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DEPARTMENT OF THE NAVY
NAVAL WEAPONS SUPPORT CENTER
CRANE, INDIANA 47522-5000

IN REPLY REFER TO:
5090/H11.9
095

10 SEP 1991
9-1-1991

Director, Waste Management Division
RCRA Permitting Branch (5HR-13)
U.S. Environmental Protection Agency, Region V
Attn: Ms. Carol Witt-Smith (Indiana Section)
230 South Dearborn Street
Chicago, IL 60604

Dear Ms. Witt-Smith:

Submitted for review is the Draft RCRA Facility Investigation (RFI) Phase II Soils and Groundwater Work Plan for the Mustard Gas Burial Grounds, Solid Waste Management Unit #01/12. The requirement for submittal of this report was set forth in the Corrective Actions portion of the Hazardous Waste Part B Permit issued to Naval Weapons Support Center Crane (NWSCC) in January 1990. Copies of this draft work plan have also been forwarded to Indiana Department of Environmental Management for review and comment.

NWSCC point of contact is Mr. Jim Hunsicker, Code 095, telephone 812-854-3233. Northern Division, Naval Facilities Engineering Command (NORTHNAVFACENGCOM) point of contact is Mr. Byron Brant, Code 1423/BB, telephone 215-897-6280.

Sincerely,

J. D. FARIS
By direction

Encl:
(1) Draft RCRA Facility Investigation (RFI) Phase II Soils and Groundwater Work Plan for the Mustard Gas Burial Grounds, Solid Waste Management Unit #01/12
(2) Certification Statement

Copy to:
NORTHNAVFACENGCOM, Philadelphia (Code 1423/BB) (w/o encl)
COMNAVSEASYSCOM (SEA 654E) (w/o encl)
USAE-WES, BILL MURPHY (GG-YH) (w/o encl)
USAE-WILMINGTON, BOB MAGEE (EN-GG) (w/o encl)

CERTIFICATION STATEMENT

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIGNATURE

ACTING PUBLIC WORKS OFFICER
BY DIRECTION

SEP 10 1991

TITLE

DATE

Enclosure (2)

IN5 170 023 498
AUGUST 1991

Draft

RFI Phase II Work Plan for Mustard Gas Burning Ground SWMU #01/12 Naval Weapons Support Center, Crane, Indiana

Prepared By:
U. S. Army Corps of Engineers
Waterways Experiment Station
Geotechnical Section
3909 Halls Ferry Road
Vicksburg, Mississippi

Prepared for:
Northern Division,
Naval Facilities Engineering Command
U.S. Naval Base, Bldg. 77 Low
Philadelphia, Pennsylvania

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Appendix G Memorandum dtd 21 June 1974, From FCV to File, Report of Trip to NAD, Crane.
Appendix H After Action Report, Chemical Burial Ground Exhumation Report, dtd October 1980.

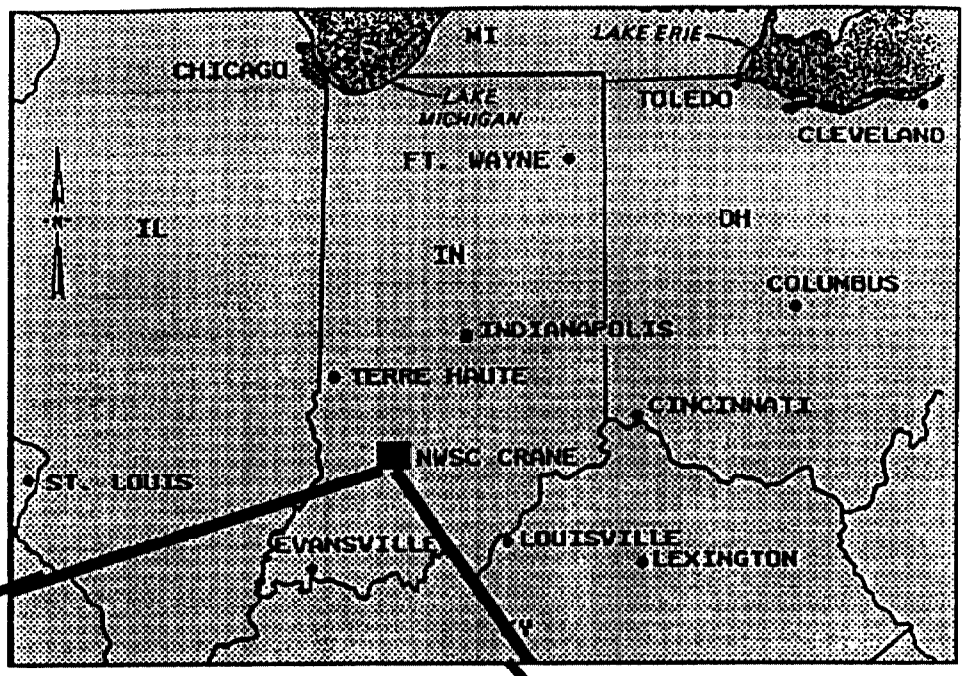
1. INTRODUCTION

1.1.0 SITE DESCRIPTION

1.1.1 BACKGROUND. To fulfill the Corrective Action Requirements (CAR) of the Federal Portion of the Final RCRA Storage Permit, Naval Weapons Support Center (NWSCC), Crane, Indiana is evaluating its hazardous waste management practices at its past and present disposal sites. This RCRA Facility Investigation (RFI) Phase II Soils and Groundwater Study will be conducted at an area known as the Mustard Gas Burial Grounds (MGBG). The US Army Corps of Engineers' (USACE), Waterways Experiment Station (USACEWES) will be conducting the study. An Initial Assessment Study (IAS) was performed in 1981 and published in 1983 by Naval Energy and Environmental Support Activity (NEESA). The IAS is the first phase of the Navy Assessment and Control of Installation Pollutants. (NACIP) program. The NACIP program intent was to evaluate pollution problems at naval facilities. With the passage of the Superfund Amendments and Reauthorization Act (SARA) the NACIP program changed character and became the Navy Installation Restoration Program (IRP). This RFI Phase II Soils Study and Phase III Groundwater Study is the response to the CAR included in the RCRA permit. The studies are performed under the IRP procedures.

1.1.2 LOCATION. NWSCC is a Navy facility located in Martin County Indiana. NWSCC covers approximately 62,463 acres (approximately 100 square miles). The MGBG site occupies approximately 2 acres. The MGBG is located in the SW 1/4 of section 24, T4N, R4W (Lat 38 45' 55" ,Long 86 48' 32"). NWSCC's location, and the site location is shown in Figure 1.1.2a. The area is in a remote portion of the facility. The countryside around this part of the facility is rural in nature with few private residences (Figure 1.1.2b). The site is accessed using Crane Road H-251 off of Crane Road H-161 (Figure 1.1.2c). This area is located on a ridge crest in a heavily forested portion of the facility. The topographical setting of the site is shown on Figure 1.1.2c. The site is fenced and marked with signs which explain the site's hazards.

1.1.3 SITE HISTORY. The MGBG was used between the end of World War II and 1956 for disposal of mustard munitions and other items. Several burial sites were marked or remarked in 1955 and 1956 with signs detailing the contents, or in some cases, the authority under which burial was performed. However, the signs gave little indication of the number of items actually buried (Appendix F). Three hazards are considered to have existed at the site. These hazards include chemical weapons, radioactive material, and waste chemicals. The disposed material was considered unfit and hazardous for transportation. In March 1973 a chemical survey was conducted by the Department of Defense Explosive Safety Board. It was the board's recommendations that all materials be excavated from the site and that the site be certified safe.



