire Training Pit (FTP) site contains an open pit that was used for fire-fighting training from 1982 through 1987. The pit is an unlined open depression approximately one foot lower than the surrounding ground surface covering an area approximately 50 by 25 feet. According to information contained in the Draft RI Report (JAYCOR, 1994), fifty-five gallon drums of solvents or fuels were placed in the pit, set ablaze, and extinguished with water by fire fighters. Solvents were used for this purpose from 1982-1984, and fuels were used from 1984 through 1987. Water used for fire extinguishing purposes was directed into the Fire Training Pit.

## 1.2 Previous Site Investigations

Previous environmental investigations at the FTP site include the following:

- Preliminary Assessment and Site Investigation conducted in 1991 by JAYCOR;
- Phase I of a RI conducted in 1992 by JAYCOR;
- Phase II of a RI conducted in 1993 by JAYCOR;
- Limited Site Investigations for Engineering Evaluations/Cost Analysis (EE/CA) studies conducted in 1995 by Harza; and
- Additional soil characterization performed by Environmental Chemical Corporation (ECC) in 1996.

Analytical results obtained from these site investigations are discussed in Section II-A-4, subsection 4.1 and 4.2 of this document.

## 1.3 Site Contaminants

Since solvents and oils were used as fuels during fire training exercises at the FTP, the soil at the FTP is contaminated with the following materials:

- metals;
- polynuclear aromatic compound (PNAs);
- other semi-volatile organic compounds (SVOC); and
- chlorinated volatile organic compounds and polycyclic aromatic volatile organic compounds (VOCs).

In addition to these compounds, low levels of dioxins and furans were detected at the FTP and are attributed to the open burning of chlorinated solvents during the fire training exercises conducted at the FTP (Section II.A.4.2).

Although the primary reason for addressing the removal of the soils is to eliminate the threat the contaminated soils pose to groundwater, groundwater remediation is not addressed as part of this removal action. The soils will be removed because they are the source of the groundwater contamination and may pose a health risk to humans and biota under current and future use scenarios. Before the groundwater can be effectively remediated, the source of contamination needs to be removed. The groundwater contamination and its remediation will be addressed during future cleanup actions at IAAAP.

## **2. Physical Location**

### **2.1 Site Location**

The FTP is part of the IAAAP facility and is located in the southwest portion of the IAAAP Explosives Disposal Area (EDA) as shown in Figure 1, Site Location Map. The surrounding land is primarily forested or used for agriculture. The IAAP facility is bordered by U.S. Highway 34 to the north, upland agricultural farms to the east and west, and the Skunk River Valley to the south. The nearest population center is Burlington, approximately 5 miles east, with an approximate population of 50,000.

### **2.2 Adjacent Sensitive Areas**

The general slope of the land is toward the southeast. The stormwater runoff from the site is toward an unnamed intermittent stream. The intermittent stream flows southeast for approximately 800 feet where it converges with Spring Creek, a perennial stream which flows southward through the EDA and ultimately discharges into the Mississippi River. The floodplain of Spring Creek is approximately 400 feet wide.

## **3. Site Characteristics**

### **3.1 Site Physical Characteristics**

Currently the Fire Training Pit (FTP) site is inactive. The FTP contains an open pit that was used for fire-fighting training and a building that was used as a smoke training vault. The pit is an unlined open depression approximately one foot lower than the surrounding ground surface covering an area approximately 50 by 25 feet. A crescent-shaped soil berm, approximately three feet high, is located on the north and west sides of the pit. The smoke training vault is approximately 75 feet northeast of the pit (Figure 2, Site Map).

#### *3.1.1 Site Geology/Hydrogeology*

The FTP is underlain by unconsolidated silt, clay, and sand overlying limestone bedrock. The thickness of the unconsolidated deposits ranges from 15 feet to 34 feet as shown in borings drilled in the pit area.

A "fat" clay layer underlies the FTP and may act as an aquitard, limiting the vertical movement of groundwater. The "fat" clay is characterized as having low plasticity and laboratory tests on samples of this clay collected near the FTP (soil boring JAB-17) indicate a hydraulic conductivity of  $1.5 \times 10^{-9}$  cm/s. The "fat" clay, described as containing sand and gravel, is present in borings in the northern portion of the site but absent in borings to the south.

Sand layers were encountered at or near the bedrock surface, in borings drilled during the RI, and in the 12 to 15 foot depth range in borings drilled during the Engineering Evaluation/Cost Analysis (EE/CA) study. The sand layers are less than five feet thick at locations where they were fully penetrated. The bedrock ranges from 15 to 34 feet below ground surface (bgs). Review of the soil boring logs indicates that the sand layers are discontinuous and may pinch out to the south.

The top of the bedrock is weathered, as indicated by iron and magnesium precipitation and secondary solution features. The decrease in the amount of solution cavities and increase in the amount of chert at greater depths acts to limit groundwater flow through the weathered, highly fractured bedrock near the till interface.

The depth to groundwater at the FTP ranges from 9 feet to 12 feet below the surface. Groundwater flow is generally to the south/southeast and toward the unnamed intermittent stream. It is assumed that the groundwater flows across the aquitard (fat clay), through the "fat" clay containing sand and gravel lenses, and deeper into the upper portion of the bedrock aquifer. A generalized geological cross-section of the FTP is illustrated in Figure 3 (Engineering Evaluation/Cost Analysis; HARZA, 1996).

### 3.2 Site Legal Characteristics

The IAAAP is an active, Federally-owned facility that began operations in 1941. The current operating contractor is Mason and Hanger Corporation under the command of the U.S. Army Industrial Operations Command (IOC), Rock Island, Illinois. Present operations at IAAAP consist of assembling and packing ammunition; including anti-personnel mines, anti-tank mines, mortar rounds, projectiles, demolition charges and warheads. Facility operations in the past have included the use of explosive materials and lead-based initiating compounds (Draft Remedial Investigation Report; JAYCOR, 1994).

### 3.3 Removal History

There were no previous removal actions at the FTP site.

## **4. Release or Threatened Release into the Environment of a Hazardous Substance, Pollutant, or Contaminant**

As described in Section II-A-1, subsection 1.1 (History of Release) of this document, solvents and oils were released to the soils of the FTP during fire training exercises. The quantity of this release is unknown. Environmental evidence for the release is the sampling data from soils and groundwater investigations. This data demonstrates contamination of the soils and the groundwater originating at the FTP.

#### 4.1 SI/RI and EE/CA Site Investigations

During the performance of the Remedial Investigation (RI), high levels of VOCs and SVOCs exceeding EPA Region III Risk Based Criteria (RBCs) for tap water were detected in the groundwater samples collected near the epicenter of the FTP (Table 1). EPA Region III RBCs are based on a carcinogenic risk of  $10^{-6}$ . The contaminants are typical for petroleum products (benzene and toluene) and solvents (tetrachloroethene and 1,1,1-trichloroethane). The presence of trichloroethylene; 1,1 -dichloroethylene; 1,1-dichloroethane; 1,2 -dichloroethane; chloroethane in the groundwater may be the result of degradation of the parent solvents: tetrachloroethylene and trichloroethane. The results indicate that the contaminants located in the soil matrix are infiltrating to the groundwater from the FTP and migrating towards the southeast. While the "fat" clay layer acts as an aquitard and prevents vertical migration of contaminated groundwater, it actually promotes horizontal migration due to the permeability difference between the glacial till and "fat clay layers.

The extent of the groundwater contamination is fully described in the Fire Training Pit EE/CA Appendix A (RI by JAYCOR) where the maps illustrate the horizontal migration of tetrachloroethylene, trichloroethane, and other breakdown products. The northern and western extent is defined by the earthen berm. The access road is the eastern extent of contamination and the intermittent stream that flows into Spring Creek is the southern limit. In January 1996, the Army observed floating product in monitoring well JAW-69 and a petroleum odor was noted. The contamination due to metals is contained in a much reduced area. This may be attributed to the natural bonding of the metals to the clay soil matrix. However, metals in the groundwater were detected in wells located 150 feet from the FTP.

The highest concentrations of VOCs and SVOCs in the soil are at the surface and decrease with depth and distance laterally away from the pit area. Since the contaminated soil at the FTP represents a continuing source for groundwater contamination, the removal of the contaminated soil will minimize potential future groundwater impacts. The extent to which contaminated soils should be removed was determined during the RI by risk-based concentrations (RBCs) for individual organic chemicals. The RBCs were obtained by selecting the most conservative values using two separate methodologies:

- Values calculated using the Summers Model; and
- Values obtained from USEPA Region III, Risk Based Concentrations for soil ingestion in the industrial setting.

The Summers Model was used to calculate soil concentrations required to meet risk-based criteria for Tap Water, as presented in the USEPA Region III, Risk-Based Concentration Table, March 7, 1995. The Summers Model simulates leaching of

individual contaminants from soil into water that originates as rainfall and percolates through the soil to the underlying aquifer. The model then determines the contaminant concentration in the groundwater based on the percolation rate of the contaminated water entering the aquifer and the groundwater flow rate in the aquifer. The input parameters for the Summers Model were obtained from existing site data or from values used previously at IAAAP.

The maximum concentrations of organic compounds detected in soil at the FTP during the SI/RI and EE/CA investigations are compared with the RBCs in Table 2. The comparison indicates that acetone, benzene, methylene chloride, 1,1-dichloroethene, tetrachlorethene, trichlorethylene, trichloroethane (chloroform), and pentachlorophenol exceed cleanup criteria in one or more samples. Therefore, these eight organic chemicals are identified as Contaminants of Concern (COCs).

For metals, the maximum detected concentration for each analyte was compared to values published in the USEPA Region III Risk Based Concentration Table for soil ingestion in the industrial setting. Lead results were compared to results from the EPA PRG Screen Model. The comparison indicates that only lead exceeds the criteria (based on the EPA PRG Screen Model). Therefore, lead is identified as a Contaminant of Concern (COC). The only sample that exceeded the above criteria for lead of 1000 mg/kg was obtained from location SB01 (Figure 4) at the ground surface. This sample had a lead concentration of 4280 mg/kg.

#### 4.2 ECC Site Investigation

Additional soil sampling was performed by ECC in 1996 to accurately determine the level of soil contamination and the lateral and vertical extent of the contamination. Samples were obtained from 35 boring locations (Figure 4) and three to four vertical intervals. Thirty-seven VOCs and SVOCs were detected during this sampling event. The average concentration of thirty-one compounds detected in the proposed excavation area are presented in Table 3. Based on the contaminants detected at the FTP, the excavated soil will be classified as a F002 RCRA listed waste. The F002 waste code describes wastes containing spent halogenated solvents that require treatment to the standards presented in 40 CFR 268.40. The highest concentrations are near the ground surface and decrease with depth and distance laterally away from the pit area (Figures 5-8). Approximately 60-percent of the contamination is located between the ground surface and three feet below the ground surface. The remainder of the contamination is fairly evenly distributed from 3 feet below ground surface to the water table at approximately 10 feet below ground surface. Soil samples were not obtained below the water table. The maximum contaminant concentrations detected during the ECC investigation are presented in Table 4. The contaminant levels were compared to the RBC's in Table 2 to determine the location and quantity of soil that exceeds the RBC's and requires

excavation. A summary of samples that exceeded the Summer Model Criteria is presented in Table 5. Table 6 presents the summary of samples that exceeded the land disposal restrictions. The recommended excavation area is shown in Figures 5 through 8 which contains the boring locations that have soil samples that exceed the excavation criteria. The excavation area has a surface area of approximately 2,500 square feet and contains approximately 900 CY of soil. Based on the sample results, approximately 2,800 pounds of VOCs and SVOCs are present in the excavation area (Table 3).

In addition to the compounds presented in Tables 2, 3 and 4, very low levels of furans and dioxins were detected as a combustion by-product at the FTP. They are not directly attributed to the disposal of chlorinated solvents. These results are presented in Table 1 of Attachment A, Human Health Risk Assessment of Dioxins and Furans at the IAAAP. The presence of low levels of these compounds can be attributed to the open burning of chlorinated solvents during the fire training exercises conducted at the FTP. The most well-known of the dioxins and furans is tetrachlorinated dioxin with chlorine atoms in the 2,3,7, and 8 positions — 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). This dioxin can produce a variety of toxic effects at low doses. This variety of dioxin was not detected at the FTP. Besides 2,3,7,8-TCDD, there are other chlorinated dibenzo-p-dioxins (CDDs) and chlorinated dibenzo furans (CDFs) that have chlorine atoms in these positions — referred to as 2,3,7,8-substituted congeners. Since 2,3,7,8-TCDD is the most potent animal carcinogen and reproductive toxin evaluated by EPA to date, it is used as a measure of toxicity for other congeners. The relative toxicity of the congener to 2,3,7,8-TCDD is its toxicity equivalency factor (TEF). For example, 1,2,3,7,8-pentachlorodibenzo furan is estimated to have approximately one-half the toxicity of 2,3,7,8-TCDD, so its TEF is 0.5.

The TEF for a dioxin or furan congener is multiplied by the congener's concentration to determine the 2,3,7,8-TCDD toxicity equivalent (TEQ). Two soil samples were collected for dioxin and furan analysis. Each sample was a composite of three subsamples collected from locations at the FTP that had the highest concentration of chlorinated solvents. The assumption was that these locations would have the highest concentrations of dioxins and furans if these contaminants were present at the site. One sample was a composite of surface samples, and the other sample was a composite of samples collected from 2 to 3 feet below the ground surface. The average 2,3,7,8-TCDD TEQ for these two samples was 0.0007 mg/kg which is less than the Land Disposal Restrictions for these compounds. Based on these low concentrations, the Human Health Risk Assessment determined that no potential for excess risk due to the presence of dioxins exists for IAAAP on-site workers above the standards set by the U.S. Environmental Protection Agency (EPA) during treatment of the soil. A more detailed analysis of the risk associated with dioxins and furans is presented in Attachment A.

## **5. National Priority List Status**

The Iowa Army Ammunition Plant was referenced on the National Priority List on August 22, 1990. The notice of placement was published in the August 30, 1990 Federal Register. The FTP is a subsite within the IAAAP soils operable unit.

## **6. Maps, Pictures, And Other Graphical Representation**

Figures illustrative of the FTP are included throughout this Action Memorandum and were generated during the EE/CA. These include the following:

- Figure 1: Site Location Map
- Figure 2: Site Map with Monitoring Wells and Boring Locations
- Figure 3: Generalized Geologic Cross-Section of FTP
- Figure 4: ECC Sample Locations
- Figure 5: FTP Trichloroethene Concentrations
- Figure 6: FTP 1,1,1-Trichloroethane Concentrations
- Figure 7: FTP 1,1-Dichloroethene Concentrations
- Figure 8: FTP Toluene Concentrations
- Figure 9: Conceptual Process Block Flow Diagram: LTTD System

## **B. Other Actions to Date**

### **1. Previous Actions**

To date, the CERCLA actions taken by the Army at the FTP include the investigations discussed in this document, an in-situ soil vapor extraction (SVE) pilot test, and a soil gas survey. The in-situ SVE pilot test operated at the site from October 31 to November 2, 1995. The purpose of the test was to evaluate the soil venting characteristics of the volatile organic contaminants in the FTP.

The soil gas survey examined 66 sampling locations. Based on the results of the soil gas investigation, it was determined that the source of contamination is localized to the vicinity of the FTP.

### **2. Current Actions**

No remedial or removal actions are currently being performed at the FTP.

## **C. State And Local Authorities Role**

EPA Region VII is providing regulatory oversight for the removal action. Remediation of the FTP site is being addressed under CERCLA removal authority and a Federal Facility Agreement



(FFA) between the Army and EPA. CERCLA removal authority is granted to the Army in Executive Order 12580. The purpose of the FFA is to provide a procedural framework for implementing CERCLA and RCRA corrective action and to facilitate cooperation and communications among the FFA signatories. The Iowa Department of Natural Resources was provided with copies of all the reports generated in conjunction with the FTP removal. However, the State has not participated in the review process.

### **III. THREATS TO PUBLIC HEALTH OR WELFARE OR THE ENVIRONMENT, AND STATUTORY AND REGULATORY AUTHORITIES**

As outlined in the following sections, the contaminants at the FTP present a threat to public health and welfare as specified in 300.415 (b) (2) of the NCP.

#### **A. Threats to Public Health or Welfare**

No risk assessment specific to the FTP site was performed to quantify the threat to public health and welfare. However, a Baseline Risk Assessment was performed for other IAAAP sites and is relevant concerning exposure pathways at the FTP site (Baseline Human Health and Ecological Risk Assessment; JAYCOR/ICAIR, 1994). Since the contaminants are present in soil and groundwater at the site above the risk-based levels of concern and Maximum Contaminant Levels (MCLs), potential contaminant migration pathways that could result in human exposure to the contaminants of concern were identified for two land use scenarios - current use and future use.

Under the current use scenario, the FTP is not used for any particular purpose; no activities are performed at the site and access by off-site persons is restricted. However, access to the site by wildlife (such as deer) or by IAAAP personnel is not restricted. The stormwater runoff from the site is toward an unnamed intermittent stream. The intermittent stream flows southeast for approximately 800 feet where it converges with Spring Creek, a perennial stream which ultimately discharges into the Mississippi River. The intermittent stream and Spring Creek are available to wildlife as a drinking water source. Based on the current use scenario, the following are the human exposure pathways:

- Inhalation/Ingestion of potentially contaminated windblown surface soils (dust) by on-site workers or visitors;
- Ingestion of contaminated groundwater; and
- Consumption of deer or other wildlife that drink contaminated water and feed on vegetation growing on contaminated soil.

Under the future use scenario, the land use may not change significantly from the current land use conditions unless the portions of the existing IAAAP property is release from government ownership. This possibility may cause the existing property lines to move closer to the FTP site and could result in encroachment of industrial development or residential housing. Based on this

future use scenario, the following human exposure pathways should be included with the exposure pathways for the current use scenario:

- Ingestion of groundwater from potential future off-site wells along the intermittent stream and Spring Creek; and
- Inhalation/ingestion of surface soils by future construction workers.

## **B. Threats to The Environment**

The nature of ecological risks associated with contaminated soils, groundwater, and surface water at the FTP are not well quantified. The FTP provides an attractive habitat for deer, waterfowl, and amphibious life forms that inhabit the IAAAP. Based on the relatively high levels of VOCs, SVOCs, and lead found in soils at this site, potential negative impacts to ecological receptors may occur. In fact, stressed vegetation was observed in the FTP. The discharge of contaminated groundwater and surface water to the intermittent stream south of the FTP is also a potential ecological impact to the wildlife that frequent the IAAAP. The intermittent stream will be sampled to determine the current extent of contamination. Presently, the magnitude and significance of the actual and potential ecological impacts are unclear.

## **IV. ENDANGERMENT DETERMINATION**

Actual or threatened releases of contaminants from this site, if not addressed by implementing the response action selected in this Action Memorandum, may present an imminent and substantial endangerment to public health, or welfare, or the environment

## **V. SELECTED ACTIONS AND ESTIMATED COSTS**

### **A. Selected Action**

#### **1. Selected Action Description**

The removal alternative for the Fire Training Pit, as discussed in the Explanation of Significant Differences (ESD) document, includes the following steps:

- Excavation of an estimated 900 CY of VOC, SVOC and lead contaminated soils exceeding the Remediation Goals (RGs) (Table 2 and Table 7);
- Segregation of metals contaminated soil from VOC and SVOC contaminated soil in separate stockpiles;
- Perform verification sampling of the excavation to ensure the RGs are attained;
- Treatment of the contaminated soil utilizing Low Temperature Thermal Desorption (LTTD) to the treatment criteria (Table 7);

- Prior to release, treat the off-gas from the LTTD system using a secondary treatment unit consisting of a thermal oxidizer operating at approximately 1800 degrees Fahrenheit with a 2-second retention time, rapid quench evaporative cooling chamber, and acid gas scrubber.;
- Stabilize metals contaminated soil that fails TCLP criteria;
- Sample stockpiles of treated soil to assure that treatment criteria has been achieved;
- Disposal of the treated soil at the IAAAP's Trench 6 Soil Repository (Trench 6) (Figure 1); and,
- Restore the site by backfilling with clean soil and seeding.

If groundwater in the excavation appears severely impacted, the excavation may be backfilled with a layer of permeable material to provide a means of extracting contaminated groundwater at a later date. This is discussed in more detail in Section V.A.1.2.

Trench 6 was constructed adjacent to the Inert Landfill as part of another non-time-critical removal action. Construction consisted of low permeability liners and leachate collection systems which meet RCRA requirements of 40 CFR 264, Subpart N. The new landfill has a capacity of approximately 80,000 CY, with capability for expansion.

### 1.1 Remediation Goals

The criteria for delineating the excavation limits at the FTP will be based on Remediation Goals (RGs) for the individual organic contaminants. The RGs were obtained by selecting the most conservative values from two methodologies:

- Values calculated using the Summers Model to meet risk-based criteria for Tap Water, based on the USEPA Region III, RBC Table, March 7, 1995; and
- Values obtained from the same USEPA Region III, RBC table for soil ingestion for an industrial/commercial setting.

These RGs provide protection from further groundwater contamination associated with the contaminants leaching from soils and are protective of direct human contact/exposure to the soil. The RGs are presented in Table 2 and Table 7.

### 1.2 LTTD Contaminated Soil Treatment

The soil will be treated utilizing low temperature thermal desorption (LTTD). Initially, the contaminated soil is excavated and stockpiled. The stockpiled soil is pre-treated to reduce the clod size to a maximum of 2- to 4-inches with a soil shredder capable of processing wet clay. Care will be taken to minimize any emissions during soil processing. Additionally, personal air monitoring will be performed during treatment activities. After the size reduction, the pre-treated soil is fed into the rotary dryer unit and

heated to approximately 500 degrees Fahrenheit. The heated gases from the dryer chamber are forced through a high temperature baghouse to remove soil fines and dust particles. The particle free gases are forced through a secondary treatment unit (STU) consisting of a thermal oxidizer operating at approximately 1800 degrees Fahrenheit, rapid quench evaporative cooling chamber, and acid gas scrubber. The STU removes over 99% of the hydrocarbons that are oxidized to carbon dioxide and water. The scrubber neutralizes the inorganic acids prior to discharge to the atmosphere. Dust from the baghouse is mixed with the soil exiting the rotary dryer. As the soil is discharged, it is re-hydrated to minimize dust production. The treated soil is placed in stockpiles that are sampled and analyzed to ensure treatment standards are achieved to meet land disposal restrictions (LDRs) prior to placement in Trench 6.

The treatment will be conducted within the FTP Area of Contamination (AOC). AOCs are generally defined as areas of contiguous contamination which represent definitive boundaries typically associated with historic waste management activities (e.g. waste pits, piles, landfills, and adjacent surface impoundments). For the purposes of CERCLA, AOCs are considered the equivalent of RCRA Solid Waste Management Units (SWMUs). The FTP at IAAAP was defined as an AOC. The EE/CA states that materials excavated from the FTP may exhibit RCRA toxicity characteristics subjecting the soil to Land Disposal Restriction (LDR) prohibitions. The EE/CA also states that the soil would be managed within the AOC to avoid *placement*, as defined in EPA's Superfund LDR Guide #5, and, subsequently, the triggering of LDRs. The recommended treatment described in this document, Low Temperature Thermal Desorption (LTTD), does not permit such an approach. Treatment utilizing LTTD will require that LDRs are achieved prior to disposal at Trench 6. Based on the contaminants detected at the FTP, the excavated soil will be classified as a F002 RCRA listed waste. This waste code describes wastes containing spent halogenated solvents and requires treatment to the standards presented in 40 CFR 268.40. Table 7 summarizes the excavation and disposal criteria for compounds that exceed the treatment criteria.

Figure 9 shows a conceptual process flow block diagram for the LTTD system. The treatment period for this alternative is one to two weeks. The treatment will be required to meet land disposal restrictions (LDRs) and the associated treatment standards for the constituents identified in 40 CFR 268.40. The treated soil will be disposed of in Trench 6.

The excavation area will be backfilled with clean material from a borrow area such as clay, sand or gravel, and restored with a layer of low permeability clay, topsoil and grass. Prior to backfilling, a rectangular "envelope" of permeable material such as gravel may be installed below the groundwater table to provide a means of extracting contaminated groundwater at a later date. The need for this feature will be based on field observations during excavation. If groundwater in the excavation appears severely impacted, the permeable material will be installed. A groundwater extraction / monitoring well may be installed in the backfilled gravel material to facilitate future treatment of contaminated groundwater.

Any free product encountered during excavation will be removed and disposed of off-site at a permitted TSD facility.

### 1.3 Air Monitoring

Air monitoring of VOC emissions and fugitive dust (per ARAR's) will be required during soil treatment. Samples will be analyzed daily for personnel exposure to site COCs. Experience has shown that, although many different VOCs are present at the FTP, BTEX sampling (with emphasis on Benzene due to its low PEL/TLV), will provide adequate exposure data. This sampling will yield worst case (i.e., "point source volatilization of organics") exposures, and work methods/modifications/PPE will be determined by the analytical results received from this sampling (24-hr turnaround is specified). This will ensure that site workers are not exposed to site contaminants in excess of regulatory limits (PEL/TLV).

### 1.4 Dioxin Formation

Theoretically, dioxins can be formed whenever organic compounds and chlorinated compounds are oxidized. However, dioxins are not thermally stable and are easily destroyed at temperatures above 1200 degrees Fahrenheit. The primary concern is post-combustion reformation of dioxins from products of incomplete combustion. Previous test burns have indicated that the potential for dioxin formation is high only in combustion units utilizing downstream heat recovery systems. This is due to the prolonged exposure of the combustion exhaust gases to temperatures between 350 and 750 degrees Fahrenheit. However, for systems that utilize a rapid quench to cool the gas stream to below 300 degrees Fahrenheit, such as the LTTD unit to be used at the FTP site, dioxin formation is low as the gas is not exposed to temperatures within the "reformation window" for more than a few milliseconds. Therefore, systems such as the LTTD unit to be used during this project have a low potential for dioxin formation.

### 1.5 Exposure Assessment During Soil Treatment

The proposed removal alternative can be readily implemented on-site since the plant has restricted access. Exposure to plant workers and local residents will be limited during implementation of the removal action. The appropriate State and Federal regulatory officials will be notified prior to beginning any work.

Stack emission measurements from an identical unit proposed for this project show that 2,3,7,8-TCDD TEQ emissions are below the proposed EPA emission limits. The stack emission measurements were made at Sanders Aviation in Tempe, Arizona during the treatment of chlorinated pesticides. These contaminants have a higher potential for dioxin formation than the contaminants at the FTP. The soil treatment rate and operating temperatures were similar to the anticipated system operating conditions at the FTP. During the performance test, total dioxin and furan emissions were measured in the off-

gas in nanograms per dry standard cubic meter and 2,3,7,8-TCDD TEQs were calculated from the data in pounds per hour. This information is provided in Table 8 with a conversion to 2,3,7,8-TCDD TEQs in nanograms per dry standard cubic meter. As shown, the results for the three test runs are below the EPA proposed standard of 0.2 ng/m<sup>3</sup> as published in the April 1996 Federal Register.

A Human Health Risk Assessment (HHRA) was performed to determine potential adverse effects of human exposure to dioxins and furans during remediation activities at the FTP. The concentration of contaminants in the off-gas used to calculate risk in the HHRA were a worst case scenario, and much higher than the measured values presented in the previous paragraph. This HHRA determined that no potential for excess cancer risk exists for IAAAP on-site workers above the standards set by the U.S. Environmental Protection Agency (EPA). The entire HHRA is presented in Attachment A.

While the concentrations of dioxins and furans in the air during LTTD treatment were above risk-based values based on the air model results and worst case assumptions, these risk-based values are for a 25-year exposure duration and an averaging time over a 70-year lifetime. The expected time to use the LTTD treatment of the IAAAP materials is actually much shorter (i.e., approximately 30 days maximum).

The HHRA discussed the exposure of on-site workers in the following scenarios:

- An assessment of on-site remediation worker exposure to untreated soil for a total of 30 days through ingestion, dermal contact, and inhalation of wind-blown soil.
- An assessment of facility worker (Mason and Hanger Corp.) exposure to particulate emissions for a maximum total exposure of 40 hours from the low temperature thermal desorption (LTTD) unit through inhalation. The particulate emissions were provided from a dispersion modeling study of dioxins and furans. The modeling study is presented in Attachment B.

Intake estimates of the contaminants are established through the use of intake equations and exposure parameters. These intakes were compared with toxicity values that are the upper boundary estimate of the probability that an individual will develop cancer if exposed to the contaminant for a lifetime.

Using the estimated limited time of exposure to the dioxins and furans, the calculated risks were equated to the lifetime carcinogenic risks and found to be below the nationally-established risk range of one in ten thousand and one in a million (1E-04 to 1E-06) established in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). Specifically, the calculated risks to the on-site remediation worker of exposure to surface soil (due to ingestion and dermal soil contact) was 3E-09, which is approximately one thousand times less than the established risk level of one in a million. The risk of exposure to subsurface soil was 8E-10.

For the facility workers exposed to particulate emissions from the LTTD unit, the risks were significantly lower than the established risk level with risk values of 6E-17 for workers at the BG-1 location and 7E-17 for workers at the CWP location. It should be noted that the air particulate emissions were based on a worst-case analysis, assuming that the LTTD would not destroy any dioxins or furans in the soil (a 0% destruction removal efficiency (DRE)). Even this conservative estimate did not indicate a potential increased cancer risk. It is expected that the DRE for the LTTD would actually be approximately 99%, resulting in a less potential for adverse health effects to on-site facility workers.

## **2. Contribution to Remedial Performance**

The removal action at the FTP is consistent with the criteria established for other response actions for the IAAAP soils OU. The removal of contaminated soil from the FTP will eliminate the source of groundwater contamination which poses a threat to human health and the environment. After excavation, soil samples will be collected and analyzed for the COCs to ensure that all soil contaminated above the excavation criteria is removed. This action will remove soil contamination and minimize potential future groundwater contamination.

## **3. Description of Alternative Technologies**

The EE/CA identified and evaluated seven soil remedial alternatives consistent with the NCP removal objectives and to achieve the NTC Removal Action scope:

- a. Natural Attenuation.
- b. In-situ Soil Vapor Extraction.
- c. Landfill Disposal:
  - c.1. Landfill Disposal Without Treatment.
  - c.2. Ex-situ Soil Vapor Extraction and Landfill Disposal.
  - c.3. Low Temperature Thermal Desorption and Landfill Disposal.
  - c.4. Incineration and Landfill Disposal (to be conducted offsite.)
  - c.5. Controlled Soil Aeration and Landfill Disposal.

For alternatives a through c, approximately 150 CY of lead-contaminated soil will be excavated, treated for VOC contamination, stabilized, and disposed at the Trench 6. For alternatives c.1, c.2, c.3, and c.5, the soil meeting disposal criteria will be taken directly to the Trench 6 landfill. Alternative c.4 consists of the treatment and disposal that will be implemented off-site.

The selected alternative is c.3, "Low Temperature Thermal Desorption and Landfill Disposal" and was described in detail in Section V-A-1, subsection 1.2 (Contaminated Soil Treatment. The other alternatives are briefly described in the following subsections.