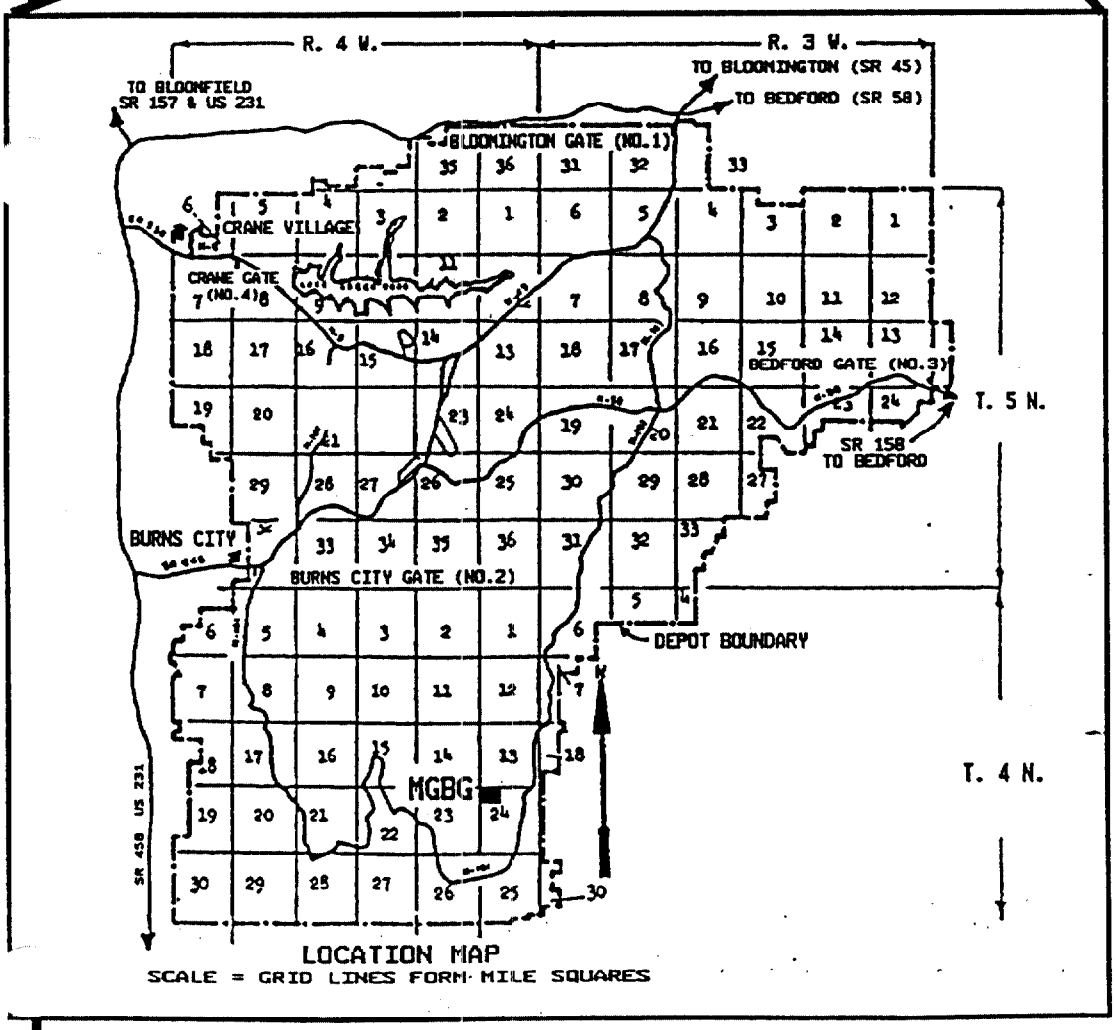
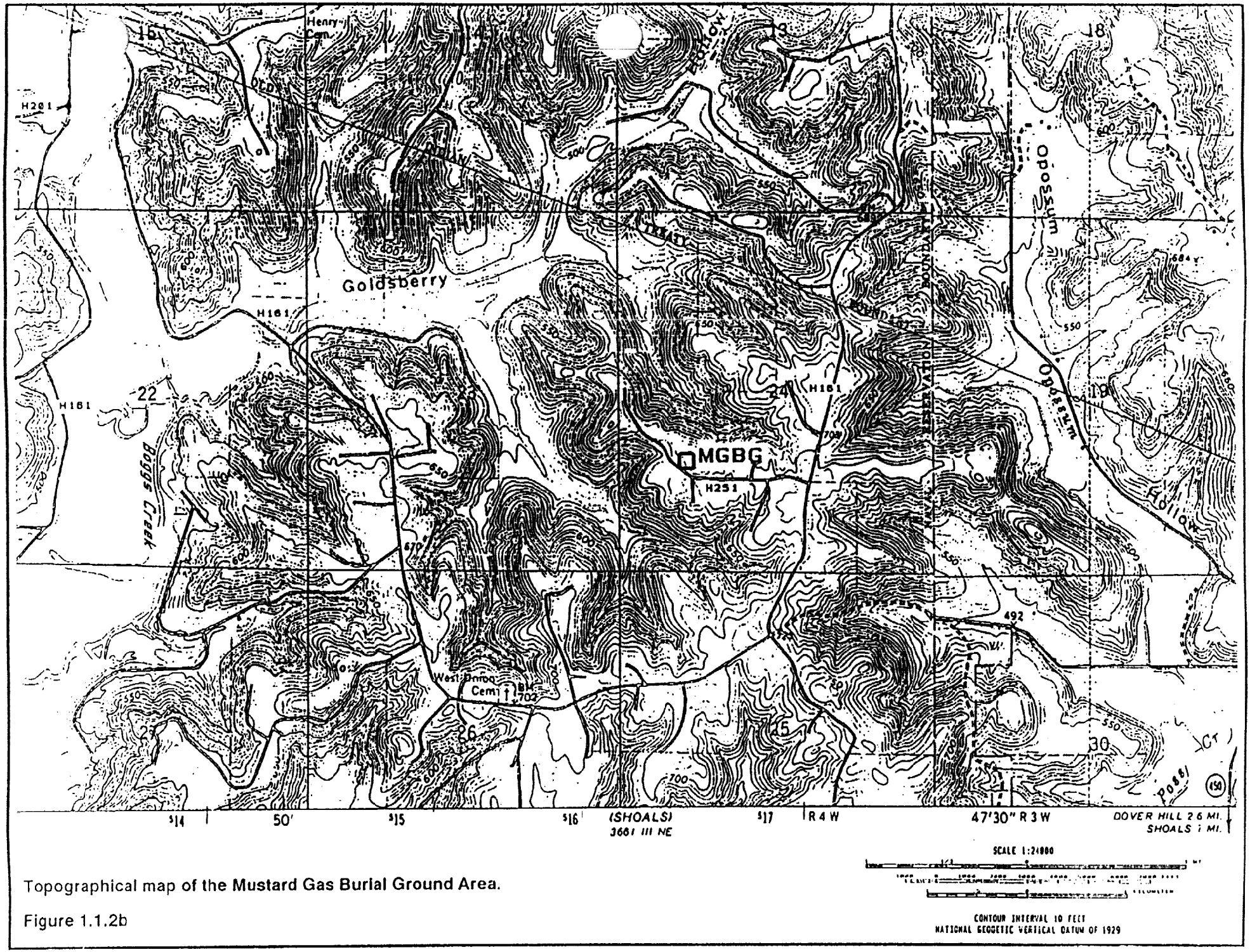
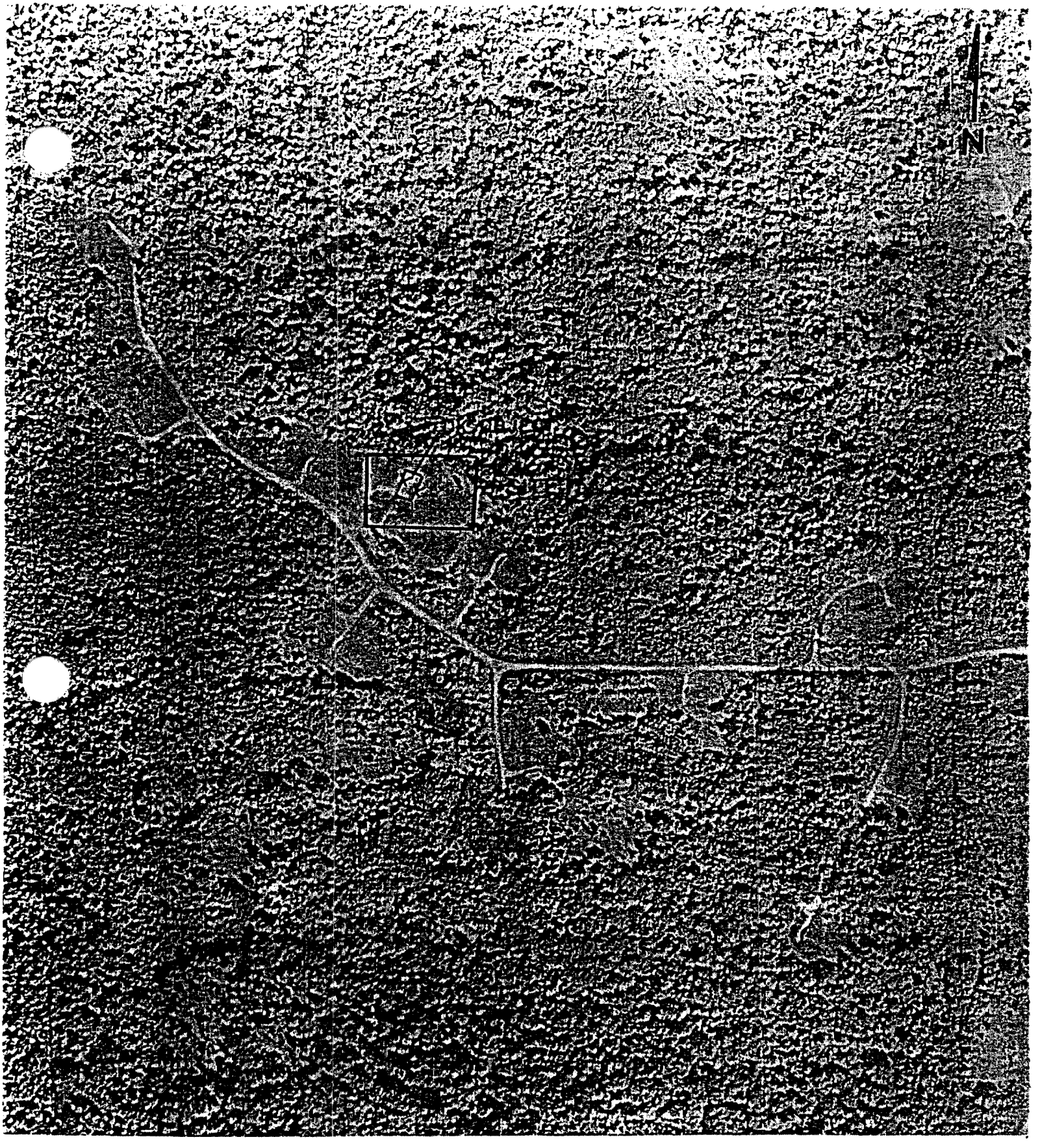


Figure 1.1.2a Location of Naval Weapons Support Center, Crane In.



Topographical map of the **Mustard Gas Burial Ground Area.**

Figure 1.1.2b



SEPTEMBER 23,1974

Figure 1.1.2c Aerial photograph of the Mustard Gas Burial Ground.
Approximate Scale 1" = 4700'

Quantities of radioactive waste material (Thorium Nitrate) and chemical weapons were buried at the site in the mid 1950's. The radioactive material Thorium Nitrate (Thorium-232) and rare earth metals were used in the experimental manufacture of illuminating candles. Aerial chemical bombs were buried at the site. These bombs were Mustard Gas (2,2 Dichloro-diethylsulfide) weapons. The origin and nationality of these weapons is in doubt. These bombs were supposedly drained and decontaminated before burial. The disposal of various laboratory chemicals at the site is documented.

An effort was made to exhume the weapons in 1974 (Appendix F). Large metal targets were located using a magnetic survey device. During the excavation effort, 10 bombs, quantities of Thorium Nitrate, and illumination devices were uncovered. Three of these devices contained chemical agents. The effort was halted at that point. The bombs and radioactive materials were secured and placed in a nearby bunker in March 1976. The radioactive material, seven 55 gallon drums of soil, Thorium Nitrate, illumination devices, and other debris, removed during the excavation effort, was shipped to a Nuclear Regulatory Commission (NRC) permitted disposal site in Barnwell, South Carolina for disposal. Three additional locations of thorium nitrate burial were identified in the MGBG site during 1980 (Figure 1.1.3). On 15 September 1980, the Naval Sea Systems Command (NAVSEASYSCOM) approved operation plans to exhume the three sites. Operations continued through 24 September 1980. This effort was designed to properly dispose of the known material, to rid the area of any chemical warfare weapons, and to return the land to its original condition. An expanded magnetometer survey was done using a Varian Surface Ordnance Locator. Additional possible burial sites were located. The original 10 bombs were dismantled, decontaminated, neutralized, and prepared for transport and disposal. Additional anomalies were investigated. Six additional empty bombs, one mustard gas identification kit, a quantity of Thorium Nitrate, and illumination candle debris were found and processed. The other anomalies were determined to be benign. The drums of illuminating devices and Thorium Nitrate contaminated soil collected in the original 1973 effort were removed from the site. The soil, both in the spoil piles and the excavation walls were searched for contaminated soil. The waste was sent to an approved facility. Based on the analysis of soil samples performed at NWSCC and verified by health physicists at the Radiological Affairs Support Office (RASO) of the NEESA, the thorium nitrate disposal sites identified in Figure 1.1.3A and Figure 1.1.3B were released for radiologically unrestricted use (IAS, NWSCC, May, 1983).