## *Cost Estimates*

The cost estimates provided in these subsections are from the EE/CA and were determined prior to the additional sampling performed by ECC. The cost comparison assumed that 1600 CY would require treatment for each alternative, including ex-situ SVE and LTTD. The additional sampling performed by ECC better defined the nature and extent of contamination and demonstrated that only approximately 900 CY will require treatment. The costs associated with ex-situ SVE are primarily capital costs that are incurred prior to treatment. These expenditures are for equipment and materials required for treatment, and O&M costs. The costs for LTTD treatment are primarily for the actual treatment of the contaminated soil. Therefore, the decrease in soil volume will result in more savings for the LTTD alternative than for ex-situ SVE

### *a. Natural Attenuation*

Remediation by natural attenuation requires no intrusive activities, only extensive soil monitoring to evaluate the rate of natural degradation and dispersion. Natural degradation for volatile organic compounds is expected to occur primarily through volatilization and solution when in contact with water. Biodegradation of chlorinated compounds is not expected to occur at significant rates under natural conditions. The approximate 150 CY of lead-contaminated soil is not expected to experience significant natural attenuation and will need to be excavated and taken off-site for treatment and disposal. This alternative allows the contaminated soil to remain a continual source of groundwater contamination resulting in prolonged and costly groundwater remediation.

- Effectiveness

The natural attenuation alternative permits extended exposure to the contaminated soils and groundwater resulting in a continued risk to human health. This alternative also may not provide a permanent solution due to the uncertainty of the degradation of the organics and the non-degradation of lead in the surface soils. The contaminants may migrate or leach to the groundwater before they are degraded and intermediate degradation products may be more mobile and toxic than the original contaminants.

- Implementability

This method requires the removal and disposal of the top two feet of soil contaminated with lead.

- Cost

The estimated cost of natural attenuation remediation is \$353,000, including 20 years of soil monitoring and the excavation and off-site disposal of the lead-contaminated soil.



**b. *In-situ Soil Vapor Extraction***

The in-situ SVE method utilizes forced or drawn-air currents to remove the volatile compounds from the contaminated soil which remains in place. The contaminant-laden air is withdrawn from the soil and vented through an emission control system. The extracted vapor can be treated using either carbon adsorbers or a catalytic oxidation system before being discharged to the atmosphere. Six wells were installed to conduct an in-situ SVE pilot test at the FTP to determine the effectiveness of this system. The pilot test results were provided in the FTP EE/CA report, May 1996. The estimated radii of influence for SVE wells ranged from 10 to 40 feet and indicate that the soil permeability is quite variable.

- Effectiveness

Remediation by in-situ SVE is assumed to require at least two years, primarily due to the dense clayey nature of the soils and the variable moisture content. Both of these factors severely hamper vaporization rates. The treatment required to attain land remediation cleanup criteria can be extended for a much longer period; given the high contaminant concentrations, low biodegradation rates, and low rates of vaporization for several COCs. Another disadvantage of this system is that it is difficult to determine if all contaminants are removed from the soil to meet RGs. This method will not remove free product which may be present in or on the surface of the groundwater. Therefore, application of this technology at the FTP may not offer the required levels of protection.

- Implementability

Although the SVE system is a proven technology, it was tested on the FTP site with mixed results due to the clayey nature of the soil.

- Cost

The estimated cost for implementing this alternative is \$736,000 including in-situ SVE and the excavation and disposal of the top layer of lead-contaminated soil.

**c.1 *Landfill Disposal Without Treatment***

As previously discussed, approximately 900 CY of the soil exceed the RCRA LDR criteria for land disposal of untreated wastes and will require treatment prior to landfill disposal. Therefore, this option does not comply with the ARARs and will not be considered.

## *c.2 Ex-Situ Soil Vapor Extraction and Landfill Disposal*

This process involves excavating the contaminated soil, enhancing contaminant volatilization by applying a vacuum to the stockpiled soil, and capturing the extracted contaminants. The contaminated soils will be piled to a height of approximately ten feet on a bermed unlined treatment pad. Since the soil at the FTP is mostly clay, a shredder or a screen will be needed to reduce and segregate the particle size. The lead contaminated soil also will be placed in the SVE treatment pile and kept isolated during the treatment process.

A total of four treatment piles and a segregated pile for the metal contaminated soil are planned. A network of horizontal, perforated pipes will be installed at the bottom and in the center of the soil treatment pile. The perforated pipes will be connected to a vacuum blower to create a suction draft within the soil piles. A venting blower connected to the piles will provide supplemental air for the treatment. In lieu of the installation of the perforated horizontal pipes, a gravel layer could be substituted with single or dual pipes located within the gravel itself. A plastic liner will cover the piles to prevent VOC emissions. A sump downgradient of each pile will capture any leachate generated. The stripped vapors will be passed through a carbon adsorber unit.

The remediation time can be accelerated by heating the air prior to blowing it into the soil pile. The air can heat the soil with temperatures greater than 100°F to remove moisture at a faster rate. This will accelerate the VOC volatilization process. The heated air will need to be cooled before passing through the carbon adsorbers since the performance of the carbon adsorbers may be reduced drastically when air temperature exceeds 100°F. In lieu of the heated air, a dehumidifier can be installed upstream to dry the air to promote accelerated water vaporization, faster drying of the soil, and improved contaminant volatilization/removal. The treatment period for this alternative is estimated to vary between six months to two years depending on the weather conditions (ambient air temperature and humidity), and the optional setup (air flow rates, air humidity, heat, etc.).

The treatment will continue until the analytical results indicate that LDRs are achieved for all COCs (except lead). Treated soil passing LDRs can be disposed in Trench 6. The lead contaminated soil will be treated for the VOC and SVOC contamination, stabilized, and disposed of in Trench 6.

- Effectiveness

Normally, the ex-situ soil vapor extraction is a proven, reliable technology that can effectively remediate more than 90% of the contaminated soil. However, the low permeability of the wet clayey soil at FTP will make it difficult for the ex-situ SVE system to effectively treat the soil to below Land Disposal Restrictions (LDRs) necessary for disposal in Trench 6.

- Implementability

The ex-situ SVE system is a proven technology and could possibly remove and capture the COCs over a period of time.

- Cost

The cost for the three variable options proposed to optimize costs or reduce treatment time for the ex-situ SVE alternative are listed as follows:

▶ Carbon Unit	\$659,000
▶ Catalytic Oxidation	\$787,000
▶ Carbon and Hot Air Injection	\$693,000

### ***c.3 Low Temperature Thermal Desorption and Landfill Disposal***

Low Temperature Thermal Desorption and Landfill Disposal was previously described in Section V-A-1, subsection 1.2.

- Effectiveness

LTTD is very effective treating contaminated soil with high levels of VOCs. LTTD was established by the EPA as a presumptive remedy for VOC treatment in soils. Land Disposal Restrictions (LDRs) can easily be achieved. Additionally, LTTD is effective in treating soil with a high clay content because VOCs are removed at elevated temperatures and the soil is heated evenly. Treatment using LTTD is considered effective and permanent.

- Implementability

There are numerous case histories of the successful implementation of this technology, including the remediation of 14,000 cubic yards of TCE and DCE contaminated soils at Letterkenny Army Depot, Chambersburg, Pennsylvania.

- Cost

The estimated cost for this alternative with a thermal oxidizer to treat off-gas is \$496,000.

### ***c.4 Incineration and Landfill Disposal***

Incineration is a thermal technology that uses temperatures ranging from 1600°F to 2200°F to volatilize and combust a variety of organic constituents in soils. During incineration, molecules of organic compounds are broken down into their basic atomic elements, detoxified, and reduced to ash through high temperatures.

An off-site incinerator and disposal (residue landfilling) is considered a cost-effective alternative. The off-site facility must be an approved, permitted TSD consistent with Section 300.440 of the NCP. This alternative would require off-site transportation and management of the contaminated soil.

- Effectiveness

This process usually destroys organic contaminants in the residual soils with 99.9% efficiency and concentrates non-volatile metal constituents in residues (ash). The following factors may limit the applicability and effectiveness of the process:

- ▶ Volatile metals such as lead and arsenic will require treatment of the flue gases during incineration, or
- ▶ Removal of metals prior to incineration.

- Implementability

Incineration is a proven technology and the facilities used for incineration must be an approved and permitted TSD.

- Cost

This process is more expensive than other technologies due of the handling requirements (dewatering, screening, particle reduction, separation of clays and fines), air pollution equipment, transportation, and further treatment of incinerated residue.

The estimated cost for this alternative is \$2,411,000, including soil incineration (1600 CY) and landfill disposal of residues.

### ***c.5 Controlled Aeration and Landfill Disposal***

This process involves the controlled volatilization of VOCs into the atmosphere. VOC contaminated soils are spread on a bermed treatment pad. The soils are tilled with a rotovator or a power tiller. Higher ambient temperature, higher concentrations, and more efficient tilling can accelerate the volatilization rate several fold. The contaminants of concern in the FTP soils are not readily biodegraded in this process, but can volatilize.

- Effectiveness

This method will likely remove 80 to 90 percent of the FTP organic VOC contaminants under the proper operating and environmental conditions. The lead contaminated soil will need to be stabilized and disposed of off-site if the LDRs are not met.

This alternative does not destroy contaminants but transfers them from the soil medium to the air medium. Therefore, this process does not satisfy the CERCLA preference for treatment. The State of Iowa or the EPA may choose to restrict the amount of soil that can be aerated per day based on a required detailed risk assessment and air dispersion model. This will increase the project cost, extend the schedule of implementation and, therefore, not meet the basic NTCRA objective.

- **Implementability**

This process is successfully used to remediate soil. However, at FTP the risk to human health and the environment due to the volatility of the COCs, their concentration, and their potential toxicity require an air dispersion model and a risk assessment.

- **Cost**

The estimated cost for this alternative is \$425,000, which includes soil aeration, landfill disposal and the stabilization/disposal of approximately 150 CY of lead contaminated soil. Cost includes the establishment and implementation of protective controls. The air emissions from the contaminated soil must be monitored daily, together with the emissions limited by controlled exposure of soils by partial tilling and uncovering.

### ***Summary***

The basis for eliminating the potential alternatives, other than LTTD, are summarized as follows:

#### **Natural Attenuation.**

Effectiveness is uncertain. Contaminated soil will continue to provide a source of contaminants to groundwater. The presence of contaminated soil can pose health risks to personnel working at the FTP.

#### **Landfill Disposal.**

Landfill disposal does not meet the treatment criteria for disposal (LDRs). Therefore, it could not be implemented without an ARAR waiver. CERCLA Section 121(b) emphasizes the preference for treatment.

#### **In-situ Soil Vapor Extraction.**

This alternative is more costly than the LTTD alternative. Requires a longer treatment period compared to LTTD treatment. Presence of NAPL will continue to volatilize under vacuum conditions, possibly resulting in an extended period of remediation. This alternative

has a potential for leaving high levels of contamination in the soils, especially soil within or on the surface of the groundwater.

**Ex-situ Soil Vapor Extraction.**

Requires a long treatment period and is not suited to soil with low permeability and high VOC concentrations.

**Incineration with Landfill Disposal.**

Extremely high cost of implementation. Risk of human exposure to contaminant during loading, transportation, and handling.

**Controlled Aeration with Landfill Disposal.**

Contaminants are not destroyed, but are transferred to air medium. Risk of human exposure to contaminants is maximum. CERCLA does not endorse this application. A detailed risk assessment and air dispersion model will be required.

**4. Engineering Evaluation/Cost Analysis (EE/CA)**

The EE/CA supporting this Action Memorandum was completed in May, 1996. The EE/CA provides additional details regarding the subject removal action and the alternatives that have been considered. However, the preferred alternative identified in the EE/CA was not the alternative selected in this Action Memorandum. The rationale for selecting the present alternative is discussed in detail in the ESD.

The EE/CA is available for public review at the Burlington Public Library, the Danville City Hall, and the Administration building of the IAAAP. A press release was published on June 9, 1996, in the Burlington Hawkeye advising the public of the availability of the EE/CA document and soliciting public comment. The public comment period ended July 9, 1996. There were no public comments received on the EE/CA for the subject removal action. Comments from EPA regarding the draft EE/CA were incorporated into this Action Memorandum.

The administrative record and this Action Memorandum will also be available at the following locations for public review.

Iowa Army Ammunition Plant  
Visitors Reception Area, Building 100-101  
Middletown, IA 52683-5000  
(319) 753-7710

Burlington Public Library  
501 North 4th Street  
Burlington, IA 52601  
(319) 753-1647

Danville City Hall  
105 West Shepard  
Danville, IA 52623  
(319) 392-4685

The comment period this Action Memo will take place in January and February, 1998.  
The point of contact for public inquiries is:

Rodger Allison  
SIOIA-PPE  
Iowa Army Ammunition Plant  
17575 State Highway 79  
Army Mail Room  
Middletown, Iowa 52638-9701  
(319) 753-7130

A public meeting to address this removal action is not currently planned. However, a meeting will be scheduled upon public request.

##### **5. Applicable or Relevant and Appropriate Requirements (ARARS)**

For this alternative, most of the general ARARs and TBCs identified in Table 8 will be applicable for the reasons noted below:

- Since the excavated soil is contaminated with lead and listed organic compounds, and due to the remedial activities to take place (size reduction, loading, stockpiling of soil) during site preparation and ex-situ treatment of the soil, the following may be applicable: National Ambient Air Quality Standards (40 CFR Part 50); National Emission Standards for Hazardous Air Pollutants (40 CFR Part 61); New Source Performance Standards (40 CFR part 60); Air Emission Standards (40 CFR Part 264, Subpart AA and BB); Iowa Air Quality Excess Emission (IAQ 567-24); and Iowa Air Emission Standards (IAQ 567-23). IAQ 567-23 is equivalent to 40 CFR Part 60 (NSPS).
- During remediation, worker's safety standards under OSHA (29 CFR Part 1910) may also be applicable.
- If floating product or groundwater is encountered during excavation, the National Pretreatment Standards (40 CFR Part 403) may be applicable.

- Based on the F002 waste code, hazardous waste-related ARARs (federal and state) will be applicable. Applicable ARARs will be 40 CFR Part 261, 268, 262, 263, 264, Subpart C, Subpart F, and Subpart N, 270, 49 CFR Parts 107, and 171-177.
- If the soil to be disposed is non-hazardous and will be disposed in Trench 6 Repository, 40 CFR Parts 257 and 258 and Iowa regulations ISWDR, 567-100, 101, 102, 103 and 110 may be applicable.

A summary of applicable ARARs is presented in Table 9. The cleanup criteria (TBC) will be considered to ensure the NTCRA objective and the NCP requirements are satisfied.

## 6. Project Schedule

The tentative schedule for implementation of the recommended remedial alternative is as follows:

Final EE/CA Report Submittal:	May 1996
Public Comment Period:	June - July, 1996
Final Action Memo Submittal:	January, 1998
Public Comment Period	January - February, 1998
Contractor On-Site Mobilization:	May, 1998
Complete Remediation:	July, 1998

This schedule is tentative and is based on accelerated engineering efforts being completed. The removal action, based on the use of a LTTD system, is assumed to require about two to three months to implement. It is also assumed that logistic and weather related problems will be minimal and the project will progress on schedule. Trench 6 Soil Repository is currently ready to accept material.

### B. Estimated Costs

The most viable alternative to optimize costs and/or reduce the time of treatment is low temperature thermal desorption with a thermal oxidizer to treat off-gas; \$496,000.

This selected alternative is Alternative c.3. A detailed cost spreadsheet for this and seven other options, with assumptions, is included in the EE/CA report. A brief discussion concerning the EE/CA cost estimates is presented in Section V-A-3, Description of Alternative Technologies.

The operating period for cost purposes is assumed to be 2 months, which is a conservative estimate. The cost of stabilizing and disposing approximately 150 CY of soil contaminated with metals is included for this alternative. The costs for regulatory reporting include requirements of periodic reporting by the State of Iowa and the USEPA. Although permitting in its strict sense may not be necessary because this is a CERCLA site, the state may require some form of initial reporting to ensure that the State air, solid wastes, and water quality requirements are met.



## **VI. EXPECTED CHANGE IN THE SITUATION SHOULD ACTION BE DELAYED OR NOT TAKEN**

Any delay in implementing this removal action would allow the contaminated soil to continue as a source of groundwater contamination. Also, the contaminated soil would continue to present potential health risks through ingestion and inhalation exposure pathways.

## **VII. OUTSTANDING POLICY ISSUES**

There are no known outstanding policy issues related to this action.

## **VIII. ENFORCEMENT**

This response action is being conducted pursuant to the FFA and EO 12580 with the Army functioning as the lead agency. There are no enforcement considerations applicable to this removal action.

## **IX. RECOMMENDATION**

The recommended alternative is Low Temperature Thermal Desorption with On-Site Disposal at the Trench 6 Landfill. The major activities required to implement this alternative are:

- Excavation of an estimated 900 CY of VOC, SVOC and lead contaminated soils exceeding the Remediation Goals (RGs) (Table 2 and Table 7);
- Segregation of metals contaminated soil from VOC and SVOC contaminated soil in separate stockpiles;
- Perform verification sampling of the excavation to ensure the RGs are attained;
- Treatment of the contaminated soil utilizing Low Temperature Thermal Desorption (LTTD) to the treatment criteria (Table 7);
- Prior to release, treat the off-gas from the LTTD system using a secondary treatment unit consisting of a thermal oxidizer operating at approximately 1800 degrees Fahrenheit with a 2-second retention time, rapid quench evaporative cooling chamber, and acid gas scrubber;
- Stabilize metals contaminated soil that fails TCLP criteria;
- Sample stockpiles of treated soil to assure that treatment criteria has been achieved;
- Disposal of the treated soil at the IAAAP's Trench 6 Soil Repository (Trench 6) (Figure 1); and,
- Restore the site by backfilling with clean soil and seeding.

Any non-aqueous phase liquids and excessive water encountered during excavation will be removed and disposed off-site at a permitted facility.

LTTD is a low cost alternative and provides the greatest reliability, and effectiveness in meeting remedial objectives. The contaminated soil is treated to below LDRs, resulting in a long term and permanent solution. In addition this alternative facilitates the removal of any free floating product, if present.

This decision document represents the selected removal action for the Fire Training Pit at the Iowa Army Ammunition Plant site, near Middletown, Iowa, developed in accordance with CERCLA as amended, and not inconsistent with the NCP. This decision is based on the administrative record for the site.

**Table 1**

**Highest VOC and SVOC Concentrations Detected in Groundwater During the SI/RI<sup>(1)</sup> Investigation**

VOCs			
Compound	Highest Detected Concentration (ug/L)		Tap Water Criteria <sup>(2)</sup> (ug/L)
	Pit	JAW-69	
1,1,1-trichloroethane	28,000	5,000	1,300
1,1,2-trichloroethane	ND	52	Excluded
1,1-dichloroethane	910	4,100	810
1,1-dichloroethene	2,150	3,040	0.044
1,2-dichloroethane	2,100	400	0.12
1,2-dichloroethene	ND	21,000	55
acetone	250,000	140,000	3,700
benzene	508	520	0.36
chloroethane	ND	31	Excluded
chloroform	450	ND	0.15
methylene chloride	130,000	540	4.1
methylethl phenol	240,000	ND	1,900
methylisobutyl ketone	580,000	ND	2,900
tetrachloroethene	520	24	1.1
toluene	32,900	15,800	750
trichloroethene	3,440	393	1.6
SVOCs			
2-methylnaphthalene	ND	130	None
4-methylphenol	930	58	180
bis-(2ethylhexl)phthalate	25	14,000	4.8
dimethyl phthalate	48	ND	Excluded
di-n-butyl phthalate	ND	5.2	None
fluorene	ND	5.3	1,500
naphthalene	23	91	1,500
phenanthrene	ND	9	None
phenol	2,000	60	22,000

(1) Draft RI Report, JAYCOR, 1994

(2) Based on USEPA Region III Risk Based concentrations developed for Tap Water (Risk-Based concentration Tables, January-June 1995, March 7, 1995)

**Table 2**  
**Highest VOC and SVOC Concentrations Detected in Soil Borings During the SI/RI<sup>(1)</sup> and EE/CA Investigations**

VOCs						
Compound	SI/RI		EE/CA		Excavation Criteria and Remediation Goals <sup>(5)</sup>	
	Location	Maximum Concentration (mg/kg)	Location	Maximum Concentration (mg/kg)	Summers Model Criteria (mg/kg)	Industrial Criteria (2) (mg/kg)
1,1,1-trichloroethane	Pit	42.2	SB01	900	5,478	180,000
1,1-dichloroethane	JAW-69(15)	280	SB01	25	1,793	200,000
1,1-dichloroethene	--	--	--	--	0.12	9.5
<b>acetone</b>	<b>PIT</b>	<b>100</b>	--	ND	<b>72</b>	200,000
<b>benzene</b>	--	ND	<b>SB01</b>	<b>1.6</b>	<b>0.87</b>	200
ethylbenzene	JAW-69(9.5)	220	SB01	60	Excluded	Excluded
<b>methylene chloride</b>	<b>PIT</b>	<b>31.7</b>	<b>SB01</b>	<b>200</b>	<b>2.8</b>	760
methylisobutyl ketone	PIT	100	--	ND	2,543	160,000
<b>tetrachloroethene</b>	<b>PIT</b>	<b>15.6</b>	<b>SB01</b>	<b>16</b>	<b>14</b>	110
toluene	JAW-69(9.5)	3,900	SB01	2700	4,182	410,000
<b>trichloroethene</b>	<b>PIT</b>	<b>6.66</b>	<b>SB01</b>	<b>510</b>	<b>6.4</b>	520
trichlorofluoromethane	JAW-80	6.8	--	ND	4,759	610,000
xylene	JAW-69(9.5)	1,400	SB01	280	132,808	1,000,000

SVOCs						
Compound	SI/RI		EE/CA		Excavation Criteria and Remediation Goals <sup>(5)</sup>	
	Location	Maximum Concentration (mg/kg)	Location	Maximum Concentration (mg/kg)	Summers Model Criteria (mg/kg)	Industrial Criteria <sup>(2)</sup> (mg/kg)
2-methylnaphthalene	JAW-69(15)	6.0	SB03	1.4	9,961	
acenaphthene	JAW-69(9.5)	0.08	SB03	0.11	458,868	120,000
bis-2ethylhexlphthalate	JAW-80	12	SB02	3.6	17,858	410
dibenzofuran	JAW-69(15)	0.26	SB03	0.054	1,009	8,200
fluorene	JAW-69(15)	0.36	SB02	110	508,246	82,000
naphthalene	JAW-69(15)	1.4	SB01	1.2	61,551	82,000
phenanthrene	JAW-69(15)	0.48	SB01	0.39	7,023	30,000
methyl phenol	PIT	0.85	SB02	1.03	521 (4)	10,000 (4)
<b>pentachlorophenol</b>	--	ND	<b>SB01</b>	<b>5.9</b>	<b>2.8</b>	<b>48</b>

(1) Draft RI Report, JAYCOR, 1994

(2) Based on USEPA Region III Risk Based concentrations developed for Tap Water (Risk-Based concentration Tables, January-June 1995, March 7, 1995)

(3) 3&4-methylphenol and 2-methylphenol respectively

(4) 4 Methylphenol

(5) Excavation Criteria and Site Remediation Goals are the lowest value from the Summers Model Criteria and Industrial Criteria

**Table 3**

**IAAAP Fire Training Pit  
Excavation Area <sup>1)</sup>  
Average VOC Concentrations and Total Mass Estimate**

Compound	Units	Average Concentrations at Depth Interval below Ground Surface (ft)				
		Total ( 0 to 10)	0 to 3	3 to 6	6 to 8	8 to 10
1,1,1-Trichloroethane	ug/kg	657,475	1,670,376	285,061	365,100	89,900
1,1,2-Trichloroethane	ug/kg	34	0	1	168	0
1,1-Dichloroethane	ug/kg	977	2,952	299	248	0
1,1-Dichloroethene	ug/kg	4,325	8,843	2,058	5,030	0
1,2,4-Trimethylbenzene	ug/kg	13,790	11,325	13,718	10,677	33,500
1,2-Dichlorobenzene	ug/kg	37	0	87	0	0
1,2-Dichloroethane	ug/kg	1	0	2	0	0
1,3,5-Trimethylbenzene	ug/kg	4,351	3,815	4,275	2,993	11,100
2-Methylnaphthalene	ug/kg	2,443	0	1,970	2,430	5,370
2-Methylphenol	ug/kg	253	0	470	214	329
3 & 4-Methylphenol	ug/kg	959	0	1,580	924	1,330
4-Isopropyltoluene	ug/kg	1,314	1,158	1,352	878	2,990
Anthracene	ug/kg	28	0	0	110	0
Benzene	ug/kg	41	0	1	0	600
bis(2-Ethylhexyl)phthalate	ug/kg	589	0	819	556	979
Chloroform	ug/kg	37	138	1	0	0
cis-1,2-Dichloroethene	ug/kg	3,937	555	6,702	3,307	0
Ethylbenzene	ug/kg	11,766	20,325	8,258	7,997	13,400
Isopropylbenzene	ug/kg	921	1,305	699	592	1,930
Methylene Chloride	ug/kg	4,254	3,025	851	6,487	26,300
N-Nitrosodiphenylamine (1)	ug/kg	145	0	210	0	368
n-Propylbenzene	ug/kg	1,722	1,493	1,636	1,317	4,460
Naphthalene	ug/kg	947	664	934	570	2,460
Phenanthrene	ug/kg	281	0	117	317	690
sec-Butylbenzene	ug/kg	966	673	1,034	691	2,480
Styrene	ug/kg	1,087	0	659	3,900	0
tert-Butylbenzene	ug/kg	23	0	50	0	0
Tetrachloroethene	ug/kg	2,110	1,483	2,081	1,133	7,750
Toluene	ug/kg	148,444	151,150	113,384	159,038	262,090
Trichloroethene	ug/kg	114,005	168,659	70,234	155,833	76,300
Xylene (total)	ug/kg	67,416	118,775	46,509	42,890	81,900
<b>Total Average Concentration (ug/kg)</b>		<b>1,044,676</b>	<b>2,166,713</b>	<b>565,051</b>	<b>773,399</b>	<b>626,226</b>
<b>Contaminant Mass (kg)</b>		<b>1,282</b>	<b>798</b>	<b>208</b>	<b>190</b>	<b>154</b>
<b>Contaminant Mass (lbs)</b>		<b>2,821</b>	<b>1,755</b>	<b>458</b>	<b>418</b>	<b>338</b>
<b>Percent Total</b>		<b>100%</b>	<b>59%</b>	<b>15%</b>	<b>14%</b>	<b>11%</b>

1) The excavation area contains approximately 900 CY of soil and has a surface area of approximately 2,340 square feet

**Table 4**

**Highest VOC and SVOC Concentrations Detected in Soil Borings During the ECC Investigation**

VOCs				
Compound	ECC		Summers Model Criteria (mg/kg)	Industrial Criteria (2) (mg/kg)
	Location (depth)	Maximum Concentration (mg/kg)		
<b>1,1,1-trichloroethane</b>	<b>03/01(1)</b>	<b>6,060</b>	<b>5,478</b>	180,000
1,1-dichloroethane	03/01(0)	11.2	1,793	200,000
<b>1,1-dichloroethene</b>	<b>03/01(1)</b>	<b>33.6</b>	<b>0.12</b>	<b>9.5</b>
<b>acetone</b>	<b>03/01(7)</b>	<b>195</b>	<b>72</b>	200,000
benzene	05/03(9)	0.6	0.87	200
ethylbenzene	03/01(1)	63.8	Excluded	Excluded
<b>methylene chloride</b>	<b>05/03(9)</b>	<b>26.3</b>	<b>2.8</b>	760
methylisobutyl ketone	03/01(4)	14.5	2,543	160,000
<b>tetrachloroethene</b>	<b>02/02(9)</b>	<b>41.1</b>	<b>14</b>	110
toluene	05/03(7)	523	4,182	410,000
<b>trichloroethene</b>	<b>05/01(1)</b>	<b>414</b>	<b>6.4</b>	520
trichlorofluoromethane	--	ND	4,759	610,000
xylenes	03/01(1)	378	132,808	1,000,000

SVOCs				
Compound	ECC		Summers Model Criteria (mg/kg)	Industrial Criteria (mg/kg)
	Location	Maximum Concentration (mg/kg)		
2-methylnaphthalene	06/02(9)	9.56	9,961	
acenaphthene	--	ND	458,868	120,000
bis-2ethylhexylphthalate	02/02(9)	2.09	17,858	410
dibenzofuran	06/02(9)	0.36	1,009	8,200
fluorene	06/02(9)	0.44	508,246	82,000
naphthalene	06/02(9)	3.6	61,551	82,000
phenanthrene	02/02(9)	1.2	7,023	30,000
methyl phenol	06/02(9)	1.8, 0.64 (3)	521 (4)	10,000 (4)
pentachlorophenol	03/03(0)	0.54	2.8	48

(1) Draft RI Report, JAYCOR, 1994

(2) Based on USEPA Region III Risk Based concentrations developed for Tap Water (Risk-Based concentration Tables, January-June 1995, March 7, 1995)

(3) 3&4-methylphenol and 2-methylphenol respectively

(4) 4 Methylphenol



**TABLE 5**

**IAAAP Fire Training Pit  
Summary of Samples Exceeding Summers Model Criteria  
(ECC Investigation)**

Sample ID	X - Coordinate	Y - Coordinate	Depth	Compound	Result (ug/kg)	CAS No.	Summers Model Criteria (ug/kg)
F01S0301	-15	-35	1	1,1,1-Trichloroethane	6,060,000	71-55-6	5,478,000
F01S0301	-15	-35	1	1,1-Dichloroethene	33,600	75-35-4	120
F07S0301	-15	-35	7	1,1-Dichloroethene	13,400	75-35-4	120
F04S0301	-15	-35	4	1,1-Dichloroethene	11,600	75-35-4	120
F01S0501	15	-35	1	1,1-Dichloroethene	1,740	75-35-4	120
F07S0501	15	-35	7	1,1-Dichloroethene	1,690	75-35-4	120
F5.5SFTP03	0	-48.3	5.5	1,1-Dichloroethene	1,020	75-35-4	120
F04S0501	15	-35	4	1,1-Dichloroethene	879	75-35-4	120
F5.5SFTP05	-9.6	-12.6	5.5	1,1-Dichloroethene	830	75-35-4	120
F04S0301	-15	-35	4	Acetone	195,000	67-64-1	72,000
F07S0301	-15	-35	7	Acetone	195,000	67-64-1	72,000
F04S0501	15	-35	4	Acetone	112,000	67-64-1	72,000
F01S0301	-15	-35	1	Chloroform	550	67-66-3	360
F09S0503	15	0	9	Methylene Chloride	26,300	75-09-2	2,800
F01S0301	-15	-35	1	Methylene Chloride	12,100	75-09-2	2,800
F07S0503	15	0	7	Methylene Chloride	9,500	75-09-2	2,800
F07S0301	-15	-35	7	Methylene Chloride	7,900	75-09-2	2,800
F04S0301	-15	-35	4	Methylene Chloride	3,650	75-09-2	2,800
F09S0202	-30	-20	9	Tetrachloroethene	41,100	127-18-4	14,000
F01S0501	15	-35	1	Trichloroethene	414,000	79-01-6	6,400
F07S0301	-15	-35	7	Trichloroethene	266,000	79-01-6	6,400
F01S0301	-15	-35	1	Trichloroethene	259,000	79-01-6	6,400
F04S0301	-15	-35	4	Trichloroethene	200,000	79-01-6	6,400
F07S0503	15	0	7	Trichloroethene	186,000	79-01-6	6,400
F04S0501	15	-35	4	Trichloroethene	149,000	79-01-6	6,400
F04S0503	15	0	4	Trichloroethene	128,000	79-01-6	6,400
F09S0503	15	0	9	Trichloroethene	76,300	79-01-6	6,400
F07S0501	15	-35	7	Trichloroethene	15,500	79-01-6	6,400