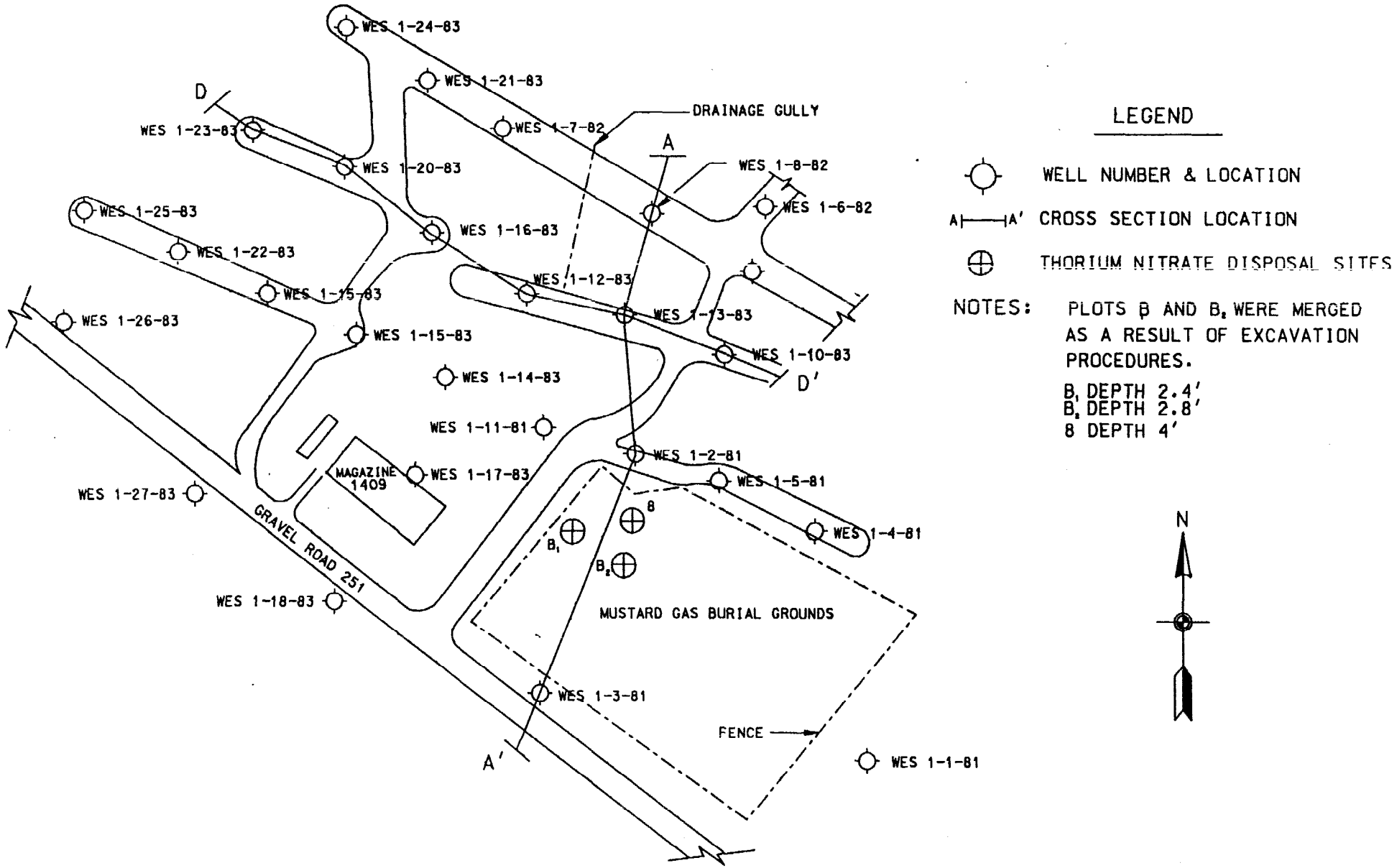


FIGURE 1.1.3A MUSTARD GAS BURIAL GROUNDS BORING & CROSS-SECTION LOCATIONS

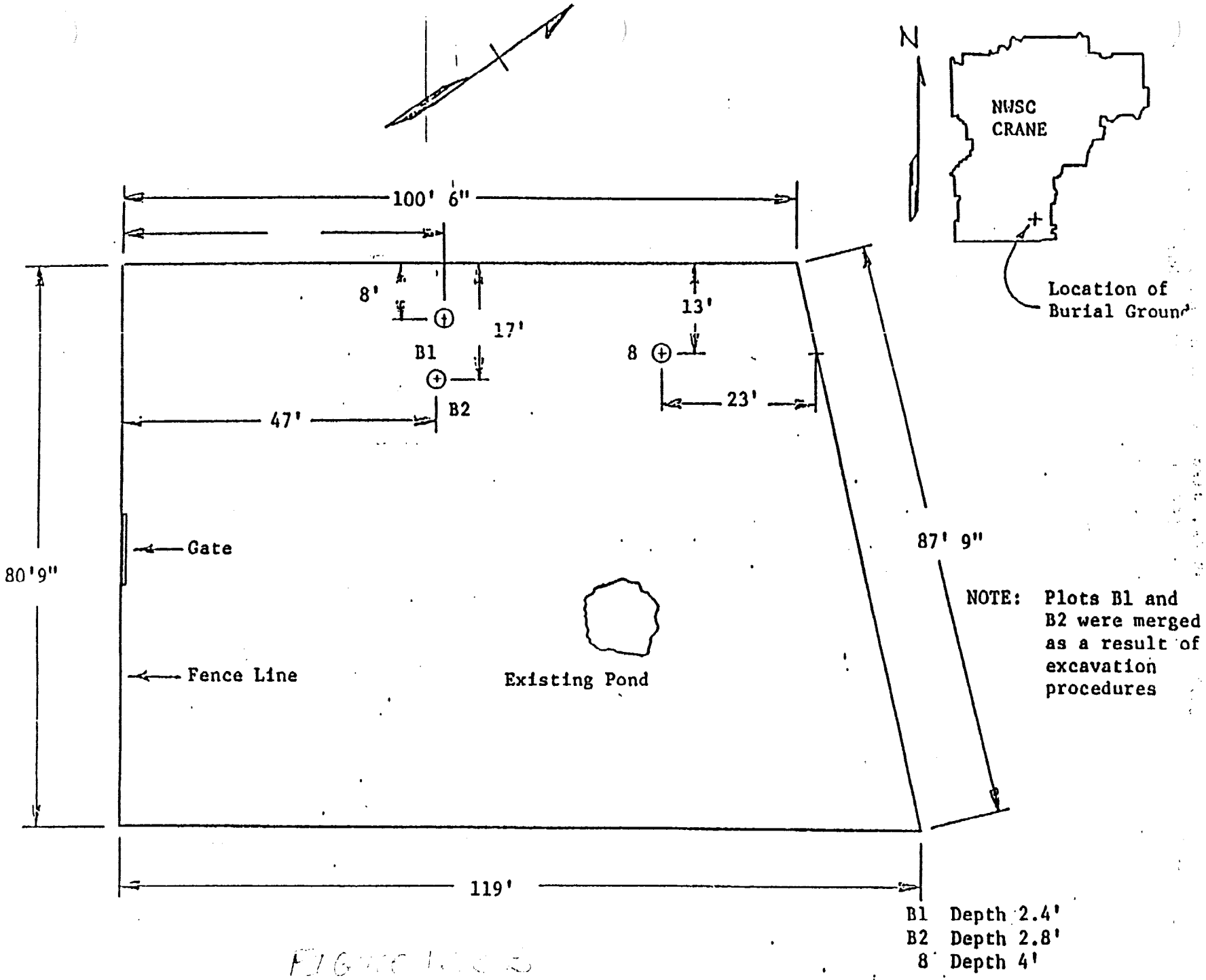


FIGURE [illegible]

Thorium Nitrate Disposal Sites with Respect to Chemical Burial Ground Located at NWSC

A groundwater monitoring effort was started in 1981. Five monitoring wells were installed and sampled. Chemical contamination was detected. The detection level was set at 50 ppb. Twelve additional wells were installed. A north-northwest trending plume was detected. The groundwater movement mimics the land surface. The plume is moving in the same general direction as the groundwater flow. An additional 10 wells installed in 1983 were to determine the lateral extent of the groundwater pollution. The total number of groundwater monitoring wells at the site is 27. No groundwater monitoring has occurred since 1986. The source of the chemical contamination is unknown.

1.1.4 SITE HYDROGEOLOGY. The MGBG is located on a northwesterly trending ridge. The soil overburden is made up of 2 to 15 feet of clay, sand, and gravel. The soil character varies horizontally and vertically. The bedrock is interbedded sandstone, shale, discontinuous beds of limestone, and coal of the Mansfield Formation, Raccoon Creek Group (Figures 1.1.4a and 1.1.4d) (Dunbar, 1984). The Mansfield Formation is composed of predominately interbedded sandstone, shale, and scattered coal seams and is more than 110ft thick at the MGBG. The sandstone ranges from various shades of brown, to white or buff, to light and dark grey. The sandstone is fine to very fine-grained and contains lenses and thin beds of shale and siltstone. Shale occurrence in the formation increases with a color change to a darker grey. Several seams of bituminous coal are encountered beneath the MGBG and are brownish black to black, soft, blocky in appearance, and contain less than 1 percent oxidized sulfides, particularly pyrite.

The area's water table is in open communication with the shallow bedrock aquifer system. The depth to the groundwater in past studies was found to range from 5 feet to 40 feet below the ground surface (Figure 1.1.4d). The depth to the surface of the groundwater table is relatively uniform. Fluctuations in the groundwater monitoring data of greater then 2 feet are unusual. The area is a groundwater recharge area. The groundwater flow is expected to have a strong vertical component. Surface topography (Figure 1.1.2b) strongly effects the groundwater flow gradient. Contaminants moving in the groundwater from the MGBG are likely to be present at deeper subsurface depths. Surface drainage is into Goldsberry Hollow and Boggs Creek.

1.2.0 STUDY HISTORY

1.2.1 PREVIOUS INVESTIGATIONS. Various non-intrusive magnetometer studies have been carried out at the site. The intent of those studies was to locate chemical and radioactive burial sites. Two excavation and removal efforts have been completed there. Three related groundwater investigative projects have been completed. They were reported in Dunbar reports 1982, 1983 and 1984. Groundwater contamination, primarily chlorinated solvents, has been detected in the upper most aquifer of the MGBG. The groundwater flow pattern of the area has been determined. The existence of groundwater contamination has been confirmed. The detected groundwater

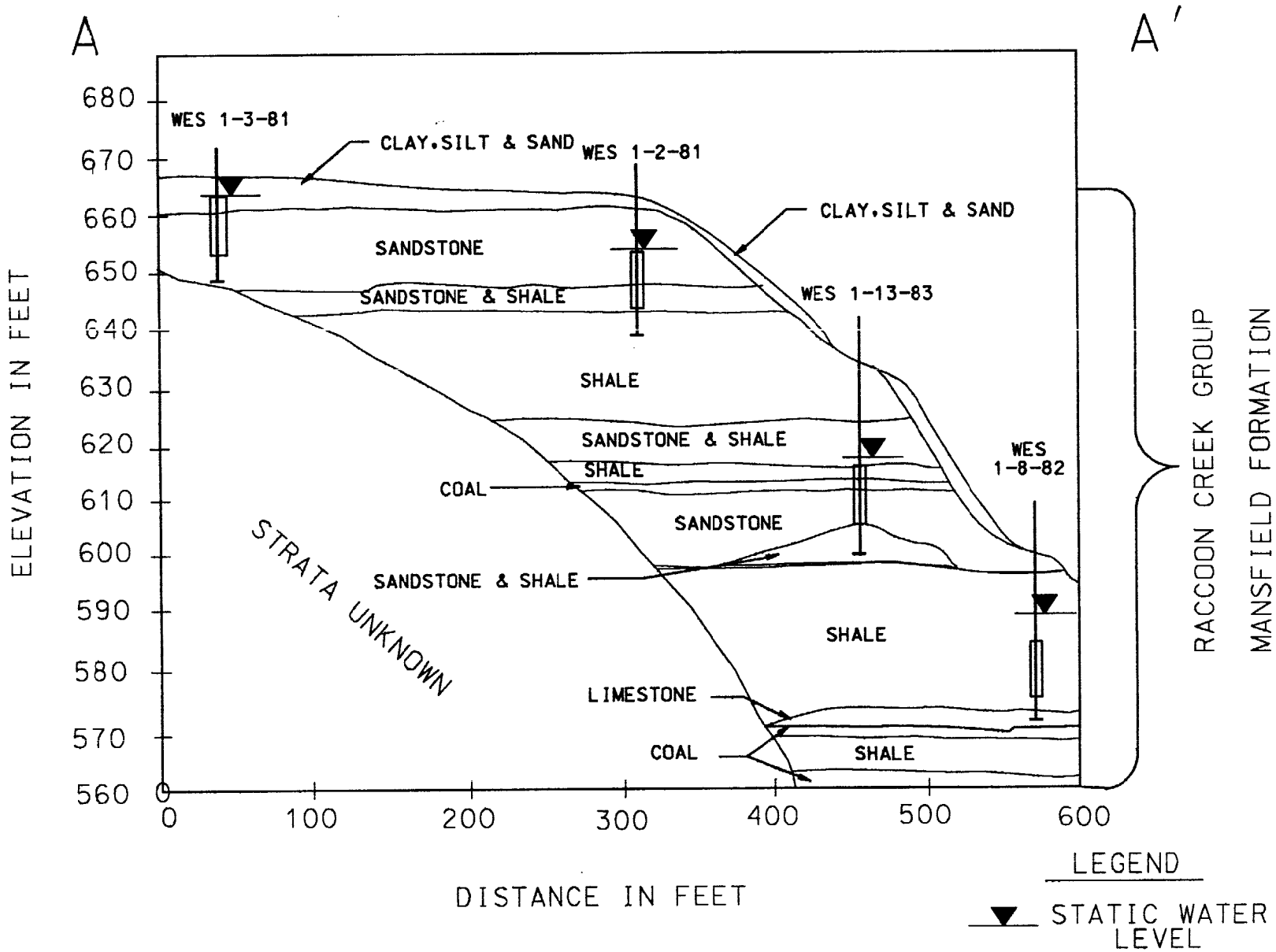
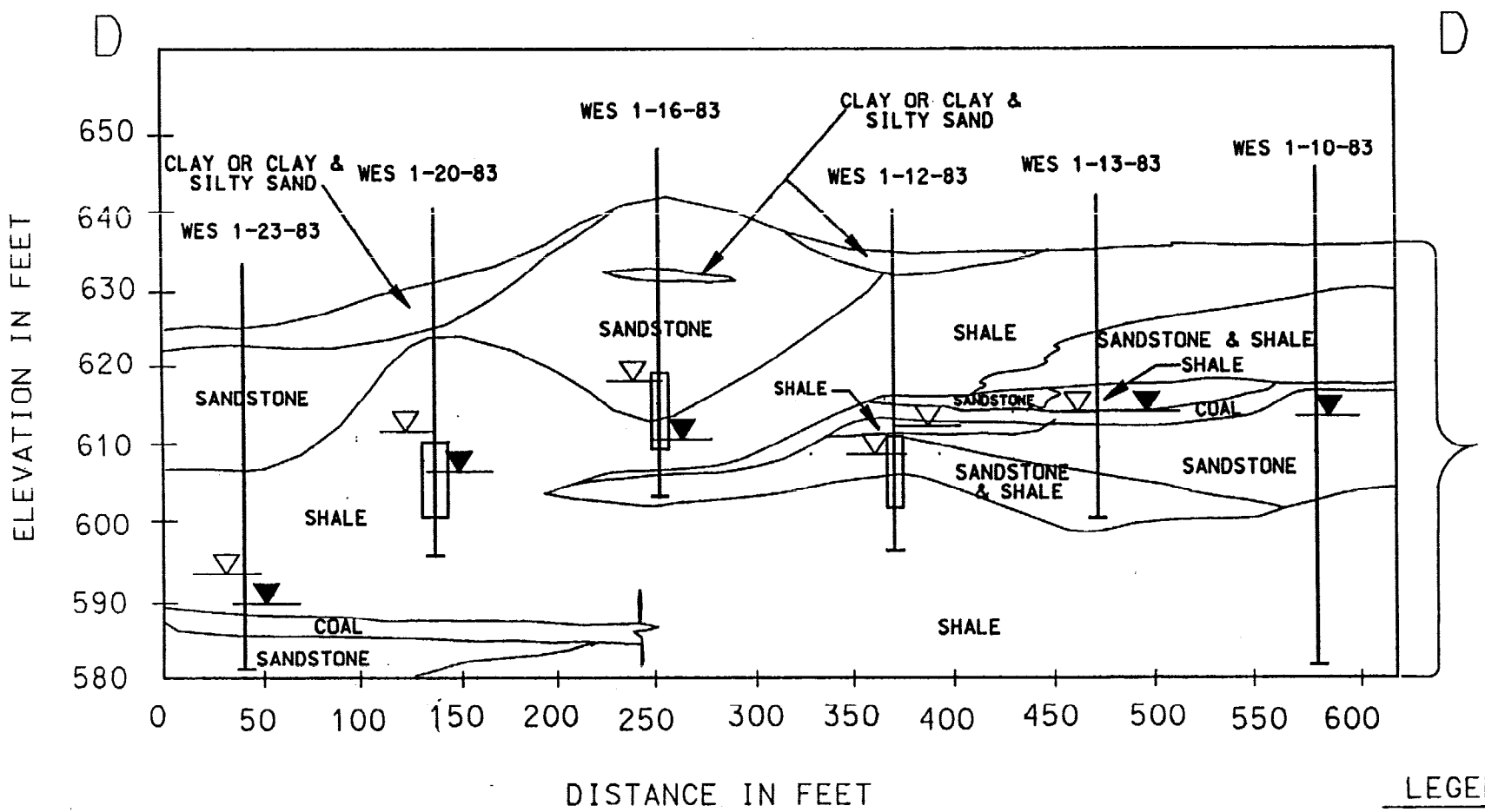


FIGURE 1.1.4a GEOLOGIC CROSS-SECTION A-A' OF MUSTARD GAS BURIAL GROUNDS



LEGEND

▼ STATIC WATER LEVEL

▽ WATER LEVEL AT TIME OF DRILLING

FIGURE 1.1.4d GEOLOGIC CROSS SECTION D-D' OF MUSTARD GAS BURIAL GROUNDS

pollutants are: 1,2-Dichloromethane, 1,1,2-Trichlorethane, 1,1,1-Trichlorethane, 1,1,2,2-Tetrachloroethane, Bromoform, Dibromochloromethane, Tetrachloroethene, Trichloroethene, and Trichloroethylene (Dunbar, 1984). The source or sources of pollution, its chemical and physical character, and its lateral extent is undefined (Appendix C).

1.2.2 **REGULATORY STATUS.** Under RCRA as amended by Hazardous and Solid Waste Amendments (HSWA), a hazardous waste treatment, storage, and disposal facility must be permitted by the Environmental Protection Agency (EPA). In 1989 NWSCC was issued a Storage Operating Permit. The facility was required to complete a RFI. The MGBG was named as a Solid Waste Management Unit (SWMU). CARs were negotiated between the Navy and the USEPA Region V. As part of the CAR, NWSCC is to conduct a RFI at its SWMUs. Surface and shallow subsurface soil investigations are parts of that RFI process. A RFI is a three part study, consisting of a Phase I or Environmental Monitoring Report, a Phase II or Release Assessment, and a Phase III or Release Characterization Study. A RFI Phase II Soils Study and a RFI Phase II Groundwater Study for the MGBG site, SWMU 01/12, are to be discussed in this work plan.

1.3.O MGBG WORK PLAN

1.3.1 **WORK PLAN OBJECTIVES.** This work plan is intended to adequately describe the site to be investigated, the rationale underlying procedural decisions implemented by the plan, and the quality control methods needed to assure defensible conclusions. Included in this plan are detailed directions and procedures which are to be used by the field personnel, the laboratory chemists, and the report writers. This work plan is intended to be reviewed and used by people familar with commonly used drilling, sampling, and RCRA terms.

1.3.2 **WORK PLAN STRUCTURE.** This project will combine efforts of a RFI Phase II Groundwater and Phase II Soils Study. These studies will consist of four main tasks. They are the development of a Work Plan, a Facility Investigation, an Investigation Analysis, and a Report. This enclosure is the Work Plan which is made up of six plans. Those plans are a project management plan, a sampling and analysis plan, a quality assurance project plan, a well construction plan, a health and safety plan, and a data management plan. Those individual plans will be treated as major headings and elements.

2.0 ELEMENT A: MANAGEMENT PLAN

2.1.0 PROJECT OBJECTIVES

2.1.1 STUDY INTENT. The intent of the Phase II investigation is to: 1) locate and define boundaries of the burial trenches, 2) collect soil samples in suspected or confirmed areas, 3) survey area for chemical and radiological hotspots, 4)collect groundwater samples to define the contaminate plume configuration and to develop monitoring parameters.