**TABLE 6**  
**IAAAP Fire Training Pit**  
**Summary of Samples Exceeding Land Disposal Restrictions**  
**(ECC Investigation)**  
**(40 CFR 268.40)**

Sample ID	X Coord	Y Coord	Depth	Compound	CAS No	Result (ug/kg)	LDR Criteria (ug/kg) 40 CFR 268.40
F01S0301	-15	-35	0	1,1,1-Trichloroethane	71-55-6	6,060,000	6,000
F04S0301	-15	-35	4	1,1,1-Trichloroethane	71-55-6	1,620,000	6,000
F07S0301	-15	-35	7	1,1,1-Trichloroethane	71-55-6	903,000	6,000
F01S0501	15	-35	0	1,1,1-Trichloroethane	71-55-6	617,000	6,000
F04S0501	15	-35	4	1,1,1-Trichloroethane	71-55-6	204,000	6,000
F07S0503	15	0	7	1,1,1-Trichloroethane	71-55-6	115,000	6,000
F09S0503	15	0	9	1,1,1-Trichloroethane	71-55-6	89,900	6,000
F07S0501	15	-35	7	1,1,1-Trichloroethane	71-55-6	77,300	6,000
F5.5SFTP05	-9.6	-12.6	5.5	1,1,1-Trichloroethane	71-55-6	70,900	6,000
F5.5SFTP03	0	-48.3	5.5	1,1,1-Trichloroethane	71-55-6	48,500	6,000
F04S0503	15	0	4	1,1,1-Trichloroethane	71-55-6	46,700	6,000
F09S0202	-30	-20	9	1,1,1-Trichloroethane	71-55-6	15,100	6,000
F07S0602	30	-20	7	1,1,1-Trichloroethane	71-55-6	10,200	6,000
F09S0602	30	-20	9	1,1,1-Trichloroethane	71-55-6	8,040	6,000
F07S0301	-15	-35	7	Acetone	67-64-1	195,000	160,000
F04S0301	-15	-35	4	Acetone	67-64-1	195,000	160,000
F01S0301	-15	-35	0	Ethylbenzene	100-41-4	63,800	10,000
F01S0501	15	-35	0	Ethylbenzene	100-41-4	17,500	10,000
F04S0301	-15	-35	4	Ethylbenzene	100-41-4	16,800	10,000
F07S0503	15	0	7	Ethylbenzene	100-41-4	14,300	10,000
F09S0503	15	0	9	Ethylbenzene	100-41-4	13,400	10,000
F04S0503	15	0	4	Ethylbenzene	100-41-4	12,600	10,000
F04S0501	15	-35	4	Ethylbenzene	100-41-4	12,200	10,000
F5.5SFTP05	-9.6	-12.6	5.5	Ethylbenzene	100-41-4	10,800	10,000
F09S0202	-30	-20	9	Tetrachloroethene	127-18-4	41,100	6,000
F5.5SFTP05	-9.6	-12.6	5.5	Tetrachloroethene	127-18-4	8,800	6,000
F09S0503	15	0	9	Tetrachloroethene	127-18-4	7,750	6,000
F07S0503	15	0	7	Toluene	108-88-3	523,000	10,000
F09S0503	15	0	9	Toluene	108-88-3	517,000	10,000
F01S0301	-15	-35	0	Toluene	108-88-3	506,000	10,000
F04S0503	15	0	4	Toluene	108-88-3	328,000	10,000
F5.5SFTP05	-9.6	-12.6	5.5	Toluene	108-88-3	203,000	10,000
F04S0301	-15	-35	4	Toluene	108-88-3	181,000	10,000
F04S0501	15	-35	4	Toluene	108-88-3	130,000	10,000
F09S0602	30	-20	9	Toluene	108-88-3	106,000	10,000
F01S0501	15	-35	0	Toluene	108-88-3	98,600	10,000
F07S0301	-15	-35	7	Toluene	108-88-3	70,000	10,000
F07S04X2	0	-60	7	Toluene	108-88-3	36,400	10,000
F07S0501	15	-35	7	Toluene	108-88-3	33,400	10,000
F5.5SFTP03	0	-48.3	5.5	Toluene	108-88-3	31,600	10,000
F09S0202	-30	-20	9	Toluene	108-88-3	22,400	10,000
F5.5SFTP01	15.3	10.4	5.5	Toluene	108-88-3	20,100	10,000
F07S0602	30	-20	7	Toluene	108-88-3	18,300	10,000
F01S0501	15	-35	0	Trichloroethene	79-01-6	414,000	6,000
F07S0301	-15	-35	7	Trichloroethene	79-01-6	266,000	6,000
F01S0301	-15	-35	0	Trichloroethene	79-01-6	259,000	6,000
F04S0301	-15	-35	4	Trichloroethene	79-01-6	200,000	6,000
F07S0503	15	0	7	Trichloroethene	79-01-6	186,000	6,000
F04S0501	15	-35	4	Trichloroethene	79-01-6	149,000	6,000
F04S0503	15	0	4	Trichloroethene	79-01-6	128,000	6,000
F09S0503	15	0	9	Trichloroethene	79-01-6	76,300	6,000
F07S0501	15	-35	7	Trichloroethene	79-01-6	15,500	6,000
F5.5SFTP05	-9.6	-12.6	5.5	Trichloroethene	79-01-6	6,220	6,000
F01S0301	-15	-35	0	Xylene (total)	1330-20-7	378,000	30,000
F01S0501	15	-35	0	Xylene (total)	1330-20-7	97,100	30,000
F04S0301	-15	-35	4	Xylene (total)	1330-20-7	92,500	30,000
F09S0503	15	0	9	Xylene (total)	1330-20-7	81,900	30,000
F5.5SFTP05	-9.6	-12.6	5.5	Xylene (total)	1330-20-7	72,900	30,000
F07S0503	15	0	7	Xylene (total)	1330-20-7	72,000	30,000
F04S0501	15	-35	4	Xylene (total)	1330-20-7	58,900	30,000
F04S0503	15	0	4	Xylene (total)	1330-20-7	57,000	30,000
F07S0301	-15	-35	7	Xylene (total)	1330-20-7	48,800	30,000
F07S0602	30	-20	7	Xylene (total)	1330-20-7	33,500	30,000

**TABLE 7**

**FTP Excavation and Disposal Criteria**

Contaminant	Excavation Criteria	Disposal Criteria
	RGs (mg/kg)	Treatment Standards 40 CFR 268.40 (mg/kg)
Acetone	72	160
Benzene	0.87	10
Chloroform	0.36	NA
1,1-Dichloroethene	0.12	NA
Ethylbenzene	NA	10
Methylene Chloride	2.8	30
Tetrachloroethene	14	6
Toluene	4,182	10
1,1,1-Trichloroethane	5,478	6
Trichloroethene	6.4	6
Xylene (total)	132,808	30
Lead	1000	5 mg/L TCLP

**Table 8****Sanders Aviation  
Stack Gas Emission Results**

Parameter	Test Run Date		
	9/22/95	9/22/95	9/23/95
Total PCDD/PCDF (ng/dscm)	4.37	3.31	1.98
2,3,7,8-TCDD TEQ (lb/hr)	1.32E-09	9.52E-10	6.24E-10
Alr Flow (dscf/min)	2800	2830	2570
Alr Flow (dscm/min)	79.3	80.1	72.8
Alr Flow (dscm/hr)	4757	4807	4366
Total PCDD/PCDF (ng/hr)	20786	15913	8644
Total PCDD/PCDF (lb/hr)	4.6E-08	3.5E-08	1.9E-08
Ratio (2,3,7,8-TCDD TEQ/Total PCDD/PCDF)	0.0288	0.0271	0.0327
<b>2,3,7,8-TCDD TEQ (ng/dscm)</b>	<b>0.126</b>	<b>0.090</b>	<b>0.065</b>

**Table 9**

**Applicable or Relevant and Appropriate Requirements**

Standard, Requirement, or Criteria	Citation	Description	Applicable/ Relevant & Appropriate	Reasons
<b>Federal - Chemical Specific</b>				
<b>Safe Drinking Water Act - 40 USC 300</b>				
National Primary Drinking Water Standards	40 CFR Part 141	Establishes health-based standards for public water systems and specifies maximum contaminant levels (MCLs).	Yes/NA	Previous analytical data indicated groundwater contamination if the site groundwater is a potential future source of drinking water, the clean-up standards may be based on MCLs.
Maximum Contamination Level Goals (MCLG)	40 CFR Part 141	Establishes drinking water quality goals set at levels of no known or anticipated adverse health effects, with an adequate margin of safety. Nonzero MCLGs are ARARs; where MCLGs are zeros, the MCL becomes the ARAR.	Yes/NA	Groundwater appears to be contaminated. The groundwater clean-up standards may be used on non-zero MCLGs, if groundwater is categorized as potential future source.
<b>Clean Water Act - 33 USC 1251-1376</b>				
Water Quality Criteria	40 CFR Part 131	Establishes criteria for water quality based on toxicity to human health.	Yes/NA	The groundwater cleanup standards could be based on water quality criteria if other standards for groundwater cleanup are not available.
Ambient Water Quality Criteria	40 CFR Part 131	Establishes criteria for water quality based on toxicity to aquatic organisms.	Yes/NA	The groundwater cleanup standards could be based on ambient water quality criteria if other standards such as drinking water or water quality criteria are not available.
<b>Federal - Action Specific to be considered "TBC"</b>				
National Secondary Drinking Water Standards	40 CFR Part 143	Establishes secondary maximum contaminant levels (SMCLs) which are nonenforceable guidelines for public drinking water systems to protect aesthetic quality of water.	"TBC"	SMCL may be "to be considered" if groundwater is a potential future source of drinking water.
Proposed Soil Cleanup Criteria	EPA/540/R .94/101 & Summer's Model	Establishes site-specific risk-based clean-up criteria which are protective of human health and the environment.	"TBC"	In the absence of specific guidance, this criteria should be used.
<b>Solid Waste Disposal Act - 42 USC 6901-6987</b>				
Criteria for the Identification and Listing of Hazardous Waste	40 CFR Part 261	Establishes solid wastes which are subject to regulation as hazardous waste under 40 CFR Parts 124, 262-265, 268, and 270	Yes/NA	If wastes generated during excavation fail TCLP Tests. They may be subject to 40 CFR Part 268 before disposal.

Standard, Requirement, or Criteria	Citation	Description	Applicable/ Relevant & Appropriate	Reasons
Land Disposal Restrictions	40 CFR Part 268	Establishes criteria and standards for Hazardous Wastes which are subject to land disposal restriction.	Yes/NA	Wastes contaminated with RCRA constituents should be treated to technology based pretreatment standards before disposal.
Requirements for Releases from Solid Waste Management Units	40 CFR Part 264, Subpart F	Establishes practical quantitation limits for hazardous constituents in the groundwater.	Yes/NA	Applicable if organic and inorganic contamination of groundwater is to be monitored.
<b>Clean Air Act - 42 USC 7401</b>				
National Ambient Air Quality Standards	40 CFR Part 50	Establishes primary and secondary standards for six pollutants: PM <sub>10</sub> , SO <sub>2</sub> , CO, ozone, NO <sub>2</sub> and lead.	Yes/NA	Monitoring of PM <sub>10</sub> and lead may be required during excavation. PM <sub>10</sub> and lead in ambient air may be compared to National Ambient Air Quality Criteria.
National Emissions Standards for Hazardous Air Pollutants	40 CFR Part 61	Establishes regulatory standards for specific air pollutants: arsenic, asbestos, benzene, beryllium, mercury, radionuclides, and vinyl chloride.	No/Yes	Benzene has been detected as a contaminant at the site. therefore, NESHAP pollutant standard may be applicable.
<b>State - Chemical Specific</b>				
<b>Iowa Air Quality 567 Chapters 23, 24</b>				
Iowa Air Quality. Excess Emission	IAQ 567-24	Establishes criteria for excess emission reporting during startup, shutdown or cleaning of stacks.	Yes/NA	Applicable because there is the potential for release of emissions during the SVE operations.
Iowa Air Quality. Emission Standards	IAQ 567-23	Establishes criteria for emission standards for new stationary source (NSPS).	Yes/NA	Applicable because it is similar to 40 CFR Part 60.
<b>Federal - Action Specific</b>				
<b>Clean Water Act - 33 USC 1251-1376</b>				
National Pollutant Discharge Elimination System Requirements	40 CFR Part 122	Establishes requirements for permits to authorize the point source discharge of pollutants into storm water sewer systems.	Yes/NA	Excavated soils during remediation may cause migration of contaminants into storm sewers due to run-on and run-off. Best Management Practice approach as described in 40 CFR 122 will minimize/eliminate the potential contamination of storm sewers.
National Pretreatment Standards	40 CFR Part 403	Establishes standards for controlling pollutants which interfere with treatment processes in publicly owned treatment works (POTW) or which may contaminate sewage.	Yes/NA	Remediation plan should consider on-site pretreatment of water generated during remediation prior to discharge into POTW.

Standard, Requirement, or Criteria	Citation	Description	Applicable/ Relevant & Appropriate	Reasons
<b>Solid Waste Disposal Act - 42 USC 6901-6987</b>				
Regulations for Federally Administered Hazardous Waste Permit Programs	40 CFR Part 270	Establishes provisions for the regulation of Hazardous Waste Permit Programs under Subtitle C of the Solid Waste Disposal Act amended under RCRA 1986.	Yes/NA	These provisions may be applicable since IAAP is a Federally administered facility.
Criteria for Municipal Solid Waste Landfills	40 CFR Part 258	Establishes minimum federal criteria under subtitle D for all municipal solid waste landfills.	Yes/NA	Applicable since on-site (Trench 6) disposal is a part of remediation strategy.
Standards Applicable to Generators of Hazardous Waste	40 CFR Part 262	Establishes requirements for generators of hazardous wastes.	Yes/NA	Applicable if excavated soils fail TCLP test because remediation strategy.
Standards Applicable to Transporters of Hazardous Wastes	40 CFR Part 263	Establishes requirements for transporters of hazardous wastes.	Yes/NA	Applicable if soils fail TCLP test and considered hazardous waste.
Standards of Preparedness and Prevention	40 CFR Part 264 Subpart C	Establishes requirements for preparedness and prevention at hazardous waste treatment, storage, or disposal facilities.	No/Yes	Preparedness and prevention of measures may be developed if needed, to implement other 40 CFR Part 264 requirements.
Standards for Landfills	40 CFR Part 264 Subpart N	Establishes design and operational requirements for hazardous waste landfills.	Yes/NA	Applicable because remediation strategy includes off-site hazardous waste landfills if soils fail TCLP test.
Standards for Miscellaneous Units	40 CFR Part 264 Subpart X	Establishes environmental performance standards for miscellaneous units. e.g., LTTD.	Yes/NA	Applicable because the LTTD alternative uses portable on-site systems and includes possible on-site disposal.
<b>Clean Air Act - 42 USC 7401</b>				
Air Emission Standards for Process Vents and Equipment Leaks	40 CFR Part 264, Subpart AA, BB	Establishes air emission standards for process vents and equipment leaks in desorption operations e.g., LTTD	Yes/NA	Applicable because this applies to on-site treatments such as exsitu soil vapor extraction.
<b>Occupational Safety and Health Act - 29 USC 651-678</b>				
Worker Safety Standards	29 CFR Part 1910	Establishes standards for worker safety at hazardous waste facilities.	Yes/NA	Worker safety requirements will be in accordance with the requirements of this part.
<b>Hazardous Materials Transportation Act - 49 USC 1801-1813</b>				
Hazardous Materials Transportation Requirements	49 CFR parts 107 and 171-177	Establishes requirements for transportation of hazardous materials.	Yes/NA	Transportation of hazardous materials off-site will be in accordance with the requirements of these parts if the soil fails TCLP.

Standard, Requirement, or Criteria	Citation	Description	Applicable/ Relevant & Appropriate	Reasons
<b>State - Action Specific</b>				
Iowa Solid Waste Disposal Regulation	ISWDR 567-100	Defines the applicability of rules, design criteria, monitoring requirements, etc. and Title VIII-Solid Waste Management and Disposal.	Yes/NA	These criteria may be applicable to this site. Design criteria described under this act are comparable to criteria for classification of solid waste disposal facilities (described under 40 CFR Part 257).
Iowa Solid Waste Management and Disposal (General Requirement)	ISWDR 567-101	Provides general requirements relative to solid waste management and disposal (e.g., compliance, variances general conditions of solid waste disposal. Describes detailed content of comprehensive plan "Guidelines for Solid Waste Comprehensive Plants, Part I: Solid Waste Management Alternatives, 1990).	Yes/NA	These requirements may be applicable if off-site disposal of solid wastes is required.
Iowa Solid Waste Management and Disposal (Construction Permit Requirements)	ISWDR 567-102, 103	Rule 567-102 presents information on four types of permit requirements under Title VIII: Solid Waste Management and Disposal.	Yes/NA	The construction permit requirements may be applicable for selected on/off-site and remediation disposal.



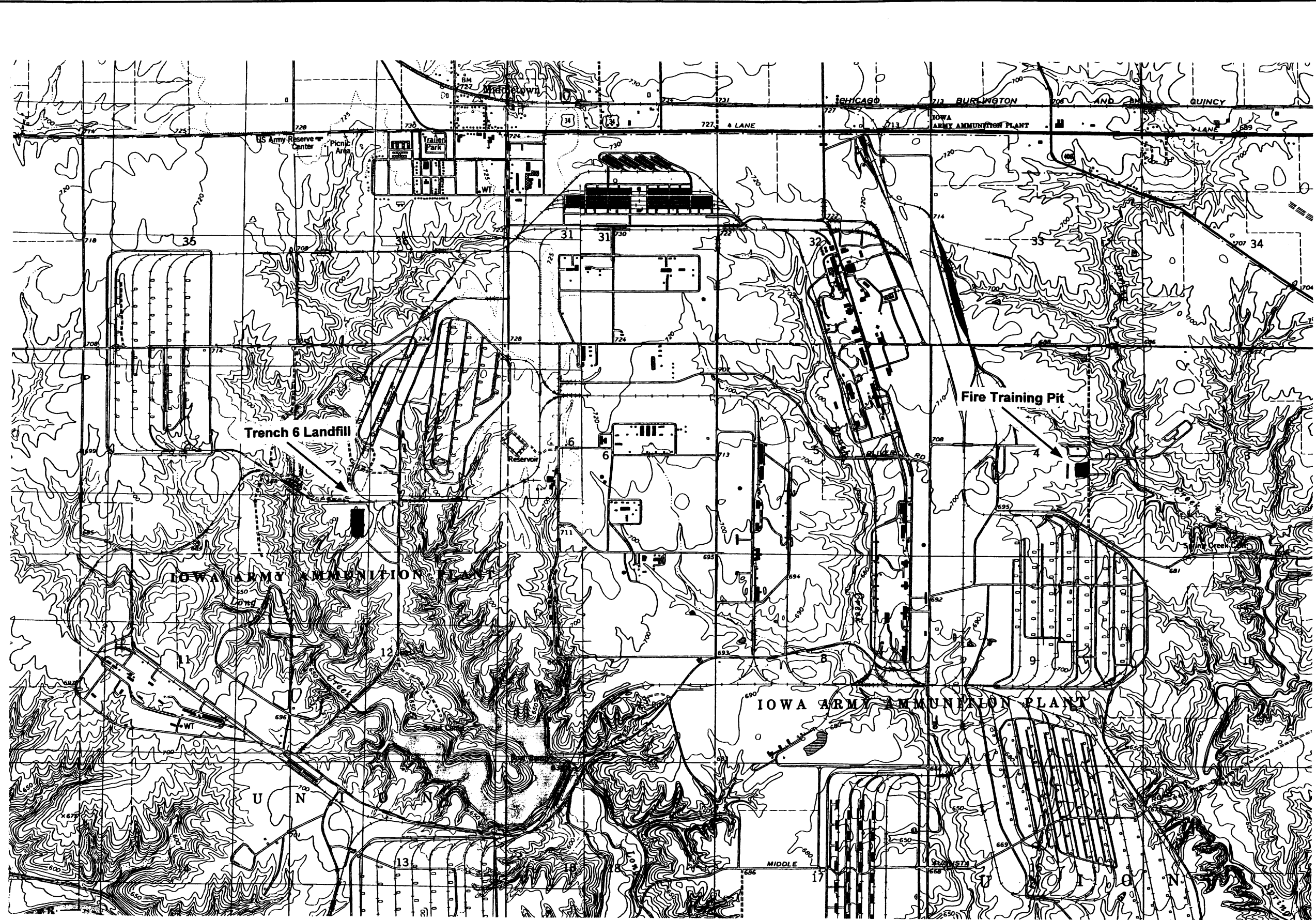
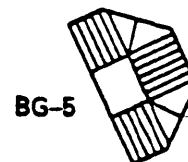
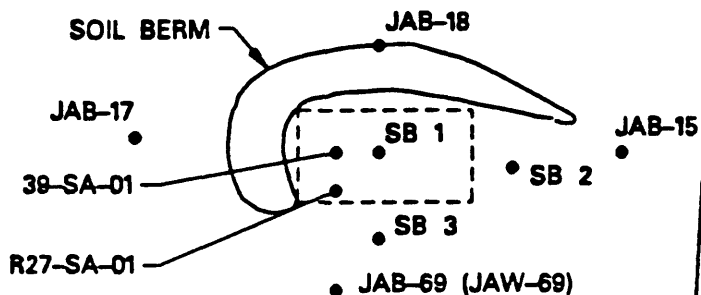






Figure 1  
Date: 12/30/1997 | j:\5400\figure\figure1.vsd

**Iowa Army Ammunition Plant  
Site Location Map**





LEGEND:

-  ROAD
-  BUILDING #
-  SOIL SAMPLE LOCATION
-  APPROXIMATE FIRE TRAINING PIT BOUNDARY

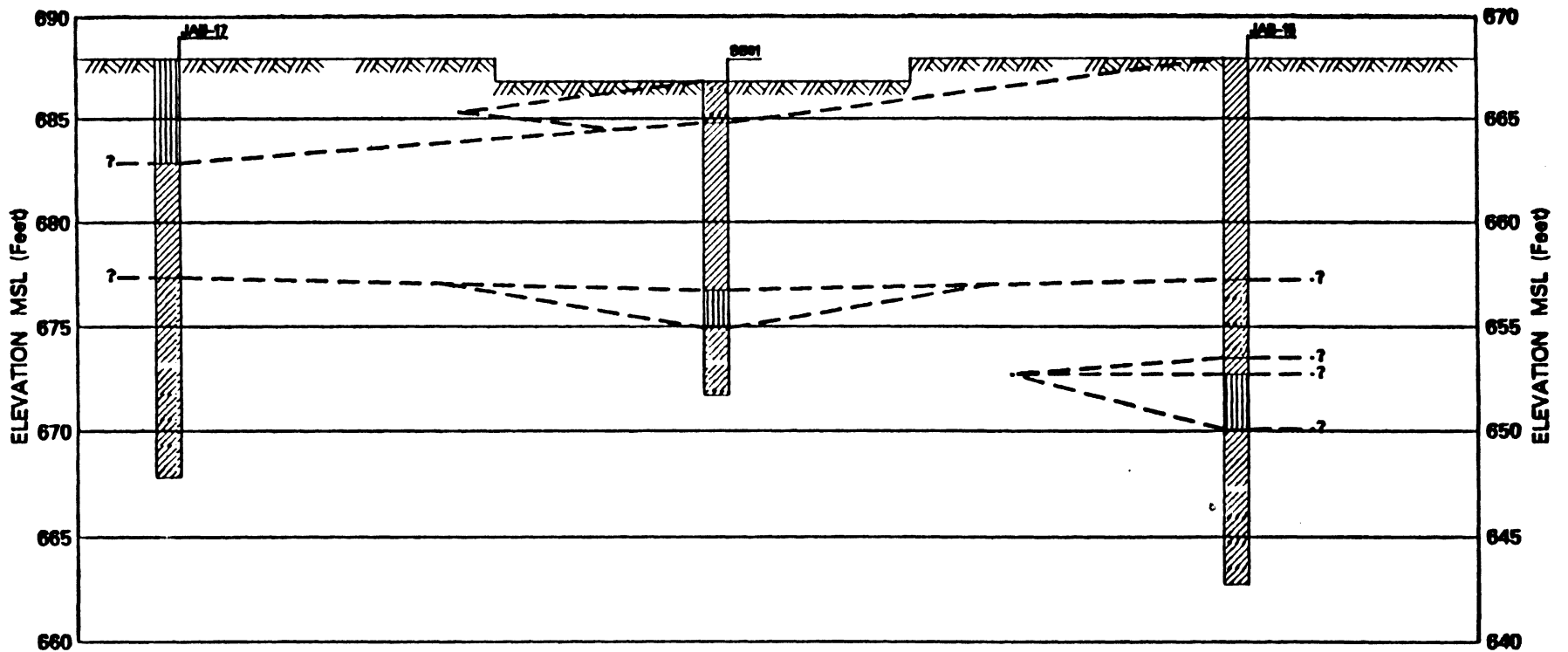


SOURCE:







Base Map Provided by U. S.  
Army Corps of Engineers, Omaha, NE

Figure 2  
**SITE MAP WITH MONITORING WELLS  
AND BORING LOCATIONS**  
IOWA ARMY AMMUNITION PLANT (IAAP)  
FIRE TRAINING PIT  
Middletown, Iowa

000096/08/AFIC1.dgn



LEGEND:

-  SILTY SAND
-  CLAYEY SILTY
-  SANDY SILTY CLAY
-  SILTY CLAY
-  SANDY SILT
-  LITHOLOGIC CONTACT (INFERRED)

NOTE:

SURFACE ELEVATION APPROXIMATED FROM TOPOGRAPHIC MAP  
CONTAINED IN IAAP REVISED DRAFT RI, JAYCOR, NOVEMBER 1995.

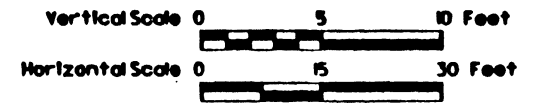
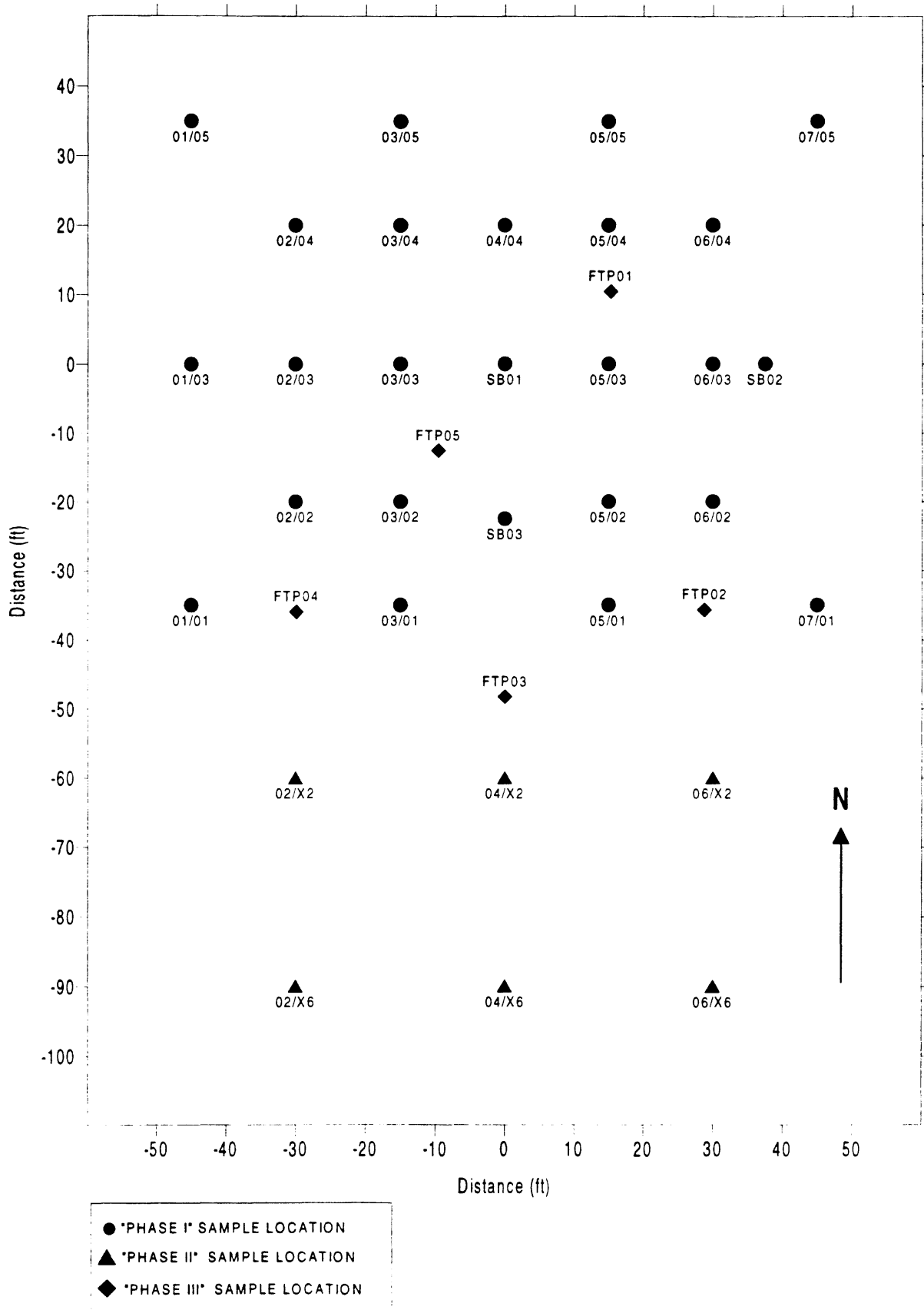
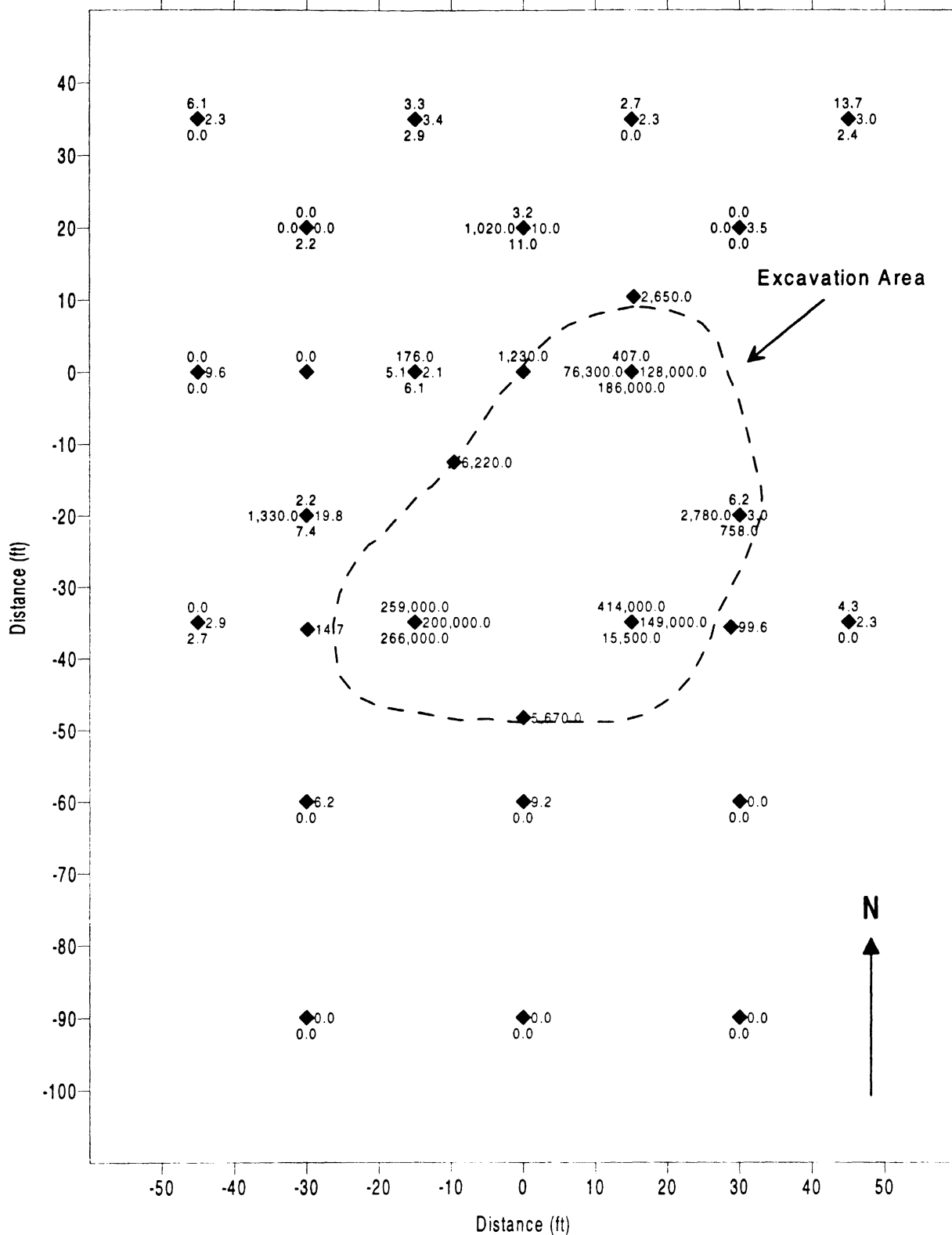