2.1.2 PROJECT DESCRIPTION. This project is made up of two separate efforts which share common goals. The work effort is to locate sites of residual soil contamination, and to characterize the hydrogeologic environment of the area. The projects shared goals are to fully assess the conditions existent at the MGBG site. To reach this goal, a 6-part effort is planned.

1) Using the existing monitoring wells, the groundwater will be sampled and analyzed. This is to be done to determine if the known contaminant description may have changed.

2) The disposal site will be investigated using non-intrusive geophysical exploratory methods (radioactivity screening, ground penetrating radar, and conductivity). The goal of this effort is to confirm the completeness of past surveys and exhumations. The search will be concentrated within the fenced area.

3) Soil samples will be gathered at those sites where contamination is confirmed or suspected. Those samples will be tested to confirm the existence of and to describe the contamination.

4) To fully describe the groundwater system of the area, additional rock borings will be drilled and monitoring wells will be installed. The goals of this part of the work are to determine the vertical extent of the surface aquifer, to gather information about additional aquifers, and to place additional monitoring wells as needed. One well is intended to be placed to detail the character of the contamination in the deeper portions of the surface aquifer system. Samples will be taken and analyzed for the presence or absence of chemical contamination.

5) Slug tests will be run to derive the aquifer characteristics. The slug test results will be used to derive aquifer permeability values. Existing and additional wells will be used for the testing. The information will be needed to design a remedial effort and to predict the spreading rate of the contaminant.

6) Five rounds of groundwater sampling and testing are planned on a quarterly basis. A list of analyte parameters (Table 3.1.4) are prescribed for the first two rounds. The number of analyte parameters will be reduced in the remaining three rounds. Only target compounds (those parameters determined through test results reveal to be characteristics of the contaminant).

Conclusions concerning the presence or absence of contamination, the risk posed by those contaminants, and the possible future steps to be taken will be developed. A report explaining the findings, conclusions, and the future studies will be issued.

2.2.0 TECHNICAL APPROACH

2.2.1 PHYSICAL AND CHEMICAL SCREENING. An effort is planned to quickly check the site for chemical and radiological hot spots. For the detection of chemical parameters a Foxboro OVA or a HNU, will be used. These are direct reading devices which are designed to detect the presence of volatile organic compounds. Their readings are of concentrations in the parts per million range. The device will be used to detect the presence of organic volatiles in the breathing zone. The breathing zone readings are taken at the mid chest level. A Eberline PG-2 or equivalent device will be used to detect radiological hot spots. This investigation is designed to detect radiation levels at 6 inches above the ground. This instrument is a direct reading device. The readings are presented in units of millirems per hour (mrem/hr.). Two men will move through the site in a designed pattern. The site is divided into a 20' X 20' gridded pattern of node points. This reduces to 10 traverses of 20 points per traverse. The individual readings will be read and recorded into the field log book. These readings will be presented as contour maps to display points of higher readings. These groups of higher readings will be considered possible hot spots and will be targeted for more investigation.

2.2.2 SURVEY PLAN. All surveying will be performed by certified professional surveyors. Surveys will be done before all other work inside of the fenced area is to be started. The top of casing of every well will be surveyed to determine its elevation (NGVD) and east-west coordinates using the Indiana State Plane Coordinate System. The survey point will be marked on the casing. Accuracy must be $\pm$ 0.5 ft. Accuracy of ground surface elevation must be $\pm$ 0.01 ft. The surveyors will supply USACEWES with all field survey data and a table of well elevations and locations describing physical and chemical screening collection.

2.2.3 GEOPHYSICAL INVESTIGATIONS. Geophysical surveys at the MGBG will be done. The goal of this work effort is to confirm the completeness of past surveys and exhumations. To locate and define the boundaries of the subsurface features (burial pits) at the MGBG, geophysical

surveys will be conducted. A number of methods and devices are available to conduct the required geophysical surveys. These include electromagnetic (EM) induction, magnetometer, and ground penetrating radar (GPR). Electromagnetic induction and magnetometer surveys will be conducted first. EM and magnetometer survey results will then be assessed in the field to determine if additional surveys using one or more of the other techniques are warranted. Their results can be reduced in the field and quickly used to guide the remaining work.

a) EM surveying is used to measure differences in terrain conductivity which are affected by changes in soil porosity, water content, and physical and chemical properties of the ground water and soil. The main advantage of Conductivity surveying is its speed and ease of data acquisition. It is a non-intrusive geophysical technique. Its limitations are that its data is not conformatory by itself (other complementary geophysical methods must be used), urban and atmospheric noise, and conductive materials can effect the acquisition of the data, accurate depth quantification is difficult, and multiple tools are needed to develope multiple depth profiles.

b) Magnetic surveying will be conducted with a proton-precession magnetometer, a device which measures the intensity of the earth's magnetic field. The instrument works so that a relative apparent magnetic field is measured. This allows for the sighting of targets. The field methods are straight-forward and non-intrusive. Both iron and non-iron metals may be detected, the target size is more important than its mass, and evaluations are rapid and detailed. The results are only qualitative, there are depth limitations, and metal litter and urban noise interfere with target definition.

c) GPR responds to changes in soil and rock conditions having sufficiently different electrical properties such as those caused by clay content, soil moisture or ground water, voids, cementation, or man-made objects. High frequency EM signals are induced into the subsurface where reflective waves of energy are generated. These reflected waves are record at the surface and displayed as a produced graph which is a continuous cross-sectional time profile of the shallow subsurface. The technique under favorable conditions produces a high resolution, real-time cross-section. The data can be recorded for later image processing. Its limitations are that wave transmission is effected by clay content in the soil, its penetration is often less then 30 feet, and its "width of track" is very narrow. An experienced operator/analyst is needed to evaluate the records accurately.

2.2.4 **SAMPLE LOCATIONS**. Existing groundwater monitoring wells will be used to sample the groundwater. Their location and condition will be surveyed and the condition of the well screen will be checked for blockage using a plunker attached to a steel tape measure. Where needed the wells will be redeveloped. Additional drilling will be needed to install groundwater wells and to gather hydrogeologic data.

The location of these additional drilling sites both for soil borings and well installation will be dependent on the results of the early round of groundwater sampling and the geophysical investigation. The source of the contamination is probably shallow disposal pits. Following that reasoning, the soil borings will be biased toward known and suspected disposal sites. The locations of the previously excavated burial sites are known. Additional suspected burial sites may be uncovered by the geophysical investigations. The site will be sectioned using a location grid which will be related to established bench marks. All surface and subsurface investigations will be located using that grid.

2.2.5 **SOIL SAMPLE COLLECTION.** Soil samples will be taken using soil boring methods and a tube sampler. The exact number of borings planned for this site will be dependent on the results of the geophysical investigation. Two or more samples per boring will be taken. Samples will be taken from a shallow subsurface soil interval, from any evident or suspected contaminated zone, from the base of fill material, and from the top of the groundwater table or the top of the rock. This scheme is to be used because most contaminants will move in or with the water column and will be deposited along horizons of changed physical or chemical character. The effort's intent is to sample the sites of contaminant deposition. It is proposed that the contamination is migrating vertically in the soil column.

To protect the safety of both the field personnel and the lab personnel, a field instituted detection program will be used. With the extraction of each drive, the soil sample will be inspected for the presence of mustard gas or radioactive contamination. The soil will be screened using a M18A2 Test Kit and a Eberline PG-2 (or equivalent) survey device. A positive indication (a reaction with the test kit or a reading of 10 pCi/g of contamination will be considered a verification of contamination and no further soil samples will be taken.

2.2.6 **GROUNDWATER SAMPLE COLLECTION.** Groundwater monitoring wells will be used to gather groundwater samples. First, the wells presently at the site will be inspected to determine their condition, redeveloped (using compressed air and a filter-in-line system or flushing with water) if needed, and then will be used to sample the groundwater. The sampling effort will be done using a bailer which is to be cleaned between each sample. Samples will be taken from the least-to-most contaminated wells.

2.2.7 SURETY TESTING. Because chemical agents were once found here, the presence of residual agent can not be dismissed. To preclude further exposure to chemical agent, a chemical surety program is to be instituted at the site. A Chemical Surety Program is designed to ensure the safety, security, and reliability of chemical agents and to provide controls to prevent chemical accidents, or incidents. The Army's Chemical Surety Program pertains to all chemical agent storage facilities. It pertains to all storage facilities and chemical surety material in transit in both wartime and peace times. Chemical surety activities include the following:

1) Compliance with approved safety and technical procedures.
2) Chemical logistics considerations (storage, handling, maintenance, transportation, and accountablility).
3) Operations security (OPSEC) at chemical storage and operational sites.
4) Established procedures to ensure that chemical surety contracts contain the necessary clauses to implement the provisions of this regulation.