Figure 3  
**GENERALIZED GEOLOGIC CROSS-SECTION OF FTP**  
 IOWA ARMY AMMUNITION PLANT (IAAP)  
 FIRE TRAINING PIT  
 Middletown, Iowa

**FIGURE 4**  
**IAAAP FIRE TRAINING PIT**  
**ECC SAMPLE LOCATIONS**

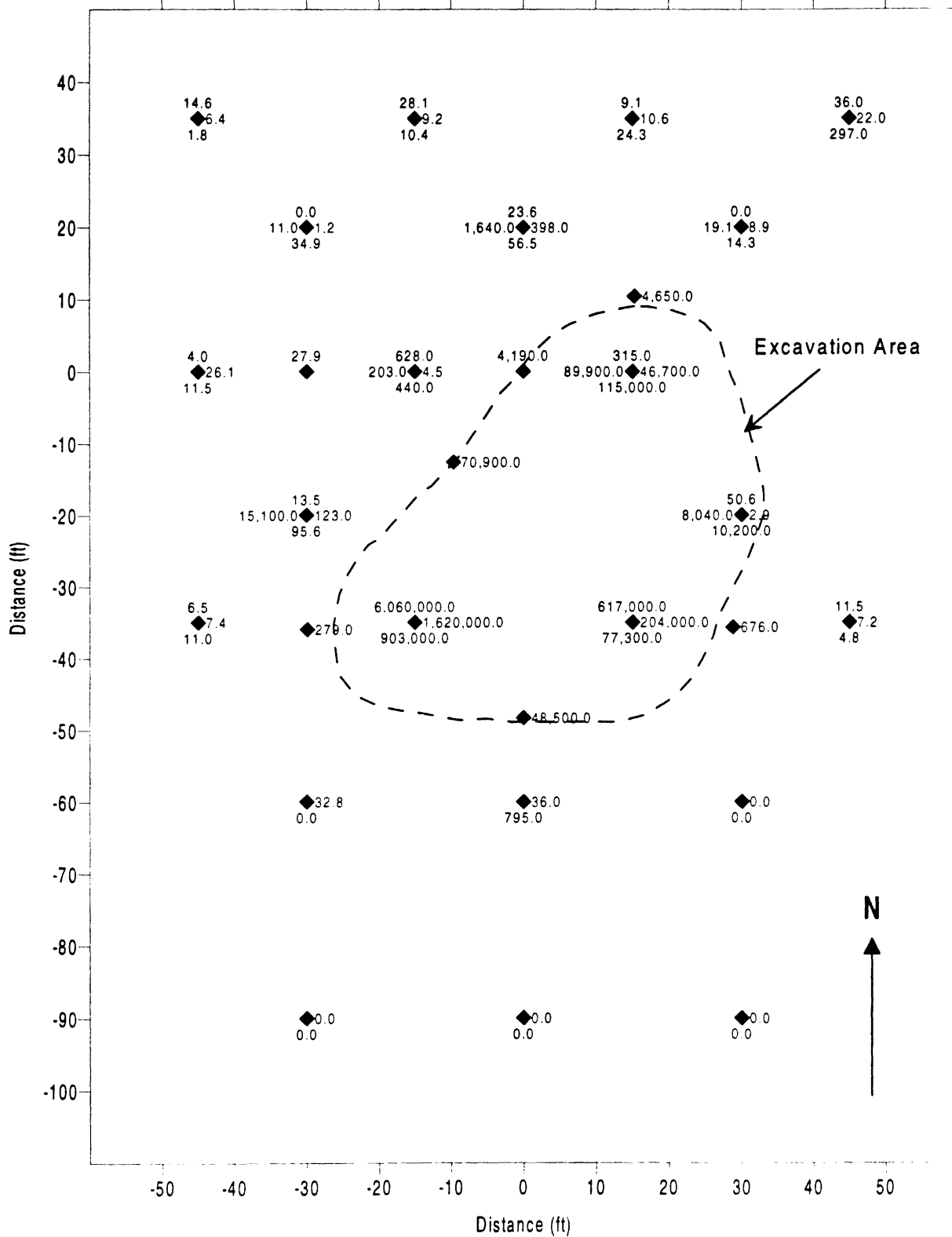


**FIGURE 5**  
**IAAAP FIRE TRAINING PIT**  
**TRICHLOROETHENE CONCENTRATIONS**  
**(ECC INVESTIGATION)**  
**(ug/kg)**



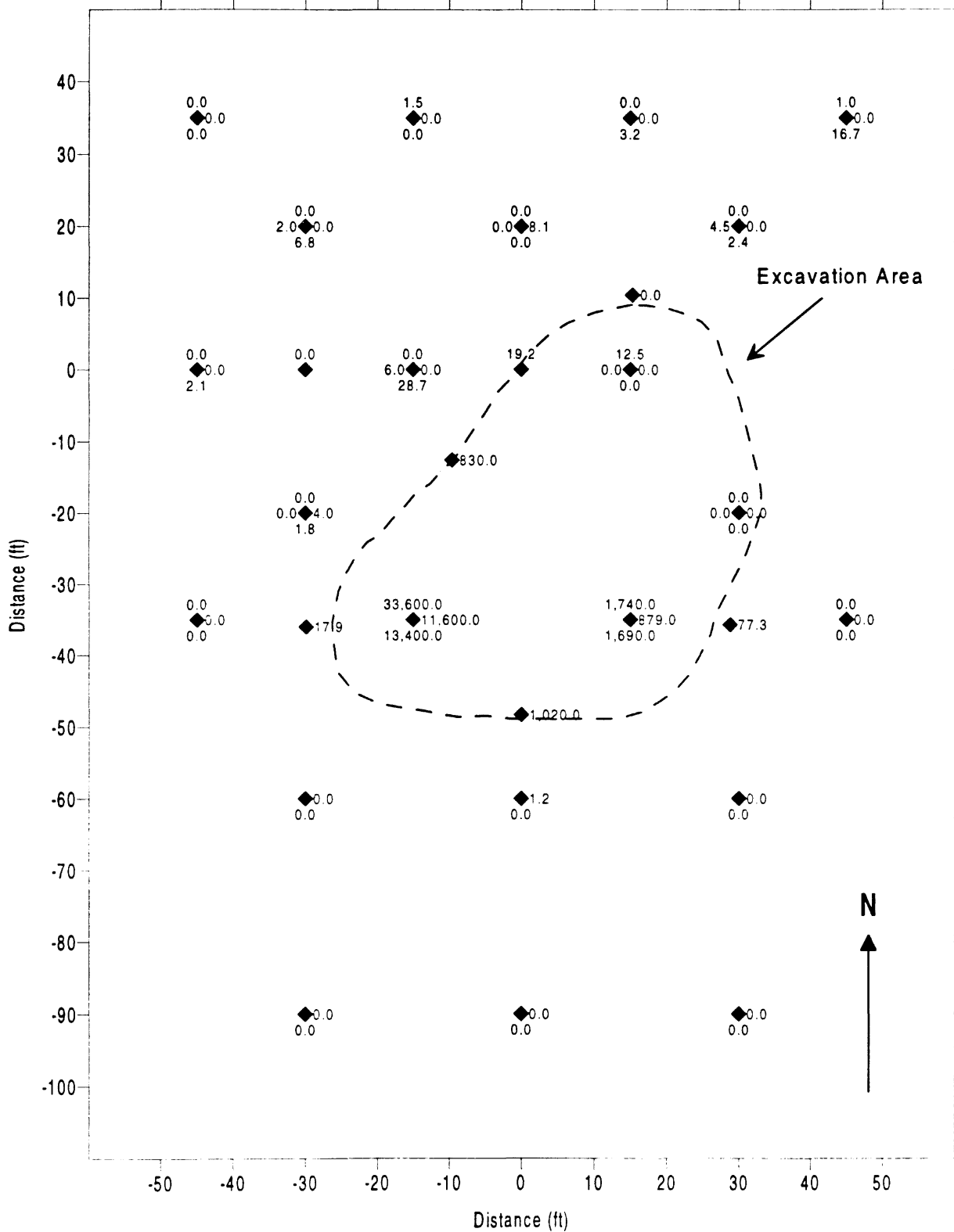
TCE: depth = 0 to 1 ft  
 TCE: depth = 9 feet ◆ TCE: depth = 4 to 5.5 ft  
 TCE: depth = 7 feet

**FIGURE 6**  
**IAAAP FIRE TRAINING PIT**  
**1,1,1-TRICHLOROETHANE CONCENTRATIONS**  
**(ECC INVESTIGATION)**  
**(ug/kg)**



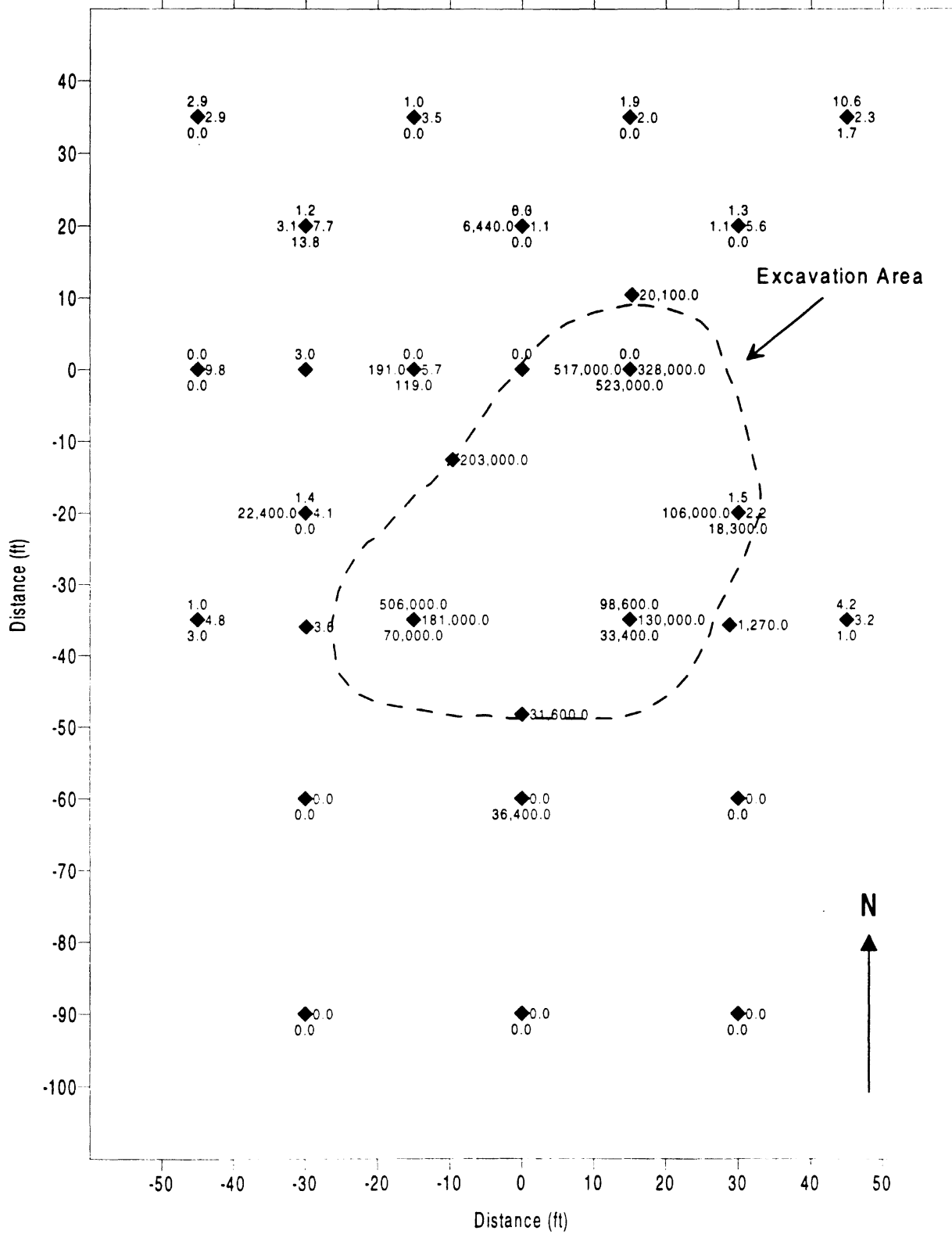
TCA: depth = 0 to 1 ft  
 TCA: depth = 9 feet ◆ TCA: depth = 4 to 5.5 ft  
 TCA: depth = 7 feet

**FIGURE 7**  
**IAAAP FIRE TRAINING PIT**  
**1,1-DICHLOROETHENE CONCENTRATIONS**  
**(ECC INVESTIGATION)**  
**(ug/kg)**



DCE: depth = 0 to 1 ft  
 DCE: depth = 9 feet ◆ DCE: depth = 4 to 5.5 ft  
 DCE: depth = 7 feet

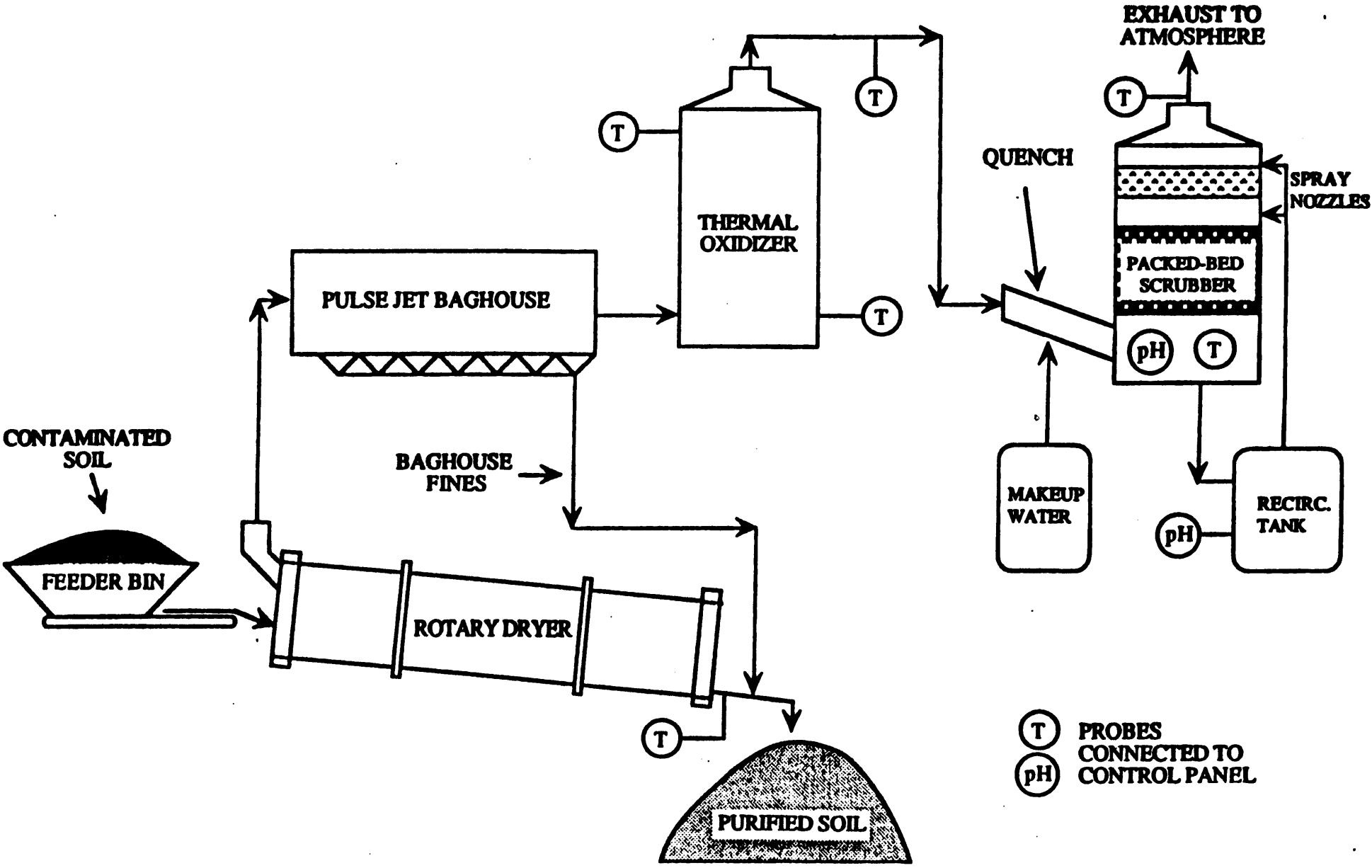
# FIGURE 8 IAAAP FIRE TRAINING PIT TOLUENE CONCENTRATIONS (ECC INVESTIGATION) (ug/kg)



Toluene: depth = 0 to 1 ft  
 Toluene: depth = 9 feet ◆ Toluene: depth = 4 to 5.5 ft  
 Toluene: depth = 7 feet



**FIGURE 9**  
**L.T.T.D. PROCESS FLOW DIAGRAM**



# **ATTACHMENT A**

## **Human Health Risk Assessment of Dioxins and Furans at the Iowa Army Ammunition Plant Fire Training Pit**

The Iowa Army Ammunition Plant (IAAAP) is proposing to treat contaminated soil at the Fire Training Pit (FTP) using low temperature thermal desorption (LTTD). This report describes in detail the methodology and results of the Human Health Risk Assessment (HHRA) for exposure to dioxins and furans at the FTP.

### **SUMMARY AND CONCLUSIONS**

A Human Health Risk Assessment (HHRA) was performed to determine potential adverse effects of human exposure to dioxins and furans during remediation activities at the FTP. This HHRA determined that no potential for excess cancer risk exists for IAAAP on-site workers above the standards set by the U.S. Environmental Protection Agency (EPA).

While the concentrations of dioxins and furans in the soil and the air following LTTD treatment were above risk-based values, these risk-based values are for a 25-year exposure duration and an averaging time over a 70-year lifetime. The expected time to use the LTTD treatment of the IAAAP materials is actually much shorter (i.e., approximately 30 days maximum).

The HHRA included exposure of on-site workers in the following scenarios:

- C An assessment of on-site remediation worker exposure to untreated soil for a total of 30 days through ingestion, dermal contact, and inhalation of wind-blown soil.
- C An assessment of facility worker (Mason and Hanger-Silas Mason Co., Inc.) exposure to particulate emissions for a maximum total exposure of 40 hours from the low temperature thermal desorption (LTTD) unit through inhalation. The particulate emissions were provided from a dispersion modeling study of dioxins and furans. The modeling study is presented in Attachment B.

Intake estimates of the contaminants are established through the use of intake equations and exposure parameters. These intakes were compared with toxicity values that are the upper boundary estimate of the probability that an individual will develop cancer if exposed to the contaminant for a lifetime.

Using the estimated limited time of exposure to the dioxins and furans, the calculated risks were equated to the lifetime cancer carcinogenic risks and found to be below the nationally-established risk range of one in ten thousand and one in a million ( $1E-04$  to  $1E-06$ ). Specifically, the calculated risks to the on-site remediation worker of exposure to surface soil (due to ingestion and dermal soil contact) was  $3E-09$ , which is approximately one thousand times less than the established risk level of one in a million. The risk of exposure to subsurface soil was  $8E-10$ .

For the facility workers exposed to particulate emissions from the LTTD unit, the risks were significantly lower than the established risk level with risk values of  $6E-17$  for workers at the

BG-1 location and 7E-17 for workers at the CWP location. It should be noted that the air particulate emissions were based on a worst-case analysis, assuming that the LTTD would not destroy any dioxins or furans in the soil (a 0% destruction removal efficiency (DRE)). Even this conservative estimate did not indicate a potential increased cancer risk. It is expected that the DRE for the LTTD would actually be approximately 99%, resulting in a less potential for adverse health effects to on-site facility workers.

## INITIAL SCREENING EVALUATION

Two composite samples were obtained from the FTP and analyzed for dioxins and furans according to EPA Method 8280. As an initial screening measure, the resulting soil data was initially compared to risk-based concentrations (RBCs) from EPA Regions III and IX as presented in Table 1. If the measured concentration for dioxins and furans in the soil or estimated concentration of air-borne particulates did not exceed the minimum RBC from EPA Region III or IX, or the concentration-based exception criteria (CBEC), it would not be necessary to perform a risk assessment.

The most well-known of the dioxins and furans is tetrachlorinated dioxin with chlorine atoms in the 2,3,7, and 8 positions — 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). This dioxin can produce a variety of toxic effects at very low doses, including cancer and reproductive effects in research animals. The placement of the chlorine atoms at these specific positions increases the biological activity of this compound compared to other chlorinated dibenzo-p-dioxins (CDDs) or chlorinated dibenzo furans (CDFs). Although other CDDs and CDFs have not been studied as intensely as 2,3,7,8-TCDD, research has demonstrated a strong structure-biological activity relationship between the chemical structure of the specific CDD or CDF and its ability to elicit a biological/toxic response in living organisms.

Besides 2,3,7,8-TCDD, there are other CDDs and CDFs that have chlorine atoms in these positions — referred to as 2,3,7,8-substituted congeners. The congeners also have toxic effects, although they are generally much weaker than those of 2,3,7,8-TCDD. These 2,3,7,8-substituted congeners are compared with CBEC identified in Appendix XI, FR Vol. 87, No. 98, 20 May 1992, Proposed Rule as presented in Table 1. Several of the CDDs and CDFs are above the CBEC; therefore, an evaluation of dioxins and furans is necessary.

Since 2,3,7,8-TCDD is the most potent animal carcinogen and reproductive toxin evaluated by EPA to date, it is used as a measure of toxicity for other congeners. The relative toxicity of the congener to 2,3,7,8-TCDD is its toxicity equivalency factor (TEF). For example, 1,2,3,7,8-pentachlorodibenzo furan is estimated to have approximately one-half the toxicity of 2,3,7,8-TCDD, so its TEF is 0.5. The TEFs presented on Table 1 were developed through an international effort adopted by EPA (EPA, 1989a).

The TEFs of different congeners are used to convert the concentration of congener mixtures into an equivalent concentration of 2,3,7,8-TCDD to assess exposure risks. The toxicity of such mixtures is the sum of each congener concentration multiplied by its TEF for all congeners in the mixture. The sum of the products of concentration and the TEFs is the toxicity equivalent (TEQ)

of the mixture, expressed as if the toxicity were due entirely to 2,3,7,8-TCDD. The percentage of TEQ that is actually contributed by 2,3,7,8-TCDD is shown with the TEQ. The TEQs for both soil samples are presented in Table 1. The TEQs for soil were estimated as air particulates from wind-blown soil assuming that the outdoor air contains 50 mg of respirable fugitive dust/m<sup>3</sup>. The TEQs for both soil samples from wind-blown soil are also presented in Table 1.

As can be observed in Table 1, the soil TEQs for both soil samples are greater than the minimum industrial soil RBC for 2,3,7,8-TCDD. Only the surface soil TEQ was slightly above the nationally-established limit of 1 ppb (0.001 ppm) with a value of 0.0011 ppm. These results indicate an on-site remediation worker exposure scenario to ingestion and dermal contact with the soil is necessary. However, the TEQs for air particulates (5.5E-11 and 1.5E-11 mg/kg for surface soil and 3 feet below ground surface (BGS), respectively) are much less than the minimum inhalation RBCs (2.2E-07); therefore an inhalation pathway was not assessed for the on-site remediation worker.

Annualized modeled results from the TSCREEN for 2,3,7,8-TCDD particulate emissions from the LTTD were also compared with inhalation RBCs as presented in Table 1. As shown, all results with the destruction removal efficiency (DRE) of 0% have modeled concentrations greater than the respective RBC for both locations of the receptors. The only modeled concentration with the DRE of 99% that is greater than any RBC is for the BG-1 worker and that is slightly above the EPA Region IX (4.58E-08 vs. 4.5E-08 µg/m<sup>3</sup>) RBC. Using the worst-case scenario of 0% DRE, it was appropriate to perform an assessment for the on-site facility workers. This is a very conservative estimate since it is expected that the DRE for the LTTD would actually be 99%, resulting in much less air concentrations than those used in this human health risk assessment.

## **HUMAN HEALTH RISK ASSESSMENT**

### **On-Site Remediation Worker**

For the potentially exposed populations and exposure scenarios to be assessed, the surface soil pathway and associated exposure routes are applicable to the on-site remediation worker and the following routes of exposure for this pathway were considered:

- C Soil ingestion
- C Dermal absorption from soil.

As discussed in the previous section, an inhalation pathway was not assessed for the on-site remediation worker as the initial evaluation indicates that there is little potential for adverse effects from this exposure pathway.

Route-specific exposures or intakes were quantified through the use of intake equations, exposure parameters, and exposure concentrations. Intake equations, exposure parameters, and exposure concentrations for this particular risk assessment were assumed to be route- and scenario-specific. Exposure concentrations are those TEQs estimated in the initial evaluation.

The intake equations and exposure parameters used are presented in Table 2.

Toxicity values were used to quantitatively estimate the risk in the risk assessment and were obtained from two major sources. The primary source of information is the EPA's Integrated Risk Information System (IRIS). IRIS contains only those toxicity values that have been verified by EPA work groups. The IRIS database is updated monthly, is available on the EPA internet website (<http://www.epa.gov/iris>), and supersedes all other toxicity information. If the necessary data are not available in IRIS, the EPA's most recent issue of Health Effects Assessment Summary Tables (HEAST) (EPA, 1995) will be used. HEAST contains a comprehensive listing of provisional risk assessment information that has undergone review to be recognized as high-quality, agency-wide consensus information. If toxicity data are not available in IRIS or HEAST, EPA Region III periodically published toxicity data will also be consulted as an alternative information source.

The toxicity assessment portion of this human health risk assessment dealt only with the toxicity of 2,3,7,8-TCDD as this is the only congener with toxicity values and the intake values are in TEQ of 2,3,7,8-TCDD. Oral and inhalation slope factors (carcinogenic risk probabilities) are available for 2,3,7,8-TCDD from the Health Effects Assessment Summary Tables (HEAST) (there is no IRIS information for dioxins or furans). These are presented in Tables 1 and 2. There are no toxicity risk values for noncarcinogenic effects available from EPA.

Risk characterization combines the results of the exposure and toxicity assessments to provide numerical estimates of health risk. These estimates are comparisons of exposure levels with non-carcinogenic effect levels or estimates of the lifetime cancer risk for a given intake. To quantify the health risks, the intakes are first calculated for the 2,3,7,8-TCDD congener for each pathway (soil ingestion or dermal contact) and scenario (on-site remediation worker exposure). The intakes are then compared to the slope factors for 2,3,7,8-TCDD.

The following calculations were used to determine carcinogenic effects by obtaining numerical estimates (i.e., unitless probability) of lifetime cancer risks:

$$\text{RISK} = \text{INTAKE} \times \text{SF}$$

where:

Risk	=	Potential lifetime excess cancer risk (unitless)
SF	=	Slope factor (per mg/kg-day)
Intake	=	Chemical intake (mg/kg-day)

Inhalation and oral ingestion SFs were used with respective inhalation and ingestion intakes to estimate risk. Cancer risks are typically summed separately for each chemical carcinogen across the different pathways for each scenario. This calculation was completed for the on-site remediation worker as presented on Table 2.

Each of the pathways and soil depths for the on-site remediation worker resulted in risks less

than the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) risk range of one in ten thousand to one in a million (1E-04 to 1E-06). The highest risk is 2E-09. The total risk for the on-site remediation worker was 3E-09 for surface soil and 8E-10 for soil 3 feet BGS.

### **Mason and Hanger-Silas Mason Co., Inc. Facility Worker**

For the potentially exposed populations and exposure scenarios to be assessed, the particulate emissions from the LTTD unit and associated exposure routes were applicable to the on-site facility worker through inhalation. There were two primary facility worker locations (BG-1 and CWP, 250 and 1490 feet from the source, respectively) for which intakes were estimated using concentrations at 0% DRE from the TSCREEN model. As stated earlier, these values are very conservative concentrations as it is expected that the actual DRE will be 99%.

Route-specific exposures or intakes were quantified through the use of intake equations, exposure parameters, and exposure concentrations. Intake equations, exposure parameters, and exposure concentrations for this particular risk assessment were assumed to be route- and scenario-specific. The intake equations and exposure parameters used are presented on Table 3.

As discussed in the previous section, the intakes were compared to the inhalation slope factors for 2,3,7,8-TCDD to determine carcinogenic effects by obtaining numerical estimates (i.e., unitless probability) of lifetime cancer risks. These risks are presented on Table 3 and are less than the NCP risk range of 1E-04 to 1E-06. The highest risk is 7E-17.

### **REFERENCES**

EPA. 1989a. Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-Dioxins and -Dibenzofurans (DCCs and CDFs) and 1989 Update, EPA/625/3-89/016, March.