2.2.8 SOIL SAMPLE TESTING. Considering the kinds of wastes reportedly buried at the site, a specific analytical program must be run. To prevent accidental exposure to chemical agents a surety program will be carried out using procedures developed by the U.S. Army Chemical Research Development and Engineering Center (CRDEC). Soil testing for the presence of Thorium, Target Analyte List (TAL) inorganics, 8240 and 8270 organics will be done (Figure 2.2.8) There are no indications that toxins other than those covered by the analytical program exist at the site. For physical testing of the soils, at least one disturbed soil sample per boring will be collected. This sample will be taken from soil suspected to be uncontaminated but representative of the soil column. Additional samples for physical testing will be collected at horizons of major soil change. The physical tests will consist of a visual classification, grain size distribution, natural water content, USCS classification, Atterberg limits, and organic content. The samples collected for physical testing will be sent to USACEWES' Soils Investigation Laboratory. The address of the Analytical Laboratory Group (POC Ann Strong) and the Soils Investigation Laboratory (POC Mr. Jesse Oldham) is: 3909 Halls Ferry Rd.; Vicksburg, Mississippi.

2.2.9 GROUNDWATER SAMPLE TESTING. Experience at other chemical agent sites have shown that agent does not move in the groundwater column. Surety testing of groundwater samples is not required nor is it needed. Groundwater testing for the presence of inorganics by SW-846 Methods 7060, 6010, 7471, and 7740, volatiles by EPA Method 8240, semivolatiles by EPA Method 8270, TOX by SW-846 Method 9020 and analysis for Thorium will be done (Table 2.2.8). Samples collected for chemical analysis will be sent to

TABLE 2.2.8
Types and Numbers of Samples
MUSTARD GAS BURIAL GROUND

		Quality Assurance and Quality Control				
	Field Samples	Field/Dups QC	Rinsate Equip	Field Blanks	Trip Blanks	Total
GROUNDWATER:						
Volatiles						
B/N/A					NR	
TOX						
Thorium					NR	
Metals					NR	
Other*:Cl,SC					NR	
SURFACE WATER:						
Volatiles						
B/N/A					NR	
Pesticides					NR	
TRPH					NR	
Metals					NR	
Other:						
SURFACE SOILS:						
Volatiles						
B/N/A					NR	
Pesticides					NR	
TRPH					NR	
Metals					NR	
Other:						
SUBSURFACE SOILS:						
Volatiles 8240				NR		
B/N/A 8270				NR	NR	
Thorium				NR	NR	
TRPH						
Metals				NR	NR	
Other:						

*Cl = Chloride SC = Specific Conductance

USACEWES' ALG in Vicksburg, Mississippi, and the samples collected for physical characterization will be sent to USACEWES' Geotechnical Laboratory also in Vicksburg, MS. ALG's (POC Ann Strong) address is: 3909 Halls Ferry Rd.; Vicksburg, Mississippi. The address for the Soils Investigation Laboratory (POC Mr. Jesse Oldham) is: 3909 Halls Ferry Rd.; Vicksburg, Mississippi.

2.2.10 SLUG TESTING. The results from these tests will be used to derive aquifer characteristics. To get a statistically sound average characteristic 2 rounds of testing will be done. Slug tests are preferable to pumping tests for this investigation because they can be conducted without bringing contaminated water to the surface. A weight of known volume can be used to increase the head in the well and the decline in head can be measured over time. Elevation of the water surface above the transducer will be measured with a pressure transducer and recorded with a data logger (Hermit). The Bouwer and Rice Analytical method (Based on Hvorslev) will be used to calculate hydraulic conductivities. The aquifer parameters such as porosity and permeability can be empirically derived from the hydraulic parameters. The aquifer parameters of hydraulic conductivity and storativity can be computed for the area close to the well bore.

Each well test must be approached on an individual basis. A minimum of two test is required to be performed on each well. Adjustments must be made for changes in well design or aquifer conditions. Hvorslev method analysis will be used for most tests at Crane. The Hvorslev method analysis can be used for a variety of well shapes, confined or unconfined aquifers, and partial or fully penetrating screens. Changes in the well design or in aquifer conditions will necessitate changes in the equations needed to calculate hydraulic conductivity and storativity.

2.3.0 STUDY MANAGEMENT

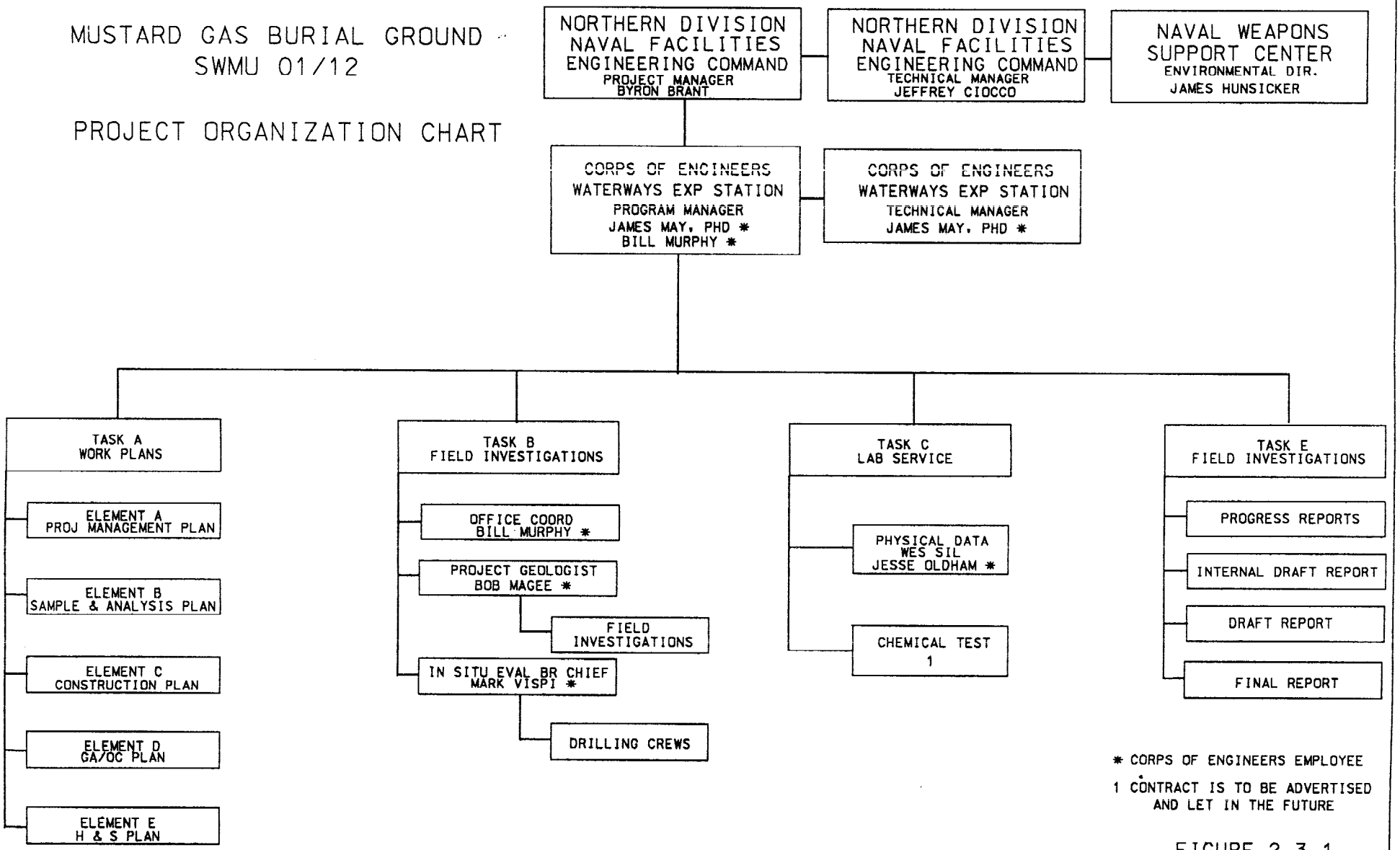
2.3.1 MANAGEMENT RESPONSIBILITIES. The Navy's prime contractor for this RCRA investigation is USACEWES. A project team, which is made up of USACE personnel, was assembled (Diagram 2.3.1). Oversight and management responsibility will be handled by Dr. James May and William Murphy of USACEWES' Geotechnical Section. The planning, scope writing, and report preparation is the responsibility of Robert Magee of USACE Engineering District, Wilmington, N.C. Field work supervision will be the responsibility of Robert Magee of USACE Engineering District, Wilmington, N.C. Drilling will be done by personnel from the In situ Evaluation Branch, Geotechnical Branch of USACEWES. Mr. Mark Vispi is the Branch Chief. The chemical analysis is to be processed through the USACEWES' Analytical Laboratory Group (ALG) under the supervision of Ann Strong. All chemical data validation will be done by Blaze Willis of USACE Engineering District, Savannah, Georgia. Soils classification and physical testing will be done at USACEWES' Soils Investigation Laboratory under the supervision of Mr. Jesse Oldham. Report preparation will be done by a team of USACE Engineering District, Wilmington, N.C. and USACEWES personnel. Field survey and project management will be done with the assistance from the RASO, the Navy Ordanance Environmental Support Office (OESO). The Navy Emergency Ordnance Demolition Detachment NWSCC will do the field sample screening for mustard agent and the NWSCC Radiation Safety Office (Code 04RL) will do the field radiological surveying and sample screening.