U.S. Environmental Protection Agency (EPA). 1989b. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). EPA/540/1/1-89/002. December. And Supplemental Guidance to RAGS: Standard Default Exposure Factors. EPA Publication 9285.6-03, March 25.

EPA. 1995. Health Effects Assessment Summary Tables (HEAST). EPA/540/R-95/036, EPA Publication 9200.6-303 (95-1), May.

**Table 1. Iowa Army Ammunition Plant Fire Training Pit Human Health Risk Assessment  
Initial Human Health Risk Assessment Evaluation**

**Toxicity Equivalency Factor (TEF) Analysis**

Parameter	Concentration-Based Exemption Criteria (CBEC) (mg/kg)	TEF	Measured value (mg/kg)			
			Surface	TEF Concentration	3 ft. BGS	TEF Concentration
<b>Furans</b>						
TCDFs (total)	NA	0	ND	0	ND	0
2,3,7,8-TCDF	7.E-05	0.1	ND	0	ND	0
PeCDFs (total)	NA	0	ND	0	ND	0
1,2,3,7,8-PeCDF	1.E-04	0.05	ND	0	ND	0
2,3,4,7,8-PeCDF	1.E-05	0.5	ND	0	ND	0
HxCDFs (total)	NA	0	0.0046	0	ND	0
1,2,3,4,7,8-HxCDF	7.E-05	0.1	ND	0	ND	0
1,2,3,6,7,8-HxCDF	7.E-05	0.1	ND	0	ND	0
2,3,4,6,7,8-HxCDF	7.E-05	0.1	ND	0	ND	0
1,2,3,7,8,9-HxCDF	7.E-05	0.1	ND	0	ND	0
HpCDFs (total)	NA	0	0.0067	0	0.0015	0
1,2,3,4,6,7,8-HpCDF	7.E-04	0.01	0.0021	* 0.000021	ND	0
1,2,3,4,7,8,9-HpCDF	7.E-04	0.01	ND	0	ND	0
OCDF	7.E-03	0.001	0.0045	* 0.0000045	ND	0
Total Furans			0.0179			
<b>Dioxins</b>						
TCDDs (total)	NA	0	ND	0	ND	0
2,3,7,8-TCDD	7.E-06	1	ND	0	ND	0
PeCDDs (total)	NA	0	ND	0	ND	0
1,2,3,7,8-PeCDD	1.E-05	0.5	ND	0	ND	0
HxCDDs (total)	NA	0	0.029	0	0.013	0
1,2,3,4,7,8-HxCDD	7.E-05	0.1	ND	0	ND	0
1,2,3,6,7,8-HxCDD	7.E-05	0.1	0.0046	* 0.00046	0.0018	* 0.00018
1,2,3,7,8,9-HxCDD	7.E-05	0.1	0.0019	* 0.00019	0.00061	* 0.000061
HpCDDs (total)	NA	0	0.051	0	0.01	0
1,2,3,4,6,7,8-HpCDD	7.E-04	0.01	0.031	* 0.00031	0.0053	* 0.000053
OCDD	7.E-03	0.001	0.11	* 0.00011	0.004	* 0.000004
Total Dioxins			0.2275			
Toxicity Equivalent (TEQ) as 2,3,7,8-TCDD in soil (mg/kg)			1.1E-03		3.0E-04	
TEQ > 1 ppb? (0.001 ppm) (nationally-established limit)			yes		no	
Percent of TEQ actually contributed by 2,3,7,8-TCDD			0.00%		0.00%	
TEQ as 2,3,7,8-TCDD in air ( $\mu\text{g}/\text{m}^3$ ) (assume 50 $\text{mg}/\text{m}^3$ air particulates)			5.5E-11		1.5E-11	

\* Measured value is greater than respective CBEC (Appendix XI, FR Vol. 57, No. 98, 20 May, 1992, Proposed Rule)

**Annualized Modeling Results from TSCREEN for 2,3,7,8-TCDD Emissions ( $\mu\text{g}/\text{m}^3$ )**

Receptor Location	DRE = 0%	DRE = 99%
BG-1 Worker	4.58E-06	4.58E-08
CWP Worker	1.98E-06	1.98E-08

**Risk-Based Concentration (RBC) Initial Screen**

**Industrial Soil RBC (mg/kg)**

EPA Region III (1E-06)	3.7E-05
EPA Region IX (1E-06)	2.4E-05

**Inhalation RBC ( $\mu\text{g}/\text{m}^3$ )**

EPA Region III (1E-06)	5.4E-08
EPA Region IX (1E-06)	4.5E-08
40 CFR 266 Appendix V (1E-05)	2.2E-07

**Slope Factors (per mg/kg)**

Oral	1.5E+05
Inhalation	1.5E+05

Soil TEQ > Minimum RBC?		Soil TEQ > Minimum RBC?	
Soil	Air Particulates	Soil	Air Particulates
yes	no	yes	no

Air Model Results DRE = 0% > RBC?		Air Model Results DRE = 99% > RBC?	
BG-1 Worker	CWP Worker	BG-1 Worker	CWP Worker
yes	yes	no	no
yes	yes	yes	no
yes	yes	no	no



**Table 2. Iowa Army Ammunition Plant Fire Training Pit Human Health Risk Assessment  
On-Site Remediation Worker**

**Soil Ingestion**

$$\text{Intake (mg/kg-day)} = \frac{C_{\text{soil}} \times \text{IR} \times \text{FI} \times \text{EF} \times \text{ED} \times \text{CF}}{\text{BW} \times \text{AT}} = \begin{matrix} 1.172\text{E-}14 & \text{Surface soil} \\ 3.188\text{E-}15 & \text{3ft BGS} \end{matrix}$$

<b>C<sub>soil</sub></b>	Contaminant concentration in soil (mg/kg)	Surface soil	0.0010955
		3 ft BGS	0.000298
<b>IR</b>	Ingestion rate (kg)		50 a
<b>FI</b>	Fraction ingested from contaminated source (unitless)		1 a
<b>EF</b>	Exposure frequency (day/yr)		5 b
<b>ED</b>	Exposure duration (yr)		0.082 b
<b>CF</b>	Conversion factor (kg/mg)		1.00E-06
<b>BW</b>	Body weight (kg)		70 a
<b>AT</b>	Average time (days)		27375 a

$$\text{Risk} = \text{Intake} \times \text{SF}_o = \begin{matrix} 2.\text{E-}09 & \text{Surface soil} \\ 5.\text{E-}10 & \text{3ft BGS} \end{matrix}$$

<b>SF<sub>o</sub></b>	Oral slope factor (per mg/kg-day)	1.5E+05
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**Dermal Soil Contact**

$$\text{Absorbed dose (mg/kg-day)} = \frac{C_{\text{soil}} \times \text{SA} \times \text{AF} \times \text{ABS} \times \text{EF} \times \text{ED} \times \text{CF}}{\text{BW} \times \text{AT}} = \begin{matrix} 7.032\text{E-}15 & \text{Surface soil} \\ 1.913\text{E-}15 & \text{3ft BGS} \end{matrix}$$

<b>SA</b>	Skin surface area available for contact (cm <sup>2</sup> )	5000 a
<b>AF</b>	Soil-to-skin adherence factor (mg/cm <sup>2</sup> )	0.2 a
<b>ABS</b>	Absorption factor (unitless)	0.03 a

$$\text{Risk} = \text{Intake} \times \text{SF}_o = \begin{matrix} 1.\text{E-}09 & \text{Surface soil} \\ 3.\text{E-}10 & \text{3ft BGS} \end{matrix}$$

<b>Total Risk</b>		3.E-09	Surface soil
		8.E-10	3ft BGS

a Exposure parameter values are default values from EPA (1989) except where noted  
b Assumed 10-hour days; 6 days/week; for 30 days total/year

**Table 3. Iowa Army Ammunition Plant Fire Training Pit Human Health Risk Assessment On-Site Facility Worker Assuming 0% DRE for the LTTD**

**Inhalation of Particulate Emissions**

$$\text{Intake (mg/kg-day)} = \frac{C_{\text{air}} \times \text{IR} \times \text{ET} \times \text{EF} \times \text{ED} \times \text{CF}}{\text{BW} \times \text{AT}} = \begin{matrix} 4.076\text{E-}22 & \text{BG-1 Worker} \\ 4.699\text{E-}22 & \text{CWP Worker} \end{matrix}$$

<b>C<sub>air</sub></b>	Contaminant concentration in air (mg/m <sup>3</sup> )	BG-1 Worker	4.58E-09	
		CWP Worker	1.98E-09	
<b>IR</b>	Inhalation rate (m <sup>3</sup> /hr)		0.83	<b>a</b>
<b>ET</b>	Exposure time (hr/day)		3	<b>b</b> BG-1 Worker
			8	<b>c</b> CWP Worker
<b>EF</b>	Exposure frequency (day/yr)		5	<b>d</b>
<b>ED</b>	Exposure duration (yr)		0.0136986	<b>d</b>
<b>CF</b>	Conversion factor (kg/mg)		1.00E-06	
<b>BW</b>	Body weight (kg)		70	<b>a</b>
<b>AT</b>	Average time (days)		27375	<b>a</b>
<b>Risk</b>	= Intake x SF <sub>i</sub>	=	6.E-17	BG-1 Worker
			7.E-17	CWP Worker
<b>SF<sub>i</sub></b>	Inhalation slope factor (per mg/kg-day)		1.5E+05	

**a** Exposure parameter values are default values from EPA (1989) except where noted

**b** Assumed 15 hours/week total average

**c** Assumed 40 hours/week total

**d** Assumed 5 days total LTTD burn

# **ATTACHMENT B**

# Dispersion Modeling Study of 2,3,7,8-TCDD Impacts at the Iowa Army Ammunition Plant

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The Iowa Army Ammunition Plant (IAAAP) is proposing to treat contaminated soil at the Fire Training Pit (FTP) using low temperature thermal desorption (LTTD). This analysis describes the worst-case airborne concentrations of 2,3,7,8-TCDD which may result from this treatment process. The analysis was performed using a USEPA approved Gaussian dispersion model, TSCREEN (Version 95250). This model is based on a commonly used screening model, SCREEN3. The results of the analysis are provided for 2 receptors and the highest impact point (as determined by TSCREEN) for 1, 24 and annualized averages. The annualized results can be used directly with cancer potency factors to determine inhalation-based cancer risk and cancer burden.

## Process Emissions

Approximately 10 tons of soil per hour will be treated using the LTTD. The system is expected to operate for 7 24-hour days. A total of 1680 tons of soil is expected to be processed over this time. The proposed system will operate in two stages, with the first at 500-600° F to treat the soil and a second stage at about 1750° F to treat the soil off-gas. The residence time for the treatment gas stream is 2 seconds. The treated flue gas will then be quenched using a rapid quench system to reduce the gas temperature to below 300° F. This will minimize dioxin formation.

The input gas stream to the thermal oxidizer is not expected to exceed 2 parts per billion (ppb), or  $2 \times 10^{-4}$  lb./hr of 2,3,7,8-TCDD. Because this is a concentration level which is extremely hard to detect while monitoring the input and output gas streams, it may be impossible to establish an accurate destruction removal efficiency (DRE) for 2,3,7,8-TCDD. Therefore, five DRE's are estimated as part of this study. The DRE has been estimated at 0%, 50%, 90%, 95% and 99%. Using all of these values will establish an absolute worst-case result which can be used to estimate health effects.

The emissions of 2,3,7,8-TCDD have been estimated below after control by the LTTD:

### *Emission Rate using a DRE of 0%*

Maximum Hourly Emission Rate:

Input Gas Rate of  $2 \times 10^{-4}$  lb./hr x Control Effectiveness (1-0.00) =  $2 \times 10^{-4}$  lb./hr

Annualized Emission Rate:

$$2 \times 10^{-4} \text{ lb./hr} \times 168 \text{ hours} = 3.36 \times 10^{-2} \text{ lb. Total Emissions}$$
$$3.36 \times 10^{-2} \text{ lb.} \div 8,760 \text{ hours/year} = 3.836 \times 10^{-6} \text{ lb./hr average annual emission rate}$$

***Emission Rate using a DRE of 50%***

Maximum Hourly Emission Rate:

$$\text{Input Gas Rate of } 2 \times 10^{-4} \text{ lb./hr} \times \text{Control Effectiveness (1-0.50)} = 1 \times 10^{-4} \text{ lb./hr}$$

Annualized Emission Rate:

$$1 \times 10^{-4} \text{ lb./hr} \times 168 \text{ hours} = 1.68 \times 10^{-2} \text{ lb. Total Emissions}$$
$$1.68 \times 10^{-2} \text{ lb.} \div 8,760 \text{ hours/year} = 1.92 \times 10^{-6} \text{ lb./hr average annual emission rate}$$

***Emission Rate using a DRE of 90%***

Maximum Hourly Emission Rate:

$$\text{Input Gas Rate of } 2 \times 10^{-4} \text{ lb./hr} \times \text{Control Effectiveness (1-0.90)} = 2 \times 10^{-5} \text{ lb./hr}$$

Annualized Emission Rate:

$$2 \times 10^{-5} \text{ lb./hr} \times 168 \text{ hours} = 3.36 \times 10^{-3} \text{ lb. Total Emissions}$$
$$3.36 \times 10^{-3} \text{ lb.} \div 8,760 \text{ hours/year} = 3.84 \times 10^{-7} \text{ lb./hr average annual emission rate}$$

***Emission Rate using a DRE of 95%***

Maximum Hourly Emission Rate:

$$\text{Input Gas Rate of } 2 \times 10^{-4} \text{ lb./hr} \times \text{Control Effectiveness (1-0.95)} = 1 \times 10^{-5} \text{ lb./hr}$$

Annualized Emission Rate:

$$1 \times 10^{-5} \text{ lb./hr} \times 168 \text{ hours} = 1.68 \times 10^{-3} \text{ lb. Total Emissions}$$
$$1.68 \times 10^{-3} \text{ lb.} \div 8,760 \text{ hours/year} = 1.92 \times 10^{-7} \text{ lb./hr average annual emission rate}$$

***Emission Rate using a DRE of 99%***

Maximum Hourly Emission Rate:

Input Gas Rate of  $2 \times 10^{-4}$  lb./hr x Control Effectiveness (1-0.99) =  $2 \times 10^{-6}$  lb./hr

Annualized Emission Rate:

$2 \times 10^{-6}$  lb./hr x 168 hours =  $3.36 \times 10^{-4}$  lb. Total Emissions  
 $3.36 \times 10^{-4}$  lb. ÷ 8,760 hours/year =  $3.84 \times 10^{-8}$  lb./hr average annual emission rate

## Dispersion Modeling Methodology

The TSCREEN model, developed by the USEPA, was employed to predict the worst-case airborne concentration of 2,3,7,8-TCDD. The model, based on the SCREEN3, is specifically designed to evaluate emission impacts for various toxic emission releases. For this analysis, the emission source is a single point source. In this mode, the model uses the same algorithms used in SCREEN3. The meteorological conditions modeled are automatically selected to simulate worst-case conditions in the model. Since the source is located in an open field, no downwash simulation was included in the analysis. Each of the DRE emission rates are separately modeled for the analysis.

The 2,3,7,8-TCDD was modeled as a gaseous release. The stack emission parameters are:

Air Flow (ACFM): 9,100

Exit Velocity (m/s): 14.71

Stack Height (m): 9.14

Stack Exit Diameter (m): 0.61

Stack Gas Temperature (°K): 333

Urban or Rural: Rural

Model results are calculated at two primary receptors. The receptors are defined as CWP and BG-1. These receptors are 1,490 and 250 feet, respectively, from the emission source. The emission source is located in the FTP. In addition, the model provides a maximum possible concentration value at a model selected distance. This concentration result is also provided.

The receptor concentrations were calculated for short-term (1 and 24 hour) concentration averages. These values assume that the source is operating at its maximum potential emission rate for the entire averaging period. The model calculates 1-hour averages as part of its algorithms. Periods longer than 1-hour are calculated using a persistence factor. The TSCREEN model uses a persistence factor of 0.4. Because the model will not provide time period results other than 1-hour for specific receptors, this factor was used to manually adjust the 1-hour averages to 24-hour averages. This function is automatically applied to the maximum possible concentration value and appears as part of the model results.

Receptor concentrations were also annualized. The system is designed to run for a period of 7 24-hour days. The mass emissions for these days is summed and then divided by the annual hours per year (8760) to provide an equivalent emission rate for an annualized period. This calculation is provided in the previous section. The model will again only output a 1-hour value for specific receptors. The model uses a 0.08 persistence factor to derive annual averages from 1-hour results. The results were manually adjusted in this manner for the two primary receptors. The maximum concentration value is automatically adjusted to an annual value by the model. The annualized concentration results can be directly used with a cancer potency factor to calculate cancer risk and cancer burden.

## **Modeling Results**

Results are presented in Table 1 for the two primary receptors and the maximum possible concentration value (as calculated by TSCREEN) for each DRE value. The maximum possible concentration occurred at a distance of 568 feet from the emission source. The results are presented in  $\mu\text{g}/\text{m}^3$  for each time period.

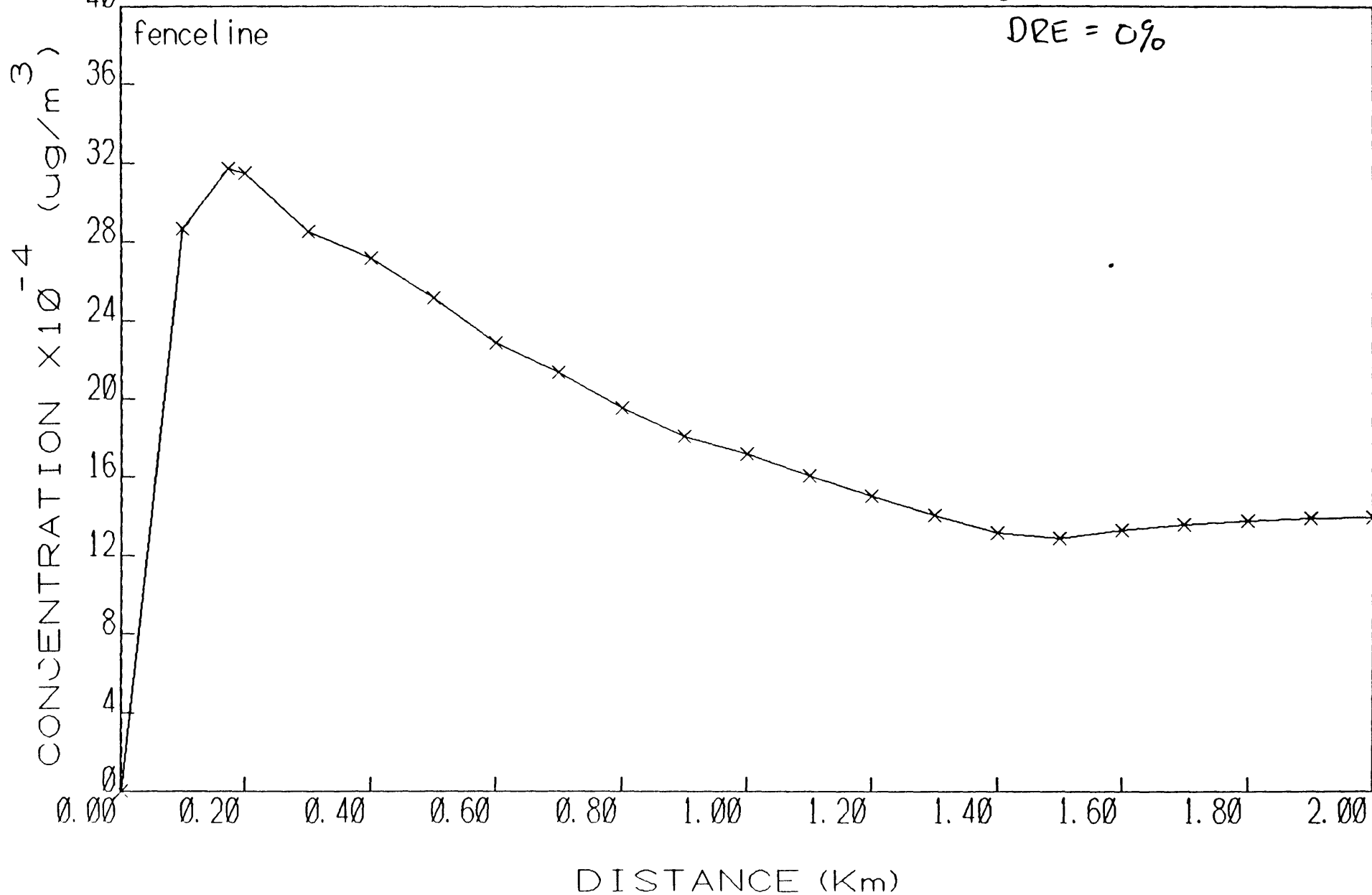
**Table 1**

**Modeling Results from TSCREEN for 2,3,7,8-TCDD Emissions**

Receptor Location	2,3,7,8-TCDD Concentrations ( $\mu\text{g}/\text{m}^3$ )		
	1-hr	24-Hour	Annualized
<i>For DRE of 0%:</i>			
CWP	$1.29 \times 10^{-3}$	$5.2 \times 10^{-4}$	$1.98 \times 10^{-6}$
BG-1	$3.0 \times 10^{-3}$	$1.2 \times 10^{-3}$	$4.58 \times 10^{-6}$
Maximum Possible Concentration	$3.2 \times 10^{-3}$	$1.3 \times 10^{-3}$	$4.87 \times 10^{-6}$
<i>For DRE of 50%:</i>			
CWP	$6.43 \times 10^{-4}$	$2.57 \times 10^{-4}$	$9.88 \times 10^{-7}$
BG-1	$1.49 \times 10^{-3}$	$5.96 \times 10^{-4}$	$2.29 \times 10^{-6}$
Maximum Possible Concentration	$1.59 \times 10^{-3}$	$6.34 \times 10^{-4}$	$2.44 \times 10^{-6}$
<i>For DRE of 90%:</i>			
CWP	$1.29 \times 10^{-4}$	$5.16 \times 10^{-5}$	$1.98 \times 10^{-7}$
BG-1	$2.98 \times 10^{-4}$	$1.19 \times 10^{-4}$	$4.58 \times 10^{-7}$
Maximum Possible Concentration	$3.17 \times 10^{-4}$	$1.27 \times 10^{-4}$	$4.87 \times 10^{-7}$
<i>For DRE of 95%:</i>			
CWP	$6.43 \times 10^{-5}$	$2.57 \times 10^{-5}$	$9.88 \times 10^{-8}$
BG-1	$1.49 \times 10^{-4}$	$5.96 \times 10^{-5}$	$2.29 \times 10^{-7}$
Maximum Possible Concentration	$1.59 \times 10^{-4}$	$6.3 \times 10^{-5}$	$2.44 \times 10^{-7}$
<i>For DRE of 99%:</i>			
CWP	$1.29 \times 10^{-5}$	$5.16 \times 10^{-6}$	$1.98 \times 10^{-8}$
BG-1	$2.98 \times 10^{-5}$	$1.19 \times 10^{-5}$	$4.58 \times 10^{-8}$
Maximum Possible Concentration	$3.17 \times 10^{-5}$	$1.3 \times 10^{-5}$	$4.87 \times 10^{-8}$



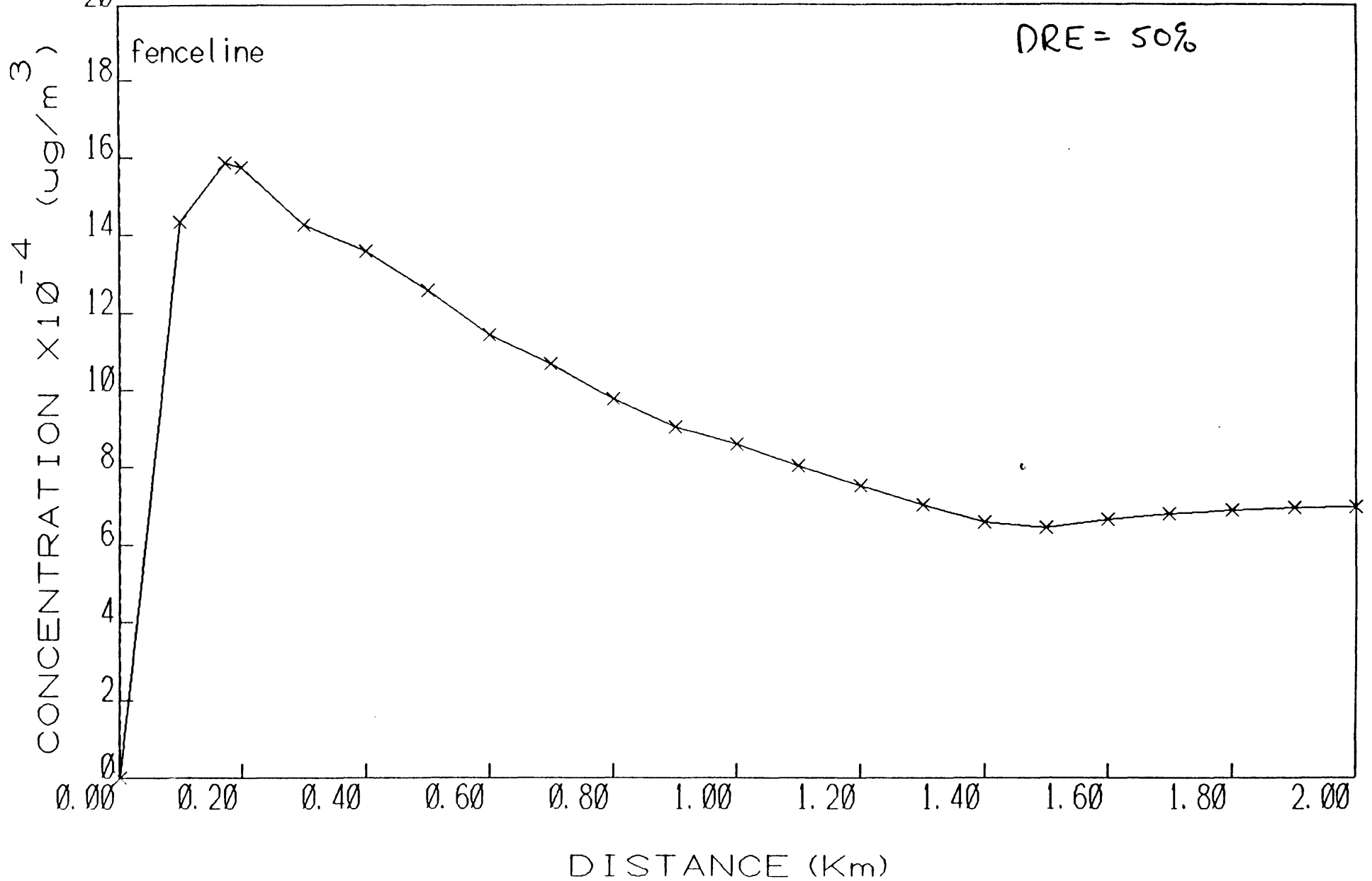
Short-Term Worst Case Modeling for 2 3 7



Maximum concentration  $3.170\text{E}-003$   $\mu\text{g}/\text{cubic m}$  at 0.173 Km (Automated Distances)

1-Hour Only

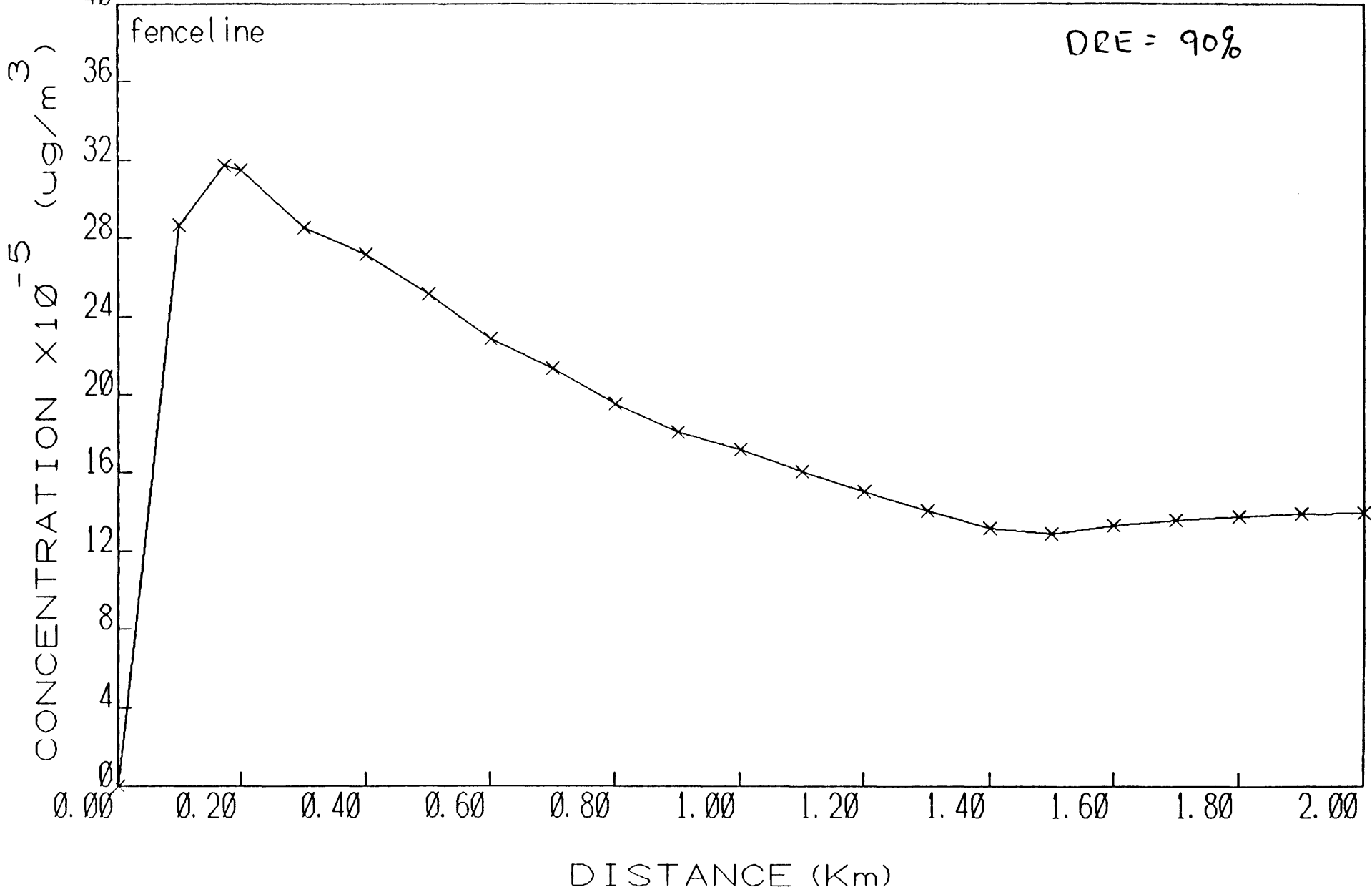
Short-Term Worst Case Modeling for 2 3 7



Maximum concentration 1.585E-003 ug/cubic m at 0.173 Km (Automated Distances)

1-hour only

# Short-Term Worst Case Modeling for 2 3 7

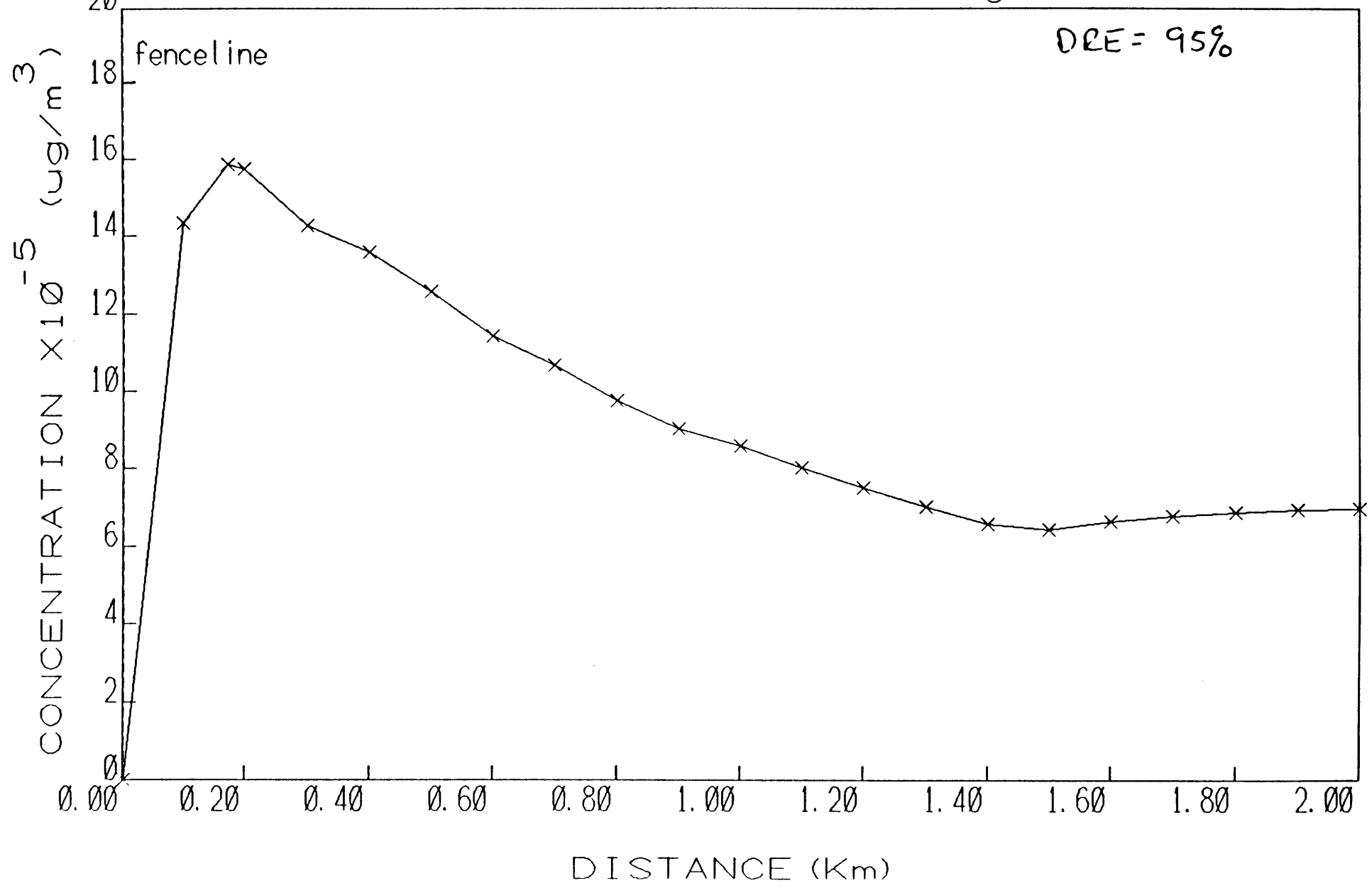


Maximum concentration  $3.170 \times 10^{-4}$   $\mu\text{g}/\text{cubic m}$  at 0.173 Km (Automated Distances)

1-hour only

Short-Term Worst Case Modeling for 2 3 7

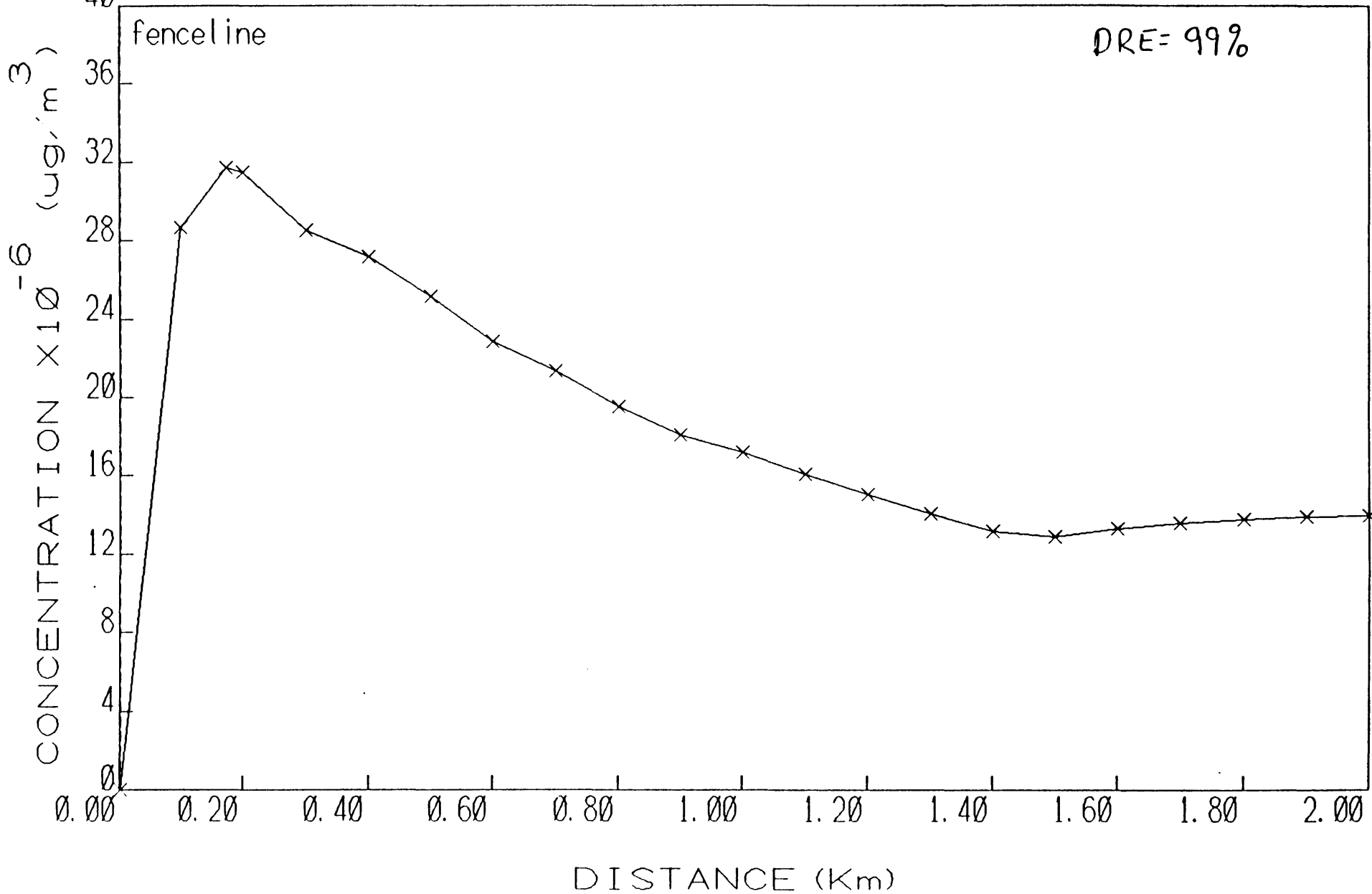
DRE = 95%



Maximum concentration 1.585E-004 ug/cubic m at 0.173 Km (Automated Distances)

1-hour only

Short-Term Worst Case Modeling for 2 3 7



Maximum concentration 3.170E-005 ug/cubic m at 0.173 Km (Automated Distances)

1-hour only

09/10/97  
22:00:51

\*\*\* SCREEN3 MODEL RUN \*\*\*  
\*\*\* VERSION DATED 95250 \*\*\*

Short-Term Worst Case Modeling for 2 3 7 8-TCDD DRE 0%

SIMPLE TERRAIN INPUTS:

SOURCE TYPE = POINT  
EMISSION RATE (G/S) = .252000E-04  
STACK HEIGHT (M) = 9.1400  
STK INSIDE DIAM (M) = .6100  
STK EXIT VELOCITY (M/S) = 14.7100  
STK GAS EXIT TEMP (K) = 333.0000  
AMBIENT AIR TEMP (K) = 293.0000  
RECEPTOR HEIGHT (M) = .0000  
URBAN/RURAL OPTION = RURAL  
BUILDING HEIGHT (M) = .0000  
MIN HORIZ BLDG DIM (M) = .0000  
MAX HORIZ BLDG DIM (M) = .0000

\*\*\*\*\*  
\*\*\* SUMMARY OF SCREEN MODEL RESULTS \*\*\*  
\*\*\*\*\*

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.3170E-02	173.	0.

\*\*\*\*\*  
\*\* REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS \*\*  
\*\*\*\*\*

BUOY. FLUX = 1.612 M\*\*4/S\*\*3; MOM. FLUX = 17.711 M\*\*4/S\*\*2.

\*\*\* FULL METEOROLOGY \*\*\*

\*\*\*\*\*  
\*\*\* SCREEN AUTOMATED DISTANCES \*\*\*  
\*\*\*\*\*

\*\*\* TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES  
\*\*\*

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	
DWASH									
1.	.0000	1	1.0	1.0	320.0	39.79	2.02	1.98	NO
100.	.2866E-02	2	4.0	4.0	1280.0	16.80	19.39	10.83	NO
200.	.3148E-02	3	3.0	3.0	960.0	19.36	23.80	14.33	NO
300.	.2854E-02	4	3.5	3.5	1120.0	17.90	22.75	12.35	NO
400.	.2716E-02	4	2.5	2.5	800.0	21.40	29.66	15.67	NO
500.	.2514E-02	4	2.0	2.0	640.0	24.46	36.41	18.81	NO
600.	.2284E-02	4	1.5	1.5	480.0	29.57	43.11	22.00	NO

700.	.2136E-02	4	1.5	1.5	480.0	29.57	49.53	24.73	NO
800.	.1951E-02	4	1.5	1.5	480.0	29.57	55.88	27.41	NO
900.	.1807E-02	4	1.0	1.0	320.0	39.79	62.50	30.74	NO
1000.	.1717E-02	4	1.0	1.0	320.0	39.79	68.69	33.27	NO
1100.	.1608E-02	4	1.0	1.0	320.0	39.79	74.82	35.23	NO
1200.	.1504E-02	4	1.0	1.0	320.0	39.79	80.91	37.14	NO
1300.	.1406E-02	4	1.0	1.0	320.0	39.79	86.96	39.00	NO
1400.	.1314E-02	4	1.0	1.0	320.0	39.79	92.97	40.81	NO
1500.	.1290E-02	6	1.0	1.0	10000.0	38.06	49.72	19.83	NO
1600.	.1329E-02	6	1.0	1.0	10000.0	38.06	52.65	20.52	NO
1700.	.1358E-02	6	1.0	1.0	10000.0	38.06	55.56	21.19	NO
1800.	.1378E-02	6	1.0	1.0	10000.0	38.06	58.45	21.86	NO
1900.	.1391E-02	6	1.0	1.0	10000.0	38.06	61.34	22.51	NO
2000.	.1397E-02	6	1.0	1.0	10000.0	38.06	64.21	23.15	NO
2100.	.1390E-02	6	1.0	1.0	10000.0	38.06	67.07	23.70	NO
2200.	.1379E-02	6	1.0	1.0	10000.0	38.06	69.91	24.23	NO
2300.	.1366E-02	6	1.0	1.0	10000.0	38.06	72.75	24.76	NO
2400.	.1352E-02	6	1.0	1.0	10000.0	38.06	75.57	25.28	NO
2500.	.1335E-02	6	1.0	1.0	10000.0	38.06	78.38	25.78	NO
2600.	.1318E-02	6	1.0	1.0	10000.0	38.06	81.19	26.28	NO
2700.	.1299E-02	6	1.0	1.0	10000.0	38.06	83.98	26.78	NO
2800.	.1280E-02	6	1.0	1.0	10000.0	38.06	86.76	27.26	NO
2900.	.1260E-02	6	1.0	1.0	10000.0	38.06	89.53	27.74	NO
3000.	.1240E-02	6	1.0	1.0	10000.0	38.06	92.29	28.21	NO
3500.	.1131E-02	6	1.0	1.0	10000.0	38.06	105.97	30.14	NO
4000.	.1033E-02	6	1.0	1.0	10000.0	38.06	119.46	31.92	NO
4500.	.9468E-03	6	1.0	1.0	10000.0	38.06	132.76	33.60	NO
5000.	.8705E-03	6	1.0	1.0	10000.0	38.06	145.90	35.19	NO
5500.	.8034E-03	6	1.0	1.0	10000.0	38.06	158.91	36.70	NO
6000.	.7442E-03	6	1.0	1.0	10000.0	38.06	171.78	38.14	NO
6500.	.6918E-03	6	1.0	1.0	10000.0	38.06	184.53	39.52	NO
7000.	.6453E-03	6	1.0	1.0	10000.0	38.06	197.17	40.85	NO
7500.	.6041E-03	6	1.0	1.0	10000.0	38.06	209.70	41.98	NO
8000.	.5674E-03	6	1.0	1.0	10000.0	38.06	222.14	43.08	NO
8500.	.5344E-03	6	1.0	1.0	10000.0	38.06	234.49	44.14	NO
9000.	.5047E-03	6	1.0	1.0	10000.0	38.06	246.75	45.16	NO
9500.	.4778E-03	6	1.0	1.0	10000.0	38.06	258.93	46.15	NO
10000.	.4533E-03	6	1.0	1.0	10000.0	38.06	271.03	47.11	NO
15000.	.2941E-03	6	1.0	1.0	10000.0	38.06	388.52	55.50	NO
20000.	.2164E-03	6	1.0	1.0	10000.0	38.06	501.02	60.86	NO
25000.	.1698E-03	6	1.0	1.0	10000.0	38.06	609.81	65.38	NO
30000.	.1391E-03	6	1.0	1.0	10000.0	38.06	715.64	69.33	NO
40000.	.1022E-03	6	1.0	1.0	10000.0	38.06	920.26	74.95	NO
50000.	.8042E-04	6	1.0	1.0	10000.0	38.06	1117.45	79.62	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 1. M:  
173. .3170E-02 3 3.5 3.5 1120.0 17.90 20.93 12.60 NO

DIST = DISTANCE FROM THE SOURCE  
CONC = MAXIMUM GROUND LEVEL CONCENTRATION  
STAB = ATMOSPHERIC STABILITY CLASS (1=A, 2=B, 3=C, 4=D, 5=E, 6=F)  
U10M = WIND SPEED AT THE 10-M LEVEL  
USTK = WIND SPEED AT STACK HEIGHT  
MIX HT = MIXING HEIGHT  
PLUME HT= PLUME CENTERLINE HEIGHT  
SIGMA Y = LATERAL DISPERSION PARAMETER  
SIGMA Z = VERTICAL DISPERSION PARAMETER  
DWASH = BUILDING DOWNWASH:  
DWASH= MEANS NO CALC MADE (CONC = 0.0)  
DWASH=NO MEANS NO BUILDING DOWNWASH USED  
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED

DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED  
 DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3\*LB

\*\*\*\*\*  
 \*\*\* SCREEN DISCRETE DISTANCES \*\*\*  
 \*\*\*\*\*

\*\*\* TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES  
 \*\*\*

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	
1.	.0000	1	1.0	1.0	320.0	39.79	2.02	1.98	NO
250.	.2980E-02	3	2.0	2.0	640.0	24.46	29.33	17.75	NO
1490.	.1286E-02	6	1.0	1.0	10000.0	38.06	49.43	19.76	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)  
 DWASH=NO MEANS NO BUILDING DOWNWASH USED  
 DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED  
 DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED  
 DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3\*LB

\*\*\*\*\*  
 \*\*\* USER SPECIFIED AVERAGING TIMES \*\*\*  
 \*\*\*\*\*

ESTIMATED MAXIMUM CONCENTRATION FOR 24 HR AVERAGING TIME:  
 0.001268 (+/- 0.000634) UG/M\*\*3

\*\*\*\*\*  
 \*\*\* END OF SCREEN MODEL OUTPUT \*\*\*  
 \*\*\*\*\*



09/10/97  
22:08:31

\*\*\* SCREEN3 MODEL RUN \*\*\*  
\*\*\* VERSION DATED 95250 \*\*\*

Short-Term Worst Case Modeling for 2 3 7 8-TCDD DRE 50%

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	.126000E-04
STACK HEIGHT (M)	=	9.1400
STK INSIDE DIAM (M)	=	.6100
STK EXIT VELOCITY (M/S)	=	14.7100
STK GAS EXIT TEMP (K)	=	333.0000
AMBIENT AIR TEMP (K)	=	293.0000
RECEPTOR HEIGHT (M)	=	.0000
URBAN/RURAL OPTION	=	RURAL
BUILDING HEIGHT (M)	=	.0000
MIN HORIZ BLDG DIM (M)	=	.0000
MAX HORIZ BLDG DIM (M)	=	.0000

\*\*\*\*\*  
\*\*\* SUMMARY OF SCREEN MODEL RESULTS \*\*\*  
\*\*\*\*\*

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
-----	-----	-----	-----
SIMPLE TERRAIN	.1585E-02	173.	0.

\*\*\*\*\*  
\*\* REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS \*\*  
\*\*\*\*\*

BUOY. FLUX = 1.612 M\*\*4/S\*\*3; MOM. FLUX = 17.711 M\*\*4/S\*\*2.

\*\*\* FULL METEOROLOGY \*\*\*

\*\*\*\*\*  
\*\*\* SCREEN AUTOMATED DISTANCES \*\*\*  
\*\*\*\*\*

\*\*\* TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES  
\*\*\*

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
DWASH									
1.	.0000	1	1.0	1.0	320.0	39.79	2.02	1.98	NO
100.	.1433E-02	2	4.0	4.0	1280.0	16.80	19.39	10.83	NO
200.	.1574E-02	3	3.0	3.0	960.0	19.36	23.80	14.33	NO
300.	.1427E-02	4	3.5	3.5	1120.0	17.90	22.75	12.35	NO
400.	.1358E-02	4	2.5	2.5	800.0	21.40	29.66	15.67	NO
500.	.1257E-02	4	2.0	2.0	640.0	24.46	36.41	18.81	NO
600.	.1142E-02	4	1.5	1.5	480.0	29.57	43.11	22.00	NO

700.	.1068E-02	4	1.5	1.5	480.0	29.57	49.53	24.73	NO
800.	.9755E-03	4	1.5	1.5	480.0	29.57	55.88	27.41	NO
900.	.9033E-03	4	1.0	1.0	320.0	39.79	62.50	30.74	NO
1000.	.8584E-03	4	1.0	1.0	320.0	39.79	68.69	33.27	NO
1100.	.8040E-03	4	1.0	1.0	320.0	39.79	74.82	35.23	NO
1200.	.7518E-03	4	1.0	1.0	320.0	39.79	80.91	37.14	NO
1300.	.7028E-03	4	1.0	1.0	320.0	39.79	86.96	39.00	NO
1400.	.6572E-03	4	1.0	1.0	320.0	39.79	92.97	40.81	NO
1500.	.6452E-03	6	1.0	1.0	10000.0	38.06	49.72	19.83	NO
1600.	.6647E-03	6	1.0	1.0	10000.0	38.06	52.65	20.52	NO
1700.	.6791E-03	6	1.0	1.0	10000.0	38.06	55.56	21.19	NO
1800.	.6892E-03	6	1.0	1.0	10000.0	38.06	58.45	21.86	NO
1900.	.6955E-03	6	1.0	1.0	10000.0	38.06	61.34	22.51	NO
2000.	.6986E-03	6	1.0	1.0	10000.0	38.06	64.21	23.15	NO
2100.	.6949E-03	6	1.0	1.0	10000.0	38.06	67.07	23.70	NO
2200.	.6897E-03	6	1.0	1.0	10000.0	38.06	69.91	24.23	NO
2300.	.6832E-03	6	1.0	1.0	10000.0	38.06	72.75	24.76	NO
2400.	.6758E-03	6	1.0	1.0	10000.0	38.06	75.57	25.28	NO
2500.	.6676E-03	6	1.0	1.0	10000.0	38.06	78.38	25.78	NO
2600.	.6588E-03	6	1.0	1.0	10000.0	38.06	81.19	26.28	NO
2700.	.6496E-03	6	1.0	1.0	10000.0	38.06	83.98	26.78	NO
2800.	.6400E-03	6	1.0	1.0	10000.0	38.06	86.76	27.26	NO
2900.	.6301E-03	6	1.0	1.0	10000.0	38.06	89.53	27.74	NO
3000.	.6201E-03	6	1.0	1.0	10000.0	38.06	92.29	28.21	NO
3500.	.5657E-03	6	1.0	1.0	10000.0	38.06	105.97	30.14	NO
4000.	.5167E-03	6	1.0	1.0	10000.0	38.06	119.46	31.92	NO
4500.	.4734E-03	6	1.0	1.0	10000.0	38.06	132.76	33.60	NO
5000.	.4352E-03	6	1.0	1.0	10000.0	38.06	145.90	35.19	NO
5500.	.4017E-03	6	1.0	1.0	10000.0	38.06	158.91	36.70	NO
6000.	.3721E-03	6	1.0	1.0	10000.0	38.06	171.78	38.14	NO
6500.	.3459E-03	6	1.0	1.0	10000.0	38.06	184.53	39.52	NO
7000.	.3226E-03	6	1.0	1.0	10000.0	38.06	197.17	40.85	NO
7500.	.3021E-03	6	1.0	1.0	10000.0	38.06	209.70	41.98	NO
8000.	.2837E-03	6	1.0	1.0	10000.0	38.06	222.14	43.08	NO
8500.	.2672E-03	6	1.0	1.0	10000.0	38.06	234.49	44.14	NO
9000.	.2523E-03	6	1.0	1.0	10000.0	38.06	246.75	45.16	NO
9500.	.2389E-03	6	1.0	1.0	10000.0	38.06	258.93	46.15	NO
10000.	.2267E-03	6	1.0	1.0	10000.0	38.06	271.03	47.11	NO
15000.	.1470E-03	6	1.0	1.0	10000.0	38.06	388.52	55.50	NO
20000.	.1082E-03	6	1.0	1.0	10000.0	38.06	501.02	60.86	NO
25000.	.8492E-04	6	1.0	1.0	10000.0	38.06	609.81	65.38	NO
30000.	.6953E-04	6	1.0	1.0	10000.0	38.06	715.64	69.33	NO
40000.	.5112E-04	6	1.0	1.0	10000.0	38.06	920.26	74.95	NO
50000.	.4021E-04	6	1.0	1.0	10000.0	38.06	1117.45	79.62	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 1. M:  
173. .1585E-02 3 3.5 3.5 1120.0 17.90 20.93 12.60 NO

DIST = DISTANCE FROM THE SOURCE  
CONC = MAXIMUM GROUND LEVEL CONCENTRATION  
STAB = ATMOSPHERIC STABILITY CLASS (1=A, 2=B, 3=C, 4=D, 5=E, 6=F)  
U10M = WIND SPEED AT THE 10-M LEVEL  
USTK = WIND SPEED AT STACK HEIGHT  
MIX HT = MIXING HEIGHT  
PLUME HT= PLUME CENTERLINE HEIGHT  
SIGMA Y = LATERAL DISPERSION PARAMETER  
SIGMA Z = VERTICAL DISPERSION PARAMETER  
DWASH = BUILDING DOWNWASH:  
DWASH= MEANS NO CALC MADE (CONC = 0.0)  
DWASH=NO MEANS NO BUILDING DOWNWASH USED  
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED

DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED  
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3\*LB

\*\*\*\*\*  
\*\*\* SCREEN DISCRETE DISTANCES \*\*\*  
\*\*\*\*\*

\*\*\* TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES  
\*\*\*

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	
DWASH									
1.	.0000	1	1.0	1.0	320.0	39.79	2.02	1.98	NO
250.	.1490E-02	3	2.0	2.0	640.0	24.46	29.33	17.75	NO
1490.	.6429E-03	6	1.0	1.0	10000.0	38.06	49.43	19.76	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)  
DWASH=NO MEANS NO BUILDING DOWNWASH USED  
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED  
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED  
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3\*LB

\*\*\*\*\*  
\*\*\* USER SPECIFIED AVERAGING TIMES \*\*\*  
\*\*\*\*\*

ESTIMATED MAXIMUM CONCENTRATION FOR 24 HR AVERAGING TIME:  
0.000634 (+/- 0.000317) UG/M\*\*3

\*\*\*\*\*  
\*\*\* END OF SCREEN MODEL OUTPUT \*\*\*  
\*\*\*\*\*

09/10/97  
22:10:45

\*\*\* SCREEN3 MODEL RUN \*\*\*  
\*\*\* VERSION DATED 95250 \*\*\*

Short-Term Worst Case Modeling for 2 3 7 8-TCDD DRE 90%

SIMPLE TERRAIN INPUTS:

SOURCE TYPE = POINT  
EMISSION RATE (G/S) = .252000E-05  
STACK HEIGHT (M) = 9.1400  
STK INSIDE DIAM (M) = .6100  
STK EXIT VELOCITY (M/S) = 14.7100  
STK GAS EXIT TEMP (K) = 333.0000  
AMBIENT AIR TEMP (K) = 293.0000  
RECEPTOR HEIGHT (M) = .0000  
URBAN/RURAL OPTION = RURAL  
BUILDING HEIGHT (M) = .0000  
MIN HORIZ BLDG DIM (M) = .0000  
MAX HORIZ BLDG DIM (M) = .0000

\*\*\*\*\*  
\*\*\* SUMMARY OF SCREEN MODEL RESULTS \*\*\*  
\*\*\*\*\*

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.3170E-03	173.	0.

\*\*\*\*\*  
\*\* REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS \*\*  
\*\*\*\*\*

BUOY. FLUX = 1.612 M\*\*4/S\*\*3; MOM. FLUX = 17.711 M\*\*4/S\*\*2.

\*\*\* FULL METEOROLOGY \*\*\*

\*\*\*\*\*  
\*\*\* SCREEN AUTOMATED DISTANCES \*\*\*  
\*\*\*\*\*

\*\*\* TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES  
\*\*\*

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	
DWASH									
1.	.0000	1	1.0	1.0	320.0	39.79	2.02	1.98	NO
100.	.2866E-03	2	4.0	4.0	1280.0	16.80	19.39	10.83	NO
200.	.3148E-03	3	3.0	3.0	960.0	19.36	23.80	14.33	NO
300.	.2854E-03	4	3.5	3.5	1120.0	17.90	22.75	12.35	NO
400.	.2716E-03	4	2.5	2.5	800.0	21.40	29.66	15.67	NO
500.	.2514E-03	4	2.0	2.0	640.0	24.46	36.41	18.81	NO
600.	.2284E-03	4	1.5	1.5	480.0	29.57	43.11	22.00	NO

700.	.2136E-03	4	1.5	1.5	480.0	29.57	49.53	24.73	NO
800.	.1951E-03	4	1.5	1.5	480.0	29.57	55.88	27.41	NO
900.	.1807E-03	4	1.0	1.0	320.0	39.79	62.50	30.74	NO
1000.	.1717E-03	4	1.0	1.0	320.0	39.79	68.69	33.27	NO
1100.	.1608E-03	4	1.0	1.0	320.0	39.79	74.82	35.23	NO
1200.	.1504E-03	4	1.0	1.0	320.0	39.79	80.91	37.14	NO
1300.	.1406E-03	4	1.0	1.0	320.0	39.79	86.96	39.00	NO
1400.	.1314E-03	4	1.0	1.0	320.0	39.79	92.97	40.81	NO
1500.	.1290E-03	6	1.0	1.0	10000.0	38.06	49.72	19.83	NO
1600.	.1329E-03	6	1.0	1.0	10000.0	38.06	52.65	20.52	NO
1700.	.1358E-03	6	1.0	1.0	10000.0	38.06	55.56	21.19	NO
1800.	.1378E-03	6	1.0	1.0	10000.0	38.06	58.45	21.86	NO
1900.	.1391E-03	6	1.0	1.0	10000.0	38.06	61.34	22.51	NO
2000.	.1397E-03	6	1.0	1.0	10000.0	38.06	64.21	23.15	NO
2100.	.1390E-03	6	1.0	1.0	10000.0	38.06	67.07	23.70	NO
2200.	.1379E-03	6	1.0	1.0	10000.0	38.06	69.91	24.23	NO
2300.	.1366E-03	6	1.0	1.0	10000.0	38.06	72.75	24.76	NO
2400.	.1352E-03	6	1.0	1.0	10000.0	38.06	75.57	25.28	NO
2500.	.1335E-03	6	1.0	1.0	10000.0	38.06	78.38	25.78	NO
2600.	.1318E-03	6	1.0	1.0	10000.0	38.06	81.19	26.28	NO
2700.	.1299E-03	6	1.0	1.0	10000.0	38.06	83.98	26.78	NO
2800.	.1280E-03	6	1.0	1.0	10000.0	38.06	86.76	27.26	NO
2900.	.1260E-03	6	1.0	1.0	10000.0	38.06	89.53	27.74	NO
3000.	.1240E-03	6	1.0	1.0	10000.0	38.06	92.29	28.21	NO
3500.	.1131E-03	6	1.0	1.0	10000.0	38.06	105.97	30.14	NO
4000.	.1033E-03	6	1.0	1.0	10000.0	38.06	119.46	31.92	NO
4500.	.9468E-04	6	1.0	1.0	10000.0	38.06	132.76	33.60	NO
5000.	.8705E-04	6	1.0	1.0	10000.0	38.06	145.90	35.19	NO
5500.	.8034E-04	6	1.0	1.0	10000.0	38.06	158.91	36.70	NO
6000.	.7442E-04	6	1.0	1.0	10000.0	38.06	171.78	38.14	NO
6500.	.6918E-04	6	1.0	1.0	10000.0	38.06	184.53	39.52	NO
7000.	.6453E-04	6	1.0	1.0	10000.0	38.06	197.17	40.85	NO
7500.	.6041E-04	6	1.0	1.0	10000.0	38.06	209.70	41.98	NO
8000.	.5674E-04	6	1.0	1.0	10000.0	38.06	222.14	43.08	NO
8500.	.5344E-04	6	1.0	1.0	10000.0	38.06	234.49	44.14	NO
9000.	.5047E-04	6	1.0	1.0	10000.0	38.06	246.75	45.16	NO
9500.	.4778E-04	6	1.0	1.0	10000.0	38.06	258.93	46.15	NO
10000.	.4533E-04	6	1.0	1.0	10000.0	38.06	271.03	47.11	NO
15000.	.2941E-04	6	1.0	1.0	10000.0	38.06	388.52	55.50	NO
20000.	.2164E-04	6	1.0	1.0	10000.0	38.06	501.02	60.86	NO
25000.	.1698E-04	6	1.0	1.0	10000.0	38.06	609.81	65.38	NO
30000.	.1391E-04	6	1.0	1.0	10000.0	38.06	715.64	69.33	NO
40000.	.1022E-04	6	1.0	1.0	10000.0	38.06	920.26	74.95	NO
50000.	.8042E-05	6	1.0	1.0	10000.0	38.06	1117.45	79.62	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 1. M:  
173. .3170E-03 3 3.5 3.5 1120.0 17.90 20.93 12.60 NO

DIST = DISTANCE FROM THE SOURCE  
CONC = MAXIMUM GROUND LEVEL CONCENTRATION  
STAB = ATMOSPHERIC STABILITY CLASS (1=A, 2=B, 3=C, 4=D, 5=E, 6=F)  
U10M = WIND SPEED AT THE 10-M LEVEL  
USTK = WIND SPEED AT STACK HEIGHT  
MIX HT = MIXING HEIGHT  
PLUME HT= PLUME CENTERLINE HEIGHT  
SIGMA Y = LATERAL DISPERSION PARAMETER  
SIGMA Z = VERTICAL DISPERSION PARAMETER  
DWASH = BUILDING DOWNWASH:  
DWASH= MEANS NO CALC MADE (CONC = 0.0)  
DWASH=NO MEANS NO BUILDING DOWNWASH USED  
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED

DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED  
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3\*LB

\*\*\*\*\*  
\*\*\* SCREEN DISCRETE DISTANCES \*\*\*  
\*\*\*\*\*

\*\*\* TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES  
\*\*\*

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	
-----									
1.	.0000	1	1.0	1.0	320.0	39.79	2.02	1.98	NO
250.	.2980E-03	3	2.0	2.0	640.0	24.46	29.33	17.75	NO
1490.	.1286E-03	6	1.0	1.0	10000.0	38.06	49.43	19.76	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)  
DWASH=NO MEANS NO BUILDING DOWNWASH USED  
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED  
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED  
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3\*LB

\*\*\*\*\*  
\*\*\* USER SPECIFIED AVERAGING TIMES \*\*\*  
\*\*\*\*\*

ESTIMATED MAXIMUM CONCENTRATION FOR 24 HR AVERAGING TIME:  
0.000127 (+/- 0.000063) UG/M\*\*3

\*\*\*\*\*  
\*\*\* END OF SCREEN MODEL OUTPUT \*\*\*  
\*\*\*\*\*

09/10/97  
22:12:22

\*\*\* SCREEN3 MODEL RUN \*\*\*  
\*\*\* VERSION DATED 95250 \*\*\*

Short-Term Worst Case Modeling for 2 3 7 8-TCDD DRE 95%

SIMPLE TERRAIN INPUTS:

SOURCE TYPE = POINT  
EMISSION RATE (G/S) = .126000E-05  
STACK HEIGHT (M) = 9.1400  
STK INSIDE DIAM (M) = .6100  
STK EXIT VELOCITY (M/S) = 14.7100  
STK GAS EXIT TEMP (K) = 333.0000  
AMBIENT AIR TEMP (K) = 293.0000  
RECEPTOR HEIGHT (M) = .0000  
URBAN/RURAL OPTION = RURAL  
BUILDING HEIGHT (M) = .0000  
MIN HORIZ BLDG DIM (M) = .0000  
MAX HORIZ BLDG DIM (M) = .0000

\*\*\*\*\*  
\*\*\* SUMMARY OF SCREEN MODEL RESULTS \*\*\*  
\*\*\*\*\*

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
-----	-----	-----	-----
SIMPLE TERRAIN	.1585E-03	173.	0.

\*\*\*\*\*  
\*\* REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS \*\*  
\*\*\*\*\*

BUOY. FLUX = 1.612 M\*\*4/S\*\*3; MOM. FLUX = 17.711 M\*\*4/S\*\*2.

\*\*\* FULL METEOROLOGY \*\*\*

\*\*\*\*\*  
\*\*\* SCREEN AUTOMATED DISTANCES \*\*\*  
\*\*\*\*\*

\*\*\* TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES  
\*\*\*

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1.	.0000	1	1.0	1.0	320.0	39.79	2.02	1.98	NO
100.	.1433E-03	2	4.0	4.0	1280.0	16.80	19.39	10.83	NO
200.	.1574E-03	3	3.0	3.0	960.0	19.36	23.80	14.33	NO
300.	.1427E-03	4	3.5	3.5	1120.0	17.90	22.75	12.35	NO
400.	.1358E-03	4	2.5	2.5	800.0	21.40	29.66	15.67	NO
500.	.1257E-03	4	2.0	2.0	640.0	24.46	36.41	18.81	NO
600.	.1142E-03	4	1.5	1.5	480.0	29.57	43.11	22.00	NO

700.	.1068E-03	4	1.5	1.5	480.0	29.57	49.53	24.73	NO
800.	.9755E-04	4	1.5	1.5	480.0	29.57	55.88	27.41	NO
900.	.9033E-04	4	1.0	1.0	320.0	39.79	62.50	30.74	NO
1000.	.8584E-04	4	1.0	1.0	320.0	39.79	68.69	33.27	NO
1100.	.8040E-04	4	1.0	1.0	320.0	39.79	74.82	35.23	NO
1200.	.7518E-04	4	1.0	1.0	320.0	39.79	80.91	37.14	NO
1300.	.7028E-04	4	1.0	1.0	320.0	39.79	86.96	39.00	NO
1400.	.6572E-04	4	1.0	1.0	320.0	39.79	92.97	40.81	NO
1500.	.6452E-04	6	1.0	1.0	10000.0	38.06	49.72	19.83	NO
1600.	.6647E-04	6	1.0	1.0	10000.0	38.06	52.65	20.52	NO
1700.	.6791E-04	6	1.0	1.0	10000.0	38.06	55.56	21.19	NO
1800.	.6892E-04	6	1.0	1.0	10000.0	38.06	58.45	21.86	NO
1900.	.6955E-04	6	1.0	1.0	10000.0	38.06	61.34	22.51	NO
2000.	.6986E-04	6	1.0	1.0	10000.0	38.06	64.21	23.15	NO
2100.	.6949E-04	6	1.0	1.0	10000.0	38.06	67.07	23.70	NO
2200.	.6897E-04	6	1.0	1.0	10000.0	38.06	69.91	24.23	NO
2300.	.6832E-04	6	1.0	1.0	10000.0	38.06	72.75	24.76	NO
2400.	.6758E-04	6	1.0	1.0	10000.0	38.06	75.57	25.28	NO
2500.	.6676E-04	6	1.0	1.0	10000.0	38.06	78.38	25.78	NO
2600.	.6588E-04	6	1.0	1.0	10000.0	38.06	81.19	26.28	NO
2700.	.6496E-04	6	1.0	1.0	10000.0	38.06	83.98	26.78	NO
2800.	.6400E-04	6	1.0	1.0	10000.0	38.06	86.76	27.26	NO
2900.	.6301E-04	6	1.0	1.0	10000.0	38.06	89.53	27.74	NO
3000.	.6201E-04	6	1.0	1.0	10000.0	38.06	92.29	28.21	NO
3500.	.5657E-04	6	1.0	1.0	10000.0	38.06	105.97	30.14	NO
4000.	.5167E-04	6	1.0	1.0	10000.0	38.06	119.46	31.92	NO
4500.	.4734E-04	6	1.0	1.0	10000.0	38.06	132.76	33.60	NO
5000.	.4352E-04	6	1.0	1.0	10000.0	38.06	145.90	35.19	NO
5500.	.4017E-04	6	1.0	1.0	10000.0	38.06	158.91	36.70	NO
6000.	.3721E-04	6	1.0	1.0	10000.0	38.06	171.78	38.14	NO
6500.	.3459E-04	6	1.0	1.0	10000.0	38.06	184.53	39.52	NO
7000.	.3226E-04	6	1.0	1.0	10000.0	38.06	197.17	40.85	NO
7500.	.3021E-04	6	1.0	1.0	10000.0	38.06	209.70	41.98	NO
8000.	.2837E-04	6	1.0	1.0	10000.0	38.06	222.14	43.08	NO
8500.	.2672E-04	6	1.0	1.0	10000.0	38.06	234.49	44.14	NO
9000.	.2523E-04	6	1.0	1.0	10000.0	38.06	246.75	45.16	NO
9500.	.2389E-04	6	1.0	1.0	10000.0	38.06	258.93	46.15	NO
10000.	.2267E-04	6	1.0	1.0	10000.0	38.06	271.03	47.11	NO
15000.	.1470E-04	6	1.0	1.0	10000.0	38.06	388.52	55.50	NO
20000.	.1082E-04	6	1.0	1.0	10000.0	38.06	501.02	60.86	NO
25000.	.8492E-05	6	1.0	1.0	10000.0	38.06	609.81	65.38	NO
30000.	.6953E-05	6	1.0	1.0	10000.0	38.06	715.64	69.33	NO
40000.	.5112E-05	6	1.0	1.0	10000.0	38.06	920.26	74.95	NO
50000.	.4021E-05	6	1.0	1.0	10000.0	38.06	1117.45	79.62	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 1. M:  
173. .1585E-03 3 3.5 3.5 1120.0 17.90 20.93 12.60 NO

DIST = DISTANCE FROM THE SOURCE  
CONC = MAXIMUM GROUND LEVEL CONCENTRATION  
STAB = ATMOSPHERIC STABILITY CLASS (1=A, 2=B, 3=C, 4=D, 5=E, 6=F)  
U10M = WIND SPEED AT THE 10-M LEVEL  
USTK = WIND SPEED AT STACK HEIGHT  
MIX HT = MIXING HEIGHT  
PLUME HT= PLUME CENTERLINE HEIGHT  
SIGMA Y = LATERAL DISPERSION PARAMETER  
SIGMA Z = VERTICAL DISPERSION PARAMETER  
DWASH = BUILDING DOWNWASH:  
DWASH= MEANS NO CALC MADE (CONC = 0.0)  
DWASH=NO MEANS NO BUILDING DOWNWASH USED  
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED



DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED  
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3\*LB

\*\*\*\*\*  
\*\*\* SCREEN DISCRETE DISTANCES \*\*\*  
\*\*\*\*\*

\*\*\* TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES  
\*\*\*

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	
DWASH									
1.	.0000	1	1.0	1.0	320.0	39.79	2.02	1.98	NO
250.	.1490E-03	3	2.0	2.0	640.0	24.46	29.33	17.75	NO
1490.	.6429E-04	6	1.0	1.0	10000.0	38.06	49.43	19.76	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)  
DWASH=NO MEANS NO BUILDING DOWNWASH USED  
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED  
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED  
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3\*LB

\*\*\*\*\*  
\*\*\* USER SPECIFIED AVERAGING TIMES \*\*\*  
\*\*\*\*\*

ESTIMATED MAXIMUM CONCENTRATION FOR 24 HR AVERAGING TIME:  
0.000063 (+/- 0.000032) UG/M\*\*3

\*\*\*\*\*  
\*\*\* END OF SCREEN MODEL OUTPUT \*\*\*  
\*\*\*\*\*

09/10/97  
22:15:11

\*\*\* SCREEN3 MODEL RUN \*\*\*  
\*\*\* VERSION DATED 95250 \*\*\*

Short-Term Worst Case Modeling for 2 3 7 8-TCDD DRE 99%

SIMPLE TERRAIN INPUTS:

SOURCE TYPE = POINT  
EMISSION RATE (G/S) = .252000E-06  
STACK HEIGHT (M) = 9.1400  
STK INSIDE DIAM (M) = .6100  
STK EXIT VELOCITY (M/S) = 14.7100  
STK GAS EXIT TEMP (K) = 333.0000  
AMBIENT AIR TEMP (K) = 293.0000  
RECEPTOR HEIGHT (M) = .0000  
URBAN/RURAL OPTION = RURAL  
BUILDING HEIGHT (M) = .0000  
MIN HORIZ BLDG DIM (M) = .0000  
MAX HORIZ BLDG DIM (M) = .0000

\*\*\*\*\*  
\*\*\* SUMMARY OF SCREEN MODEL RESULTS \*\*\*  
\*\*\*\*\*

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.3170E-04	173.	0.

\*\*\*\*\*  
\*\* REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS \*\*  
\*\*\*\*\*

BUOY. FLUX = 1.612 M\*\*4/S\*\*3; MOM. FLUX = 17.711 M\*\*4/S\*\*2.

\*\*\* FULL METEOROLOGY \*\*\*

\*\*\*\*\*  
\*\*\* SCREEN AUTOMATED DISTANCES \*\*\*  
\*\*\*\*\*

\*\*\* TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES  
\*\*\*

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	
DWASH									
1.	.0000	1	1.0	1.0	320.0	39.79	2.02	1.98	NO
100.	.2866E-04	2	4.0	4.0	1280.0	16.80	19.39	10.83	NO
200.	.3148E-04	3	3.0	3.0	960.0	19.36	23.80	14.33	NO
300.	.2854E-04	4	3.5	3.5	1120.0	17.90	22.75	12.35	NO
400.	.2715E-04	4	2.5	2.5	800.0	21.40	29.66	15.67	NO
500.	.2514E-04	4	2.0	2.0	640.0	24.46	36.41	18.81	NO
600.	.2284E-04	4	1.5	1.5	480.0	29.57	43.11	22.00	NO

700.	.2136E-04	4	1.5	1.5	480.0	29.57	49.53	24.73	NO
800.	.1951E-04	4	1.5	1.5	480.0	29.57	55.88	27.41	NO
900.	.1807E-04	4	1.0	1.0	320.0	39.79	62.50	30.74	NO
1000.	.1717E-04	4	1.0	1.0	320.0	39.79	68.69	33.27	NO
1100.	.1608E-04	4	1.0	1.0	320.0	39.79	74.82	35.23	NO
1200.	.1504E-04	4	1.0	1.0	320.0	39.79	80.91	37.14	NO
1300.	.1406E-04	4	1.0	1.0	320.0	39.79	86.96	39.00	NO
1400.	.1314E-04	4	1.0	1.0	320.0	39.79	92.97	40.81	NO
1500.	.1290E-04	6	1.0	1.0	10000.0	38.06	49.72	19.83	NO
1600.	.1329E-04	6	1.0	1.0	10000.0	38.06	52.65	20.52	NO
1700.	.1358E-04	6	1.0	1.0	10000.0	38.06	55.56	21.19	NO
1800.	.1378E-04	6	1.0	1.0	10000.0	38.06	58.45	21.86	NO
1900.	.1391E-04	6	1.0	1.0	10000.0	38.06	61.34	22.51	NO
2000.	.1397E-04	6	1.0	1.0	10000.0	38.06	64.21	23.15	NO
2100.	.1390E-04	6	1.0	1.0	10000.0	38.06	67.07	23.70	NO
2200.	.1379E-04	6	1.0	1.0	10000.0	38.06	69.91	24.23	NO
2300.	.1366E-04	6	1.0	1.0	10000.0	38.06	72.75	24.76	NO
2400.	.1352E-04	6	1.0	1.0	10000.0	38.06	75.57	25.28	NO
2500.	.1335E-04	6	1.0	1.0	10000.0	38.06	78.38	25.78	NO
2600.	.1318E-04	6	1.0	1.0	10000.0	38.06	81.19	26.28	NO
2700.	.1299E-04	6	1.0	1.0	10000.0	38.06	83.98	26.78	NO
2800.	.1280E-04	6	1.0	1.0	10000.0	38.06	86.76	27.26	NO
2900.	.1260E-04	6	1.0	1.0	10000.0	38.06	89.53	27.74	NO
3000.	.1240E-04	6	1.0	1.0	10000.0	38.06	92.29	28.21	NO
3500.	.1131E-04	6	1.0	1.0	10000.0	38.06	105.97	30.14	NO
4000.	.1033E-04	6	1.0	1.0	10000.0	38.06	119.46	31.92	NO
4500.	.9468E-05	6	1.0	1.0	10000.0	38.06	132.76	33.60	NO
5000.	.8705E-05	6	1.0	1.0	10000.0	38.06	145.90	35.19	NO
5500.	.8034E-05	6	1.0	1.0	10000.0	38.06	158.91	36.70	NO
6000.	.7442E-05	6	1.0	1.0	10000.0	38.06	171.78	38.14	NO
6500.	.6918E-05	6	1.0	1.0	10000.0	38.06	184.53	39.52	NO
7000.	.6453E-05	6	1.0	1.0	10000.0	38.06	197.17	40.85	NO
7500.	.6041E-05	6	1.0	1.0	10000.0	38.06	209.70	41.98	NO
8000.	.5674E-05	6	1.0	1.0	10000.0	38.06	222.14	43.08	NO
8500.	.5344E-05	6	1.0	1.0	10000.0	38.06	234.49	44.14	NO
9000.	.5047E-05	6	1.0	1.0	10000.0	38.06	246.75	45.16	NO
9500.	.4778E-05	6	1.0	1.0	10000.0	38.06	258.93	46.15	NO
10000.	.4533E-05	6	1.0	1.0	10000.0	38.06	271.03	47.11	NO
15000.	.2941E-05	6	1.0	1.0	10000.0	38.06	388.52	55.50	NO
20000.	.2164E-05	6	1.0	1.0	10000.0	38.06	501.02	60.86	NO
25000.	.1698E-05	6	1.0	1.0	10000.0	38.06	609.81	65.38	NO
30000.	.1391E-05	6	1.0	1.0	10000.0	38.06	715.64	69.33	NO
40000.	.1022E-05	6	1.0	1.0	10000.0	38.06	920.26	74.95	NO
50000.	.8042E-06	6	1.0	1.0	10000.0	38.06	1117.45	79.62	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 1. M:  
173. .3170E-04 3 3.5 3.5 1120.0 17.90 20.93 12.60 NO

DIST = DISTANCE FROM THE SOURCE  
CONC = MAXIMUM GROUND LEVEL CONCENTRATION  
STAB = ATMOSPHERIC STABILITY CLASS (1=A, 2=B, 3=C, 4=D, 5=E, 6=F)  
U10M = WIND SPEED AT THE 10-M LEVEL  
USTK = WIND SPEED AT STACK HEIGHT  
MIX HT = MIXING HEIGHT  
PLUME HT= PLUME CENTERLINE HEIGHT  
SIGMA Y = LATERAL DISPERSION PARAMETER  
SIGMA Z = VERTICAL DISPERSION PARAMETER  
DWASH = BUILDING DOWNWASH:  
DWASH= MEANS NO CALC MADE (CONC = 0.0)  
DWASH=NO MEANS NO BUILDING DOWNWASH USED  
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED

DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED  
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3\*LB

\*\*\*\*\*  
\*\*\* SCREEN DISCRETE DISTANCES \*\*\*  
\*\*\*\*\*

\*\*\* TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES  
\*\*\*

DWASH	DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	
-	1.	.0000	1	1.0	1.0	320.0	39.79	2.02	1.98	NO
-	250.	.2980E-04	3	2.0	2.0	640.0	24.46	29.33	17.75	NO
-	1490.	.1286E-04	6	1.0	1.0	10000.0	38.06	49.43	19.76	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)  
DWASH=NO MEANS NO BUILDING DOWNWASH USED  
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED  
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED  
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3\*LB

\*\*\*\*\*  
\*\*\* USER SPECIFIED AVERAGING TIMES \*\*\*  
\*\*\*\*\*

ESTIMATED MAXIMUM CONCENTRATION FOR 24 HR AVERAGING TIME:  
0.000013 (+/- 0.000006) UG/M\*\*3

\*\*\*\*\*  
\*\*\* END OF SCREEN MODEL OUTPUT \*\*\*  
\*\*\*\*\*

09/10/97  
22:17:31

\*\*\* SCREEN3 MODEL RUN \*\*\*  
\*\*\* VERSION DATED 95250 \*\*\*

Annualized Worst Case Modeling for 2 3 7 8-TCDD DRE 0

SIMPLE TERRAIN INPUTS:

SOURCE TYPE = POINT  
EMISSION RATE (G/S) = .484000E-06  
STACK HEIGHT (M) = 9.1400  
STK INSIDE DIAM (M) = .6100  
STK EXIT VELOCITY (M/S) = 14.7100  
STK GAS EXIT TEMP (K) = 333.0000  
AMBIENT AIR TEMP (K) = 293.0000  
RECEPTOR HEIGHT (M) = .0000  
URBAN/RURAL OPTION = RURAL  
BUILDING HEIGHT (M) = .0000  
MIN HORIZ BLDG DIM (M) = .0000  
MAX HORIZ BLDG DIM (M) = .0000

\*\*\*\*\*  
\*\*\* SUMMARY OF SCREEN MODEL RESULTS \*\*\*  
\*\*\*\*\*

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.6089E-04	173.	0.

\*\*\*\*\*  
\*\* REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS \*\*  
\*\*\*\*\*

BOUY. FLUX = 1.612 M\*\*4/S\*\*3; MOM. FLUX = 17.711 M\*\*4/S\*\*2.

\*\*\* FULL METEOROLOGY \*\*\*

\*\*\*\*\*  
\*\*\* SCREEN AUTOMATED DISTANCES \*\*\*  
\*\*\*\*\*

\*\*\* TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES  
\*\*\*

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	
DWASH									
1.	.0000	1	1.0	1.0	320.0	39.79	2.02	1.98	NO
100.	.5504E-04	2	4.0	4.0	1280.0	16.80	19.39	10.83	NO
200.	.6047E-04	3	3.0	3.0	960.0	19.36	23.80	14.33	NO
300.	.5482E-04	4	3.5	3.5	1120.0	17.90	22.75	12.35	NO
400.	.5217E-04	4	2.5	2.5	800.0	21.40	29.66	15.67	NO
500.	.4828E-04	4	2.0	2.0	640.0	24.46	36.41	18.81	NO
600.	.4387E-04	4	1.5	1.5	480.0	29.57	43.11	22.00	NO

700.	.4102E-04	4	1.5	1.5	480.0	29.57	49.53	24.73	NO
800.	.3747E-04	4	1.5	1.5	480.0	29.57	55.88	27.41	NO
900.	.3470E-04	4	1.0	1.0	320.0	39.79	62.50	30.74	NO
1000.	.3297E-04	4	1.0	1.0	320.0	39.79	68.69	33.27	NO
1100.	.3089E-04	4	1.0	1.0	320.0	39.79	74.82	35.23	NO
1200.	.2888E-04	4	1.0	1.0	320.0	39.79	80.91	37.14	NO
1300.	.2700E-04	4	1.0	1.0	320.0	39.79	86.96	39.00	NO
1400.	.2525E-04	4	1.0	1.0	320.0	39.79	92.97	40.81	NO
1500.	.2478E-04	6	1.0	1.0	10000.0	38.06	49.72	19.83	NO
1600.	.2553E-04	6	1.0	1.0	10000.0	38.06	52.65	20.52	NO
1700.	.2609E-04	6	1.0	1.0	10000.0	38.06	55.56	21.19	NO
1800.	.2647E-04	6	1.0	1.0	10000.0	38.06	58.45	21.86	NO
1900.	.2672E-04	6	1.0	1.0	10000.0	38.06	61.34	22.51	NO
2000.	.2684E-04	6	1.0	1.0	10000.0	38.06	64.21	23.15	NO
2100.	.2669E-04	6	1.0	1.0	10000.0	38.06	67.07	23.70	NO
2200.	.2649E-04	6	1.0	1.0	10000.0	38.06	69.91	24.23	NO
2300.	.2624E-04	6	1.0	1.0	10000.0	38.06	72.75	24.76	NO
2400.	.2596E-04	6	1.0	1.0	10000.0	38.06	75.57	25.28	NO
2500.	.2565E-04	6	1.0	1.0	10000.0	38.06	78.38	25.78	NO
2600.	.2531E-04	6	1.0	1.0	10000.0	38.06	81.19	26.28	NO
2700.	.2495E-04	6	1.0	1.0	10000.0	38.06	83.98	26.78	NO
2800.	.2458E-04	6	1.0	1.0	10000.0	38.06	86.76	27.26	NO
2900.	.2420E-04	6	1.0	1.0	10000.0	38.06	89.53	27.74	NO
3000.	.2382E-04	6	1.0	1.0	10000.0	38.06	92.29	28.21	NO
3500.	.2173E-04	6	1.0	1.0	10000.0	38.06	105.97	30.14	NO
4000.	.1985E-04	6	1.0	1.0	10000.0	38.06	119.46	31.92	NO
4500.	.1818E-04	6	1.0	1.0	10000.0	38.06	132.76	33.60	NO
5000.	.1672E-04	6	1.0	1.0	10000.0	38.06	145.90	35.19	NO
5500.	.1543E-04	6	1.0	1.0	10000.0	38.06	158.91	36.70	NO
6000.	.1429E-04	6	1.0	1.0	10000.0	38.06	171.78	38.14	NO
6500.	.1329E-04	6	1.0	1.0	10000.0	38.06	184.53	39.52	NO
7000.	.1239E-04	6	1.0	1.0	10000.0	38.06	197.17	40.85	NO
7500.	.1160E-04	6	1.0	1.0	10000.0	38.06	209.70	41.98	NO
8000.	.1090E-04	6	1.0	1.0	10000.0	38.06	222.14	43.08	NO
8500.	.1026E-04	6	1.0	1.0	10000.0	38.06	234.49	44.14	NO
9000.	.9693E-05	6	1.0	1.0	10000.0	38.06	246.75	45.16	NO
9500.	.9176E-05	6	1.0	1.0	10000.0	38.06	258.93	46.15	NO
10000.	.8706E-05	6	1.0	1.0	10000.0	38.06	271.03	47.11	NO
15000.	.5648E-05	6	1.0	1.0	10000.0	38.06	388.52	55.50	NO
20000.	.4155E-05	6	1.0	1.0	10000.0	38.06	501.02	60.86	NO
25000.	.3262E-05	6	1.0	1.0	10000.0	38.06	609.81	65.38	NO
30000.	.2671E-05	6	1.0	1.0	10000.0	38.06	715.64	69.33	NO
40000.	.1964E-05	6	1.0	1.0	10000.0	38.06	920.26	74.95	NO
50000.	.1545E-05	6	1.0	1.0	10000.0	38.06	1117.45	79.62	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 1. M:  
173. .6089E-04 3 3.5 3.5 1120.0 17.90 20.93 12.60 NO

DIST = DISTANCE FROM THE SOURCE  
CONC = MAXIMUM GROUND LEVEL CONCENTRATION  
STAB = ATMOSPHERIC STABILITY CLASS (1=A, 2=B, 3=C, 4=D, 5=E, 6=F)  
U10M = WIND SPEED AT THE 10-M LEVEL  
USTK = WIND SPEED AT STACK HEIGHT  
MIX HT = MIXING HEIGHT  
PLUME HT= PLUME CENTERLINE HEIGHT  
SIGMA Y = LATERAL DISPERSION PARAMETER  
SIGMA Z = VERTICAL DISPERSION PARAMETER  
DWASH = BUILDING DOWNWASH:  
DWASH= MEANS NO CALC MADE (CONC = 0.0)  
DWASH=NO MEANS NO BUILDING DOWNWASH USED  
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED

DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED  
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3\*LB

\*\*\*\*\*  
\*\*\* SCREEN DISCRETE DISTANCES \*\*\*  
\*\*\*\*\*

\*\*\* TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES  
\*\*\*

DWASH	DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	
-	1.	.0000	1	1.0	1.0	320.0	39.79	2.02	1.98	NO
	250.	.5724E-04	3	2.0	2.0	640.0	24.46	29.33	17.75	NO
	1490.	.2470E-04	6	1.0	1.0	10000.0	38.06	49.43	19.76	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)  
DWASH=NO MEANS NO BUILDING DOWNWASH USED  
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED  
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED  
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3\*LB

\*\*\*\*\*  
\*\*\* USER SPECIFIED AVERAGING TIMES \*\*\*  
\*\*\*\*\*

ESTIMATED MAXIMUM CONCENTRATION FOR ANNUAL AVERAGING TIME:  
0.000005 (+/- 0.000001) UG/M\*\*3

\*\*\*\*\*  
\*\*\* END OF SCREEN MODEL OUTPUT \*\*\*  
\*\*\*\*\*

09/10/97  
22:19:10

\*\*\* SCREEN3 MODEL RUN \*\*\*  
\*\*\* VERSION DATED 95250 \*\*\*

Annualized Worst Case Modeling for 2 3 7 8-TCDD DRE 50t

SIMPLE TERRAIN INPUTS:

SOURCE TYPE = POINT  
EMISSION RATE (G/S) = .242000E-06  
STACK HEIGHT (M) = 9.1400  
STK INSIDE DIAM (M) = .6100  
STK EXIT VELOCITY (M/S) = 14.7100  
STK GAS EXIT TEMP (K) = 333.0000  
AMBIENT AIR TEMP (K) = 293.0000  
RECEPTOR HEIGHT (M) = .0000  
URBAN/RURAL OPTION = RURAL  
BUILDING HEIGHT (M) = .0000  
MIN HORIZ BLDG DIM (M) = .0000  
MAX HORIZ BLDG DIM (M) = .0000

\*\*\*\*\*  
\*\*\* SUMMARY OF SCREEN MODEL RESULTS \*\*\*  
\*\*\*\*\*

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.3044E-04	173.	0.

\*\*\*\*\*  
\*\* REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS \*\*  
\*\*\*\*\*

BUOY. FLUX = 1.612 M\*\*4/S\*\*3; MOM. FLUX = 17.711 M\*\*4/S\*\*2.

\*\*\* FULL METEOROLOGY \*\*\*

\*\*\*\*\*  
\*\*\* SCREEN AUTOMATED DISTANCES \*\*\*  
\*\*\*\*\*

\*\*\* TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES  
\*\*\*

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	
DWASH									
1.	.0000	1	1.0	1.0	320.0	39.79	2.02	1.98	NO
100.	.2752E-04	2	4.0	4.0	1280.0	16.80	19.39	10.83	NO
200.	.3023E-04	3	3.0	3.0	960.0	19.36	23.80	14.33	NO
300.	.2741E-04	4	3.5	3.5	1120.0	17.90	22.75	12.35	NO
400.	.2608E-04	4	2.5	2.5	800.0	21.40	29.66	15.67	NO
500.	.2414E-04	4	2.0	2.0	640.0	24.46	36.41	18.81	NO
600.	.2194E-04	4	1.5	1.5	480.0	29.57	43.11	22.00	NO



700.	.2051E-04	4	1.5	1.5	480.0	29.57	49.53	24.73	NO
800.	.1874E-04	4	1.5	1.5	480.0	29.57	55.88	27.41	NO
900.	.1735E-04	4	1.0	1.0	320.0	39.79	62.50	30.74	NO
1000.	.1649E-04	4	1.0	1.0	320.0	39.79	68.69	33.27	NO
1100.	.1544E-04	4	1.0	1.0	320.0	39.79	74.82	35.23	NO
1200.	.1444E-04	4	1.0	1.0	320.0	39.79	80.91	37.14	NO
1300.	.1350E-04	4	1.0	1.0	320.0	39.79	86.96	39.00	NO
1400.	.1262E-04	4	1.0	1.0	320.0	39.79	92.97	40.81	NO
1500.	.1239E-04	6	1.0	1.0	10000.0	38.06	49.72	19.83	NO
1600.	.1277E-04	6	1.0	1.0	10000.0	38.06	52.65	20.52	NO
1700.	.1304E-04	6	1.0	1.0	10000.0	38.06	55.56	21.19	NO
1800.	.1324E-04	6	1.0	1.0	10000.0	38.06	58.45	21.86	NO
1900.	.1336E-04	6	1.0	1.0	10000.0	38.06	61.34	22.51	NO
2000.	.1342E-04	6	1.0	1.0	10000.0	38.06	64.21	23.15	NO
2100.	.1335E-04	6	1.0	1.0	10000.0	38.06	67.07	23.70	NO
2200.	.1325E-04	6	1.0	1.0	10000.0	38.06	69.91	24.23	NO
2300.	.1312E-04	6	1.0	1.0	10000.0	38.06	72.75	24.76	NO
2400.	.1298E-04	6	1.0	1.0	10000.0	38.06	75.57	25.28	NO
2500.	.1282E-04	6	1.0	1.0	10000.0	38.06	78.38	25.78	NO
2600.	.1265E-04	6	1.0	1.0	10000.0	38.06	81.19	26.28	NO
2700.	.1248E-04	6	1.0	1.0	10000.0	38.06	83.98	26.78	NO
2800.	.1229E-04	6	1.0	1.0	10000.0	38.06	86.76	27.26	NO
2900.	.1210E-04	6	1.0	1.0	10000.0	38.06	89.53	27.74	NO
3000.	.1191E-04	6	1.0	1.0	10000.0	38.06	92.29	28.21	NO
3500.	.1087E-04	6	1.0	1.0	10000.0	38.06	105.97	30.14	NO
4000.	.9925E-05	6	1.0	1.0	10000.0	38.06	119.46	31.92	NO
4500.	.9092E-05	6	1.0	1.0	10000.0	38.06	132.76	33.60	NO
5000.	.8360E-05	6	1.0	1.0	10000.0	38.06	145.90	35.19	NO
5500.	.7715E-05	6	1.0	1.0	10000.0	38.06	158.91	36.70	NO
6000.	.7147E-05	6	1.0	1.0	10000.0	38.06	171.78	38.14	NO
6500.	.6644E-05	6	1.0	1.0	10000.0	38.06	184.53	39.52	NO
7000.	.6197E-05	6	1.0	1.0	10000.0	38.06	197.17	40.85	NO
7500.	.5801E-05	6	1.0	1.0	10000.0	38.06	209.70	41.98	NO
8000.	.5449E-05	6	1.0	1.0	10000.0	38.06	222.14	43.08	NO
8500.	.5132E-05	6	1.0	1.0	10000.0	38.06	234.49	44.14	NO
9000.	.4847E-05	6	1.0	1.0	10000.0	38.06	246.75	45.16	NO
9500.	.4588E-05	6	1.0	1.0	10000.0	38.06	258.93	46.15	NO
10000.	.4353E-05	6	1.0	1.0	10000.0	38.06	271.03	47.11	NO
15000.	.2824E-05	6	1.0	1.0	10000.0	38.06	388.52	55.50	NO
20000.	.2078E-05	6	1.0	1.0	10000.0	38.06	501.02	60.86	NO
25000.	.1631E-05	6	1.0	1.0	10000.0	38.06	609.81	65.38	NO
30000.	.1335E-05	6	1.0	1.0	10000.0	38.06	715.64	69.33	NO
40000.	.9818E-06	6	1.0	1.0	10000.0	38.06	920.26	74.95	NO
50000.	.7723E-06	6	1.0	1.0	10000.0	38.06	1117.45	79.62	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 1. M:  
173. .3044E-04 3 3.5 3.5 1120.0 17.90 20.93 12.60 NO

DIST = DISTANCE FROM THE SOURCE  
CONC = MAXIMUM GROUND LEVEL CONCENTRATION  
STAB = ATMOSPHERIC STABILITY CLASS (1=A, 2=B, 3=C, 4=D, 5=E, 6=F)  
U10M = WIND SPEED AT THE 10-M LEVEL  
USTK = WIND SPEED AT STACK HEIGHT  
MIX HT = MIXING HEIGHT  
PLUME HT= PLUME CENTERLINE HEIGHT  
SIGMA Y = LATERAL DISPERSION PARAMETER  
SIGMA Z = VERTICAL DISPERSION PARAMETER  
DWASH = BUILDING DOWNWASH:  
DWASH= MEANS NO CALC MADE (CONC = 0.0)  
DWASH=NO MEANS NO BUILDING DOWNWASH USED  
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED

DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED  
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3\*LB

\*\*\*\*\*  
\*\*\* SCREEN DISCRETE DISTANCES \*\*\*  
\*\*\*\*\*

\*\*\* TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES  
\*\*\*

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	
DWASH									
1.	.0000	1	1.0	1.0	320.0	39.79	2.02	1.98	NO
250.	.2862E-04	3	2.0	2.0	640.0	24.46	29.33	17.75	NO
1490.	.1235E-04	6	1.0	1.0	10000.0	38.06	49.43	19.76	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)  
DWASH=NO MEANS NO BUILDING DOWNWASH USED  
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED  
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED  
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3\*LB

\*\*\*\*\*  
\*\*\* USER SPECIFIED AVERAGING TIMES \*\*\*  
\*\*\*\*\*

ESTIMATED MAXIMUM CONCENTRATION FOR ANNUAL AVERAGING TIME:  
0.000002 (+/- 6.09E-7) UG/M\*\*3

\*\*\*\*\*  
\*\*\* END OF SCREEN MODEL OUTPUT \*\*\*  
\*\*\*\*\*

09/10/97  
22:20:36

\*\*\* SCREEN3 MODEL RUN \*\*\*  
\*\*\* VERSION DATED 95250 \*\*\*

Annualized Worst Case Modeling for 2 3 7 8-TCDD DRE 90%

SIMPLE TERRAIN INPUTS:

SOURCE TYPE = POINT  
EMISSION RATE (G/S) = .484000E-07  
STACK HEIGHT (M) = 9.1400  
STK INSIDE DIAM (M) = .6100  
STK EXIT VELOCITY (M/S) = 14.7100  
STK GAS EXIT TEMP (K) = 333.0000  
AMBIENT AIR TEMP (K) = 293.0000  
RECEPTOR HEIGHT (M) = .0000  
URBAN/RURAL OPTION = RURAL  
BUILDING HEIGHT (M) = .0000  
MIN HORIZ BLDG DIM (M) = .0000  
MAX HORIZ BLDG DIM (M) = .0000

\*\*\*\*\*  
\*\*\* SUMMARY OF SCREEN MODEL RESULTS \*\*\*  
\*\*\*\*\*

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.6089E-05	173.	0.

\*\*\*\*\*  
\*\* REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS \*\*  
\*\*\*\*\*

BUOY. FLUX = 1.612 M\*\*4/S\*\*3; MOM. FLUX = 17.711 M\*\*4/S\*\*2.

\*\*\* FULL METEOROLOGY \*\*\*

\*\*\*\*\*  
\*\*\* SCREEN AUTOMATED DISTANCES \*\*\*  
\*\*\*\*\*

\*\*\* TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES  
\*\*\*

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	
DWASH									
1.	.0000	1	1.0	1.0	320.0	39.79	2.02	1.98	NO
100.	.5504E-05	2	4.0	4.0	1280.0	16.80	19.39	10.83	NO
200.	.6047E-05	3	3.0	3.0	960.0	19.36	23.80	14.33	NO
300.	.5482E-05	4	3.5	3.5	1120.0	17.90	22.75	12.35	NO
400.	.5217E-05	4	2.5	2.5	800.0	21.40	29.66	15.67	NO
500.	.4828E-05	4	2.0	2.0	640.0	24.46	36.41	18.81	NO
600.	.4387E-05	4	1.5	1.5	480.0	29.57	43.11	22.00	NO

700.	.4102E-05	4	1.5	1.5	480.0	29.57	49.53	24.73	NO
800.	.3747E-05	4	1.5	1.5	480.0	29.57	55.88	27.41	NO
900.	.3470E-05	4	1.0	1.0	320.0	39.79	62.50	30.74	NO
1000.	.3297E-05	4	1.0	1.0	320.0	39.79	68.69	33.27	NO
1100.	.3089E-05	4	1.0	1.0	320.0	39.79	74.82	35.23	NO
1200.	.2888E-05	4	1.0	1.0	320.0	39.79	80.91	37.14	NO
1300.	.2700E-05	4	1.0	1.0	320.0	39.79	86.96	39.00	NO
1400.	.2525E-05	4	1.0	1.0	320.0	39.79	92.97	40.81	NO
1500.	.2478E-05	6	1.0	1.0	10000.0	38.06	49.72	19.83	NO
1600.	.2553E-05	6	1.0	1.0	10000.0	38.06	52.65	20.52	NO
1700.	.2609E-05	6	1.0	1.0	10000.0	38.06	55.56	21.19	NO
1800.	.2647E-05	6	1.0	1.0	10000.0	38.06	58.45	21.86	NO
1900.	.2672E-05	6	1.0	1.0	10000.0	38.06	61.34	22.51	NO
2000.	.2684E-05	6	1.0	1.0	10000.0	38.06	64.21	23.15	NO
2100.	.2669E-05	6	1.0	1.0	10000.0	38.06	67.07	23.70	NO
2200.	.2649E-05	6	1.0	1.0	10000.0	38.06	69.91	24.23	NO
2300.	.2624E-05	6	1.0	1.0	10000.0	38.06	72.75	24.76	NO
2400.	.2596E-05	6	1.0	1.0	10000.0	38.06	75.57	25.28	NO
2500.	.2565E-05	6	1.0	1.0	10000.0	38.06	78.38	25.78	NO
2600.	.2531E-05	6	1.0	1.0	10000.0	38.06	81.19	26.28	NO
2700.	.2495E-05	6	1.0	1.0	10000.0	38.06	83.98	26.78	NO
2800.	.2458E-05	6	1.0	1.0	10000.0	38.06	86.76	27.26	NO
2900.	.2420E-05	6	1.0	1.0	10000.0	38.06	89.53	27.74	NO
3000.	.2382E-05	6	1.0	1.0	10000.0	38.06	92.29	28.21	NO
3500.	.2173E-05	6	1.0	1.0	10000.0	38.06	105.97	30.14	NO
4000.	.1985E-05	6	1.0	1.0	10000.0	38.06	119.46	31.92	NO
4500.	.1818E-05	6	1.0	1.0	10000.0	38.06	132.76	33.60	NO
5000.	.1672E-05	6	1.0	1.0	10000.0	38.06	145.90	35.19	NO
5500.	.1543E-05	6	1.0	1.0	10000.0	38.06	158.91	36.70	NO
6000.	.1429E-05	6	1.0	1.0	10000.0	38.06	171.78	38.14	NO
6500.	.1329E-05	6	1.0	1.0	10000.0	38.06	184.53	39.52	NO
7000.	.1239E-05	6	1.0	1.0	10000.0	38.06	197.17	40.85	NO
7500.	.1160E-05	6	1.0	1.0	10000.0	38.06	209.70	41.98	NO
8000.	.1090E-05	6	1.0	1.0	10000.0	38.06	222.14	43.08	NO
8500.	.1026E-05	6	1.0	1.0	10000.0	38.06	234.49	44.14	NO
9000.	.9693E-06	6	1.0	1.0	10000.0	38.06	246.75	45.16	NO
9500.	.9176E-06	6	1.0	1.0	10000.0	38.06	258.93	46.15	NO
10000.	.8706E-06	6	1.0	1.0	10000.0	38.06	271.03	47.11	NO
15000.	.5648E-06	6	1.0	1.0	10000.0	38.06	388.52	55.50	NO
20000.	.4155E-06	6	1.0	1.0	10000.0	38.06	501.02	60.86	NO
25000.	.3262E-06	6	1.0	1.0	10000.0	38.06	609.81	65.38	NO
30000.	.2671E-06	6	1.0	1.0	10000.0	38.06	715.64	69.33	NO
40000.	.1964E-06	6	1.0	1.0	10000.0	38.06	920.26	74.95	NO
50000.	.1545E-06	6	1.0	1.0	10000.0	38.06	1117.45	79.62	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 1. M:  
173. .6089E-05 3 3.5 3.5 1120.0 17.90 20.93 12.60 NO

DIST = DISTANCE FROM THE SOURCE  
CONC = MAXIMUM GROUND LEVEL CONCENTRATION  
STAB = ATMOSPHERIC STABILITY CLASS (1=A, 2=B, 3=C, 4=D, 5=E, 6=F)  
U10M = WIND SPEED AT THE 10-M LEVEL  
USTK = WIND SPEED AT STACK HEIGHT  
MIX HT = MIXING HEIGHT  
PLUME HT= PLUME CENTERLINE HEIGHT  
SIGMA Y = LATERAL DISPERSION PARAMETER  
SIGMA Z = VERTICAL DISPERSION PARAMETER  
DWASH = BUILDING DOWNWASH:  
DWASH= MEANS NO CALC MADE (CONC = 0.0)  
DWASH=NO MEANS NO BUILDING DOWNWASH USED  
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED

DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED  
 DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3\*LB

\*\*\*\*\*  
 \*\*\* SCREEN DISCRETE DISTANCES \*\*\*  
 \*\*\*\*\*

\*\*\* TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES  
 \*\*\*

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	
1.	.0000	1	1.0	1.0	320.0	39.79	2.02	1.98	NO
250.	.5724E-05	3	2.0	2.0	640.0	24.46	29.33	17.75	NO
1490.	.2470E-05	6	1.0	1.0	10000.0	38.06	49.43	19.76	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)  
 DWASH=NO MEANS NO BUILDING DOWNWASH USED  
 DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED  
 DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED  
 DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3\*LB

\*\*\*\*\*  
 \*\*\* USER SPECIFIED AVERAGING TIMES \*\*\*  
 \*\*\*\*\*

ESTIMATED MAXIMUM CONCENTRATION FOR ANNUAL AVERAGING TIME:  
 4.87E-7 (+/- 1.22E-7) UG/M\*\*3

\*\*\*\*\*  
 \*\*\* END OF SCREEN MODEL OUTPUT \*\*\*  
 \*\*\*\*\*

09/10/97  
22:22:05

\*\*\* SCREEN3 MODEL RUN \*\*\*  
\*\*\* VERSION DATED 95250 \*\*\*

Annualized Worst Case Modeling for 2 3 7 8-TCDD DRE 95%

SIMPLE TERRAIN INPUTS:

SOURCE TYPE = POINT  
EMISSION RATE (G/S) = .242000E-07  
STACK HEIGHT (M) = 9.1400  
STK INSIDE DIAM (M) = .6100  
STK EXIT VELOCITY (M/S) = 14.7100  
STK GAS EXIT TEMP (K) = 333.0000  
AMBIENT AIR TEMP (K) = 293.0000  
RECEPTOR HEIGHT (M) = .0000  
URBAN/RURAL OPTION = RURAL  
BUILDING HEIGHT (M) = .0000  
MIN HORIZ BLDG DIM (M) = .0000  
MAX HORIZ BLDG DIM (M) = .0000

\*\*\*\*\*  
\*\*\* SUMMARY OF SCREEN MODEL RESULTS \*\*\*  
\*\*\*\*\*

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.3044E-05	173.	0.

\*\*\*\*\*  
\*\* REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS \*\*  
\*\*\*\*\*

BUOY. FLUX = 1.612 M\*\*4/S\*\*3; MOM. FLUX = 17.711 M\*\*4/S\*\*2.

\*\*\* FULL METEOROLOGY \*\*\*

\*\*\*\*\*  
\*\*\* SCREEN AUTOMATED DISTANCES \*\*\*  
\*\*\*\*\*

\*\*\* TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES  
\*\*\*

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	
DWASH									
1.	.0000	1	1.0	1.0	320.0	39.79	2.02	1.98	NO
100.	.2752E-05	2	4.0	4.0	1280.0	16.80	19.39	10.83	NO
200.	.3023E-05	3	3.0	3.0	960.0	19.36	23.80	14.33	NO
300.	.2741E-05	4	3.5	3.5	1120.0	17.90	22.75	12.35	NO
400.	.2608E-05	4	2.5	2.5	800.0	21.40	29.66	15.67	NO
500.	.2414E-05	4	2.0	2.0	640.0	24.46	36.41	18.81	NO
600.	.2194E-05	4	1.5	1.5	480.0	29.57	43.11	22.00	NO

700.	.2051E-05	4	1.5	1.5	480.0	29.57	49.53	24.73	NO
800.	.1874E-05	4	1.5	1.5	480.0	29.57	55.88	27.41	NO
900.	.1735E-05	4	1.0	1.0	320.0	39.79	62.50	30.74	NO
1000.	.1649E-05	4	1.0	1.0	320.0	39.79	68.69	33.27	NO
1100.	.1544E-05	4	1.0	1.0	320.0	39.79	74.82	35.23	NO
1200.	.1444E-05	4	1.0	1.0	320.0	39.79	80.91	37.14	NO
1300.	.1350E-05	4	1.0	1.0	320.0	39.79	86.96	39.00	NO
1400.	.1262E-05	4	1.0	1.0	320.0	39.79	92.97	40.81	NO
1500.	.1239E-05	6	1.0	1.0	10000.0	38.06	49.72	19.83	NO
1600.	.1277E-05	6	1.0	1.0	10000.0	38.06	52.65	20.52	NO
1700.	.1304E-05	6	1.0	1.0	10000.0	38.06	55.56	21.19	NO
1800.	.1324E-05	6	1.0	1.0	10000.0	38.06	58.45	21.86	NO
1900.	.1336E-05	6	1.0	1.0	10000.0	38.06	61.34	22.51	NO
2000.	.1342E-05	6	1.0	1.0	10000.0	38.06	64.21	23.15	NO
2100.	.1335E-05	6	1.0	1.0	10000.0	38.06	67.07	23.70	NO
2200.	.1325E-05	6	1.0	1.0	10000.0	38.06	69.91	24.23	NO
2300.	.1312E-05	6	1.0	1.0	10000.0	38.06	72.75	24.76	NO
2400.	.1298E-05	6	1.0	1.0	10000.0	38.06	75.57	25.28	NO
2500.	.1282E-05	6	1.0	1.0	10000.0	38.06	78.38	25.78	NO
2600.	.1265E-05	6	1.0	1.0	10000.0	38.06	81.19	26.28	NO
2700.	.1248E-05	6	1.0	1.0	10000.0	38.06	83.98	26.78	NO
2800.	.1229E-05	6	1.0	1.0	10000.0	38.06	86.76	27.26	NO
2900.	.1210E-05	6	1.0	1.0	10000.0	38.06	89.53	27.74	NO
3000.	.1191E-05	6	1.0	1.0	10000.0	38.06	92.29	28.21	NO
3500.	.1087E-05	6	1.0	1.0	10000.0	38.06	105.97	30.14	NO
4000.	.9925E-06	6	1.0	1.0	10000.0	38.06	119.46	31.92	NO
4500.	.9092E-06	6	1.0	1.0	10000.0	38.06	132.76	33.60	NO
5000.	.8360E-06	6	1.0	1.0	10000.0	38.06	145.90	35.19	NO
5500.	.7715E-06	6	1.0	1.0	10000.0	38.06	158.91	36.70	NO
6000.	.7147E-06	6	1.0	1.0	10000.0	38.06	171.78	38.14	NO
6500.	.6644E-06	6	1.0	1.0	10000.0	38.06	184.53	39.52	NO
7000.	.6197E-06	6	1.0	1.0	10000.0	38.06	197.17	40.85	NO
7500.	.5801E-06	6	1.0	1.0	10000.0	38.06	209.70	41.98	NO
8000.	.5449E-06	6	1.0	1.0	10000.0	38.06	222.14	43.08	NO
8500.	.5132E-06	6	1.0	1.0	10000.0	38.06	234.49	44.14	NO
9000.	.4847E-06	6	1.0	1.0	10000.0	38.06	246.75	45.16	NO
9500.	.4588E-06	6	1.0	1.0	10000.0	38.06	258.93	46.15	NO
10000.	.4353E-06	6	1.0	1.0	10000.0	38.06	271.03	47.11	NO
15000.	.2824E-06	6	1.0	1.0	10000.0	38.06	388.52	55.50	NO
20000.	.2078E-06	6	1.0	1.0	10000.0	38.06	501.02	60.86	NO
25000.	.1631E-06	6	1.0	1.0	10000.0	38.06	609.81	65.38	NO
30000.	.1335E-06	6	1.0	1.0	10000.0	38.06	715.64	69.33	NO
40000.	.9818E-07	6	1.0	1.0	10000.0	38.06	920.26	74.95	NO
50000.	.7723E-07	6	1.0	1.0	10000.0	38.06	1117.45	79.62	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 1. M:  
173. .3044E-05 3 3.5 3.5 1120.0 17.90 20.93 12.60 NO

DIST = DISTANCE FROM THE SOURCE  
CONC = MAXIMUM GROUND LEVEL CONCENTRATION  
STAB = ATMOSPHERIC STABILITY CLASS (1=A, 2=B, 3=C, 4=D, 5=E, 6=F)  
U10M = WIND SPEED AT THE 10-M LEVEL  
USTK = WIND SPEED AT STACK HEIGHT  
MIX HT = MIXING HEIGHT  
PLUME HT= PLUME CENTERLINE HEIGHT  
SIGMA Y = LATERAL DISPERSION PARAMETER  
SIGMA Z = VERTICAL DISPERSION PARAMETER  
DWASH = BUILDING DOWNWASH:  
DWASH= MEANS NO CALC MADE (CONC = 0.0)  
DWASH=NO MEANS NO BUILDING DOWNWASH USED  
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED

DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED  
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3\*LB

\*\*\*\*\*  
\*\*\* SCREEN DISCRETE DISTANCES \*\*\*  
\*\*\*\*\*

\*\*\* TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES  
\*\*\*

DWASH	DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	
-	1.	.0000	1	1.0	1.0	320.0	39.79	2.02	1.98	NO
	250.	.2862E-05	3	2.0	2.0	640.0	24.46	29.33	17.75	NO
	1490.	.1235E-05	6	1.0	1.0	10000.0	38.06	49.43	19.76	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)  
DWASH=NO MEANS NO BUILDING DOWNWASH USED  
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED  
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED  
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3\*LB

\*\*\*\*\*  
\*\*\* USER SPECIFIED AVERAGING TIMES \*\*\*  
\*\*\*\*\*

ESTIMATED MAXIMUM CONCENTRATION FOR ANNUAL AVERAGING TIME:  
2.44E-7 (+/- 6.09E-8) UG/M\*\*3

\*\*\*\*\*  
\*\*\* END OF SCREEN MODEL OUTPUT \*\*\*  
\*\*\*\*\*



09/10/97  
22:23:40

\*\*\* SCREEN3 MODEL RUN \*\*\*  
\*\*\* VERSION DATED 95250 \*\*\*

Annualized Worst Case Modeling for 2 3 7 8-TCDD DRE 99%

SIMPLE TERRAIN INPUTS:

SOURCE TYPE = POINT  
EMISSION RATE (G/S) = .484000E-08  
STACK HEIGHT (M) = 9.1400  
STK INSIDE DIAM (M) = .6100  
STK EXIT VELOCITY (M/S) = 14.7100  
STK GAS EXIT TEMP (K) = 333.0000  
AMBIENT AIR TEMP (K) = 293.0000  
RECEPTOR HEIGHT (M) = .0000  
URBAN/RURAL OPTION = RURAL  
BUILDING HEIGHT (M) = .0000  
MIN HORIZ BLDG DIM (M) = .0000  
MAX HORIZ BLDG DIM (M) = .0000

\*\*\*\*\*  
\*\*\* SUMMARY OF SCREEN MODEL RESULTS \*\*\*  
\*\*\*\*\*

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.6089E-06	173.	0.

\*\*\*\*\*  
\*\* REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS \*\*  
\*\*\*\*\*

BUOY. FLUX = 1.612 M\*\*4/S\*\*3; MOM. FLUX = 17.711 M\*\*4/S\*\*2.

\*\*\* FULL METEOROLOGY \*\*\*

\*\*\*\*\*  
\*\*\* SCREEN AUTOMATED DISTANCES \*\*\*  
\*\*\*\*\*

\*\*\* TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES  
\*\*\*

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	
1.	.0000	1	1.0	1.0	320.0	39.79	2.02	1.98	NO
100.	.5504E-06	2	4.0	4.0	1280.0	16.80	19.39	10.83	NO
200.	.6047E-06	3	3.0	3.0	960.0	19.36	23.80	14.33	NO
300.	.5482E-06	4	3.5	3.5	1120.0	17.90	22.75	12.35	NO
400.	.5217E-06	4	2.5	2.5	800.0	21.40	29.66	15.67	NO
500.	.4828E-06	4	2.0	2.0	640.0	24.46	36.41	18.81	NO
600.	.4387E-06	4	1.5	1.5	480.0	29.57	43.11	22.00	NO

700.	.4102E-06	4	1.5	1.5	480.0	29.57	49.53	24.73	NO
800.	.3747E-06	4	1.5	1.5	480.0	29.57	55.88	27.41	NO
900.	.3470E-06	4	1.0	1.0	320.0	39.79	62.50	30.74	NO
1000.	.3297E-06	4	1.0	1.0	320.0	39.79	68.69	33.27	NO
1100.	.3089E-06	4	1.0	1.0	320.0	39.79	74.82	35.23	NO
1200.	.2888E-06	4	1.0	1.0	320.0	39.79	80.91	37.14	NO
1300.	.2700E-06	4	1.0	1.0	320.0	39.79	86.96	39.00	NO
1400.	.2525E-06	4	1.0	1.0	320.0	39.79	92.97	40.81	NO
1500.	.2478E-06	6	1.0	1.0	10000.0	38.06	49.72	19.83	NO
1600.	.2553E-06	6	1.0	1.0	10000.0	38.06	52.65	20.52	NO
1700.	.2609E-06	6	1.0	1.0	10000.0	38.06	55.56	21.19	NO
1800.	.2647E-06	6	1.0	1.0	10000.0	38.06	58.45	21.86	NO
1900.	.2672E-06	6	1.0	1.0	10000.0	38.06	61.34	22.51	NO
2000.	.2684E-06	6	1.0	1.0	10000.0	38.06	64.21	23.15	NO
2100.	.2669E-06	6	1.0	1.0	10000.0	38.06	67.07	23.70	NO
2200.	.2649E-06	6	1.0	1.0	10000.0	38.06	69.91	24.23	NO
2300.	.2624E-06	6	1.0	1.0	10000.0	38.06	72.75	24.76	NO
2400.	.2596E-06	6	1.0	1.0	10000.0	38.06	75.57	25.28	NO
2500.	.2565E-06	6	1.0	1.0	10000.0	38.06	78.38	25.78	NO
2600.	.2531E-06	6	1.0	1.0	10000.0	38.06	81.19	26.28	NO
2700.	.2495E-06	6	1.0	1.0	10000.0	38.06	83.98	26.78	NO
2800.	.2458E-06	6	1.0	1.0	10000.0	38.06	86.76	27.26	NO
2900.	.2420E-06	6	1.0	1.0	10000.0	38.06	89.53	27.74	NO
3000.	.2382E-06	6	1.0	1.0	10000.0	38.06	92.29	28.21	NO
3500.	.2173E-06	6	1.0	1.0	10000.0	38.06	105.97	30.14	NO
4000.	.1985E-06	6	1.0	1.0	10000.0	38.06	119.46	31.92	NO
4500.	.1818E-06	6	1.0	1.0	10000.0	38.06	132.76	33.60	NO
5000.	.1672E-06	6	1.0	1.0	10000.0	38.06	145.90	35.19	NO
5500.	.1543E-06	6	1.0	1.0	10000.0	38.06	158.91	36.70	NO
6000.	.1429E-06	6	1.0	1.0	10000.0	38.06	171.78	38.14	NO
6500.	.1329E-06	6	1.0	1.0	10000.0	38.06	184.53	39.52	NO
7000.	.1239E-06	6	1.0	1.0	10000.0	38.06	197.17	40.85	NO
7500.	.1160E-06	6	1.0	1.0	10000.0	38.06	209.70	41.98	NO
8000.	.1090E-06	6	1.0	1.0	10000.0	38.06	222.14	43.08	NO
8500.	.1026E-06	6	1.0	1.0	10000.0	38.06	234.49	44.14	NO
9000.	.9693E-07	6	1.0	1.0	10000.0	38.06	246.75	45.16	NO
9500.	.9176E-07	6	1.0	1.0	10000.0	38.06	258.93	46.15	NO
10000.	.8706E-07	6	1.0	1.0	10000.0	38.06	271.03	47.11	NO
15000.	.5648E-07	6	1.0	1.0	10000.0	38.06	388.52	55.50	NO
20000.	.4155E-07	6	1.0	1.0	10000.0	38.06	501.02	60.86	NO
25000.	.3262E-07	6	1.0	1.0	10000.0	38.06	609.81	65.38	NO
30000.	.2671E-07	6	1.0	1.0	10000.0	38.06	715.64	69.33	NO
40000.	.1964E-07	6	1.0	1.0	10000.0	38.06	920.26	74.95	NO
50000.	.1545E-07	6	1.0	1.0	10000.0	38.06	1117.45	79.62	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 1. M:  
173. .6089E-06 3 3.5 3.5 1120.0 17.90 20.93 12.60 NO

DIST = DISTANCE FROM THE SOURCE  
CONC = MAXIMUM GROUND LEVEL CONCENTRATION  
STAB = ATMOSPHERIC STABILITY CLASS (1=A, 2=B, 3=C, 4=D, 5=E, 6=F)  
U10M = WIND SPEED AT THE 10-M LEVEL  
USTK = WIND SPEED AT STACK HEIGHT  
MIX HT = MIXING HEIGHT  
PLUME HT= PLUME CENTERLINE HEIGHT  
SIGMA Y = LATERAL DISPERSION PARAMETER  
SIGMA Z = VERTICAL DISPERSION PARAMETER  
DWASH = BUILDING DOWNWASH:  
DWASH= MEANS NO CALC MADE (CONC = 0.0)  
DWASH=NO MEANS NO BUILDING DOWNWASH USED  
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED

DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED  
 DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3\*LB

\*\*\*\*\*  
 \*\*\* SCREEN DISCRETE DISTANCES \*\*\*  
 \*\*\*\*\*

\*\*\* TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES  
 \*\*\*

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	
1.	.0000	1	1.0	1.0	320.0	39.79	2.02	1.98	NO
250.	.5724E-06	3	2.0	2.0	640.0	24.46	29.33	17.75	NO
1490.	.2470E-06	6	1.0	1.0	10000.0	38.06	49.43	19.76	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)  
 DWASH=NO MEANS NO BUILDING DOWNWASH USED  
 DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED  
 DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED  
 DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3\*LB

\*\*\*\*\*  
 \*\*\* USER SPECIFIED AVERAGING TIMES \*\*\*  
 \*\*\*\*\*

ESTIMATED MAXIMUM CONCENTRATION FOR ANNUAL AVERAGING TIME:  
 4.87E-8 (+/- 1.22E-8) UG/M\*\*3

\*\*\*\*\*  
 \*\*\* END OF SCREEN MODEL OUTPUT \*\*\*  
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