2.3.2 PROGRAM SCHEDULE. Diagram 2.3.2 is a work schedule which illustrates expected work durations, phase structure, phase completion dates, and milestone dates. Field work weeks are to be 6-day weeks. The field work is scheduled to take 91 days total, assuming 1 boring per day. To expedite data reduction the field data will be forwarded to the Wilmington Engineering District office where it will be processed. Fifty-five days are set aside for chemical and physical analysis. This is followed by 55 days of data reduction, and 25 days of Internal Draft Report preparation. Thirty days for review of the Internal Draft is followed by 10 days of rewrite. The Internal Draft is followed by a Draft Report which is reviewed by the EPA. Forty-five days are allotted for EPA review and comment. Twenty days for incorporation of comments are scheduled to prepare the final report. The commencement of the field work. Bimonthly progress reports will be issued. These reports will include overall project progress, individual study progress, impending schedule targets, and expected or existent schedule adjustments. Because the bimonthly progress reports are independent of the individual study work plans, they are not shown on the work schedule.

RCRA FACILITY INVESTIGATION
PHASE II SOILS & GROUNDWATER

MUSTARD GAS BURIAL GROUND
SWMU 01/12

PROJECT ORGANIZATION CHART



* CORPS OF ENGINEERS EMPLOYEE

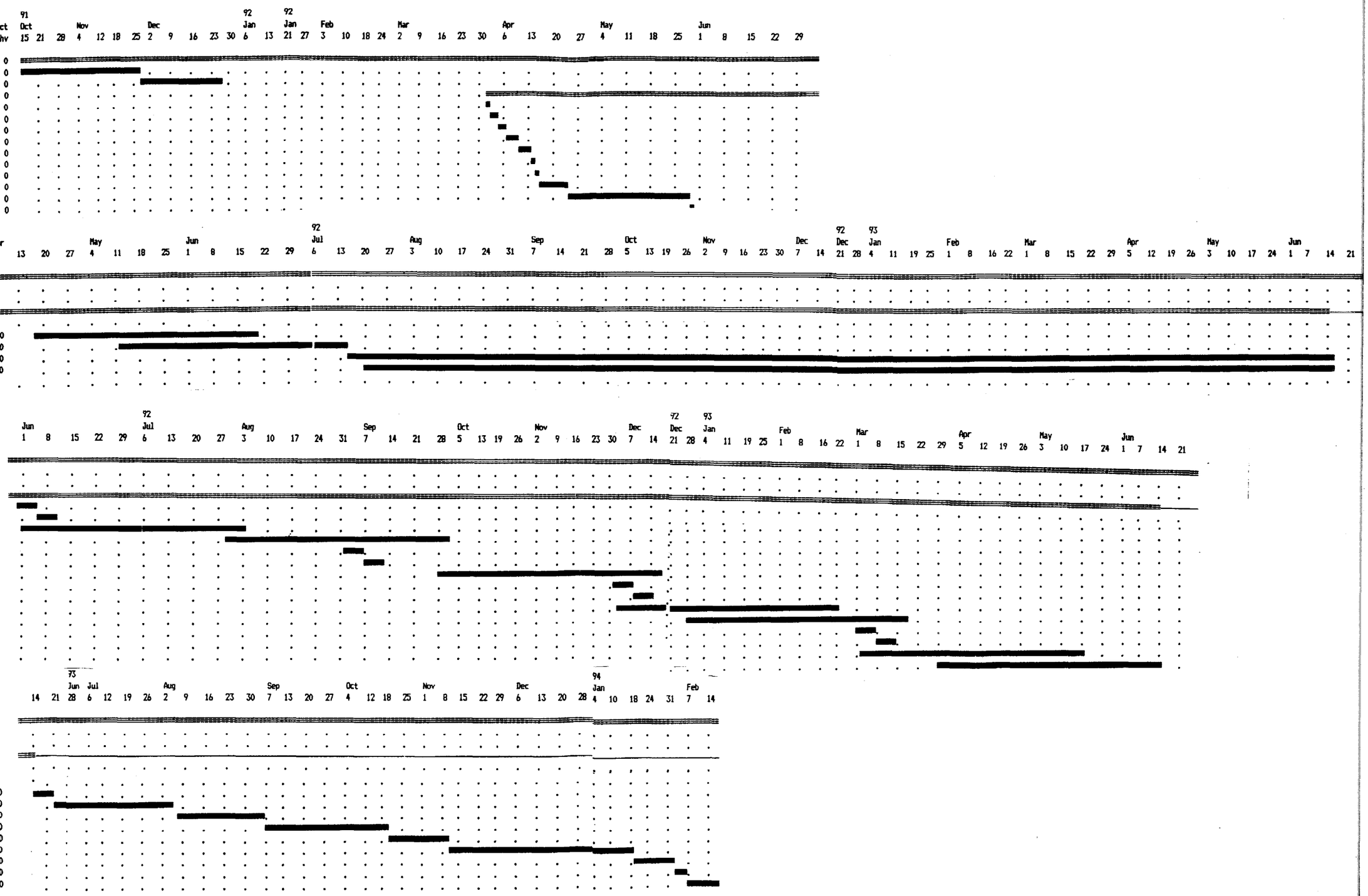
1 CONTRACT IS TO BE ADVERTISED AND LET IN THE FUTURE

FIGURE 2.3.1

dule Name : MGBG SWMU 01/12
onsible : KAMALA D. POWELL
t Date : 23-Aug-91 9:00am Schedule File : C:\TL3\DATA\MGBG

PHASE II SOILS & GW WORK PLAN/DATES SUBJECT TO CHANGE

Name	Start Date	Duratn (Days)	End Date	Pct Achv
ME SCHEDULE	15-Oct	616	16-Feb	0
EPA APPROVAL	15-Oct	30	26-Nov	0
REVISE	27-Nov	20	26-Dec	0
FIELD WORK	1-Apr	332	14-Jun	0
PHYS & CHEM SCREEN	1-Apr	1	1-Apr	0
RECON	2-Apr	2	3-Apr	0
SURVEYING	4-Apr	2	6-Apr	0
GEOPHY INVEST	7-Apr	3	9-Apr	0
SAMPLE EXIST WELLS	10-Apr	3	13-Apr	0
LOCATIONING	14-Apr	1	14-Apr	0
RIG MOB	15-Apr	1	15-Apr	0
PLACE BORINGS	16-Apr	7	23-Apr	0
PLACE MON WELLS	24-Apr	30	28-May	0
DEMOB	29-May	1	29-May	0
SOIL ANALYSIS	17-Apr	55	19-Jun	0
DATA REDUCTION	12-May	55	14-Jul	0
INTERNAL DRAFT	15-Jul	243	15-Jun	0
GRAPHICS PREPARATION	20-Jul	239	15-Jun	0
1ST ROUND GW TEST	30-May	5	4-Jun	0
AQUIFER	5-Jun	5	10-Jun	0
ANALYSIS	1-Jun	55	3-Aug	0
DATA REDUCTION	29-Jul	55	30-Sep	0
2ND ROUND GW TEST	1-Sep	5	5-Sep	0
AQUIFER TEST	7-Sep	5	11-Sep	0
DATA REDUCTION	28-Sep	55	16-Dec	0
3RD ROUND GW TEST	1-Dec	5	7-Dec	0
AQUIFER TEST	8-Dec	5	14-Dec	0
ANALYSIS	2-Dec	55	22-Feb	0
DATA REDUCTION	28-Dec	55	17-Mar	0
4TH ROUND GW TEST	1-Mar	5	5-Mar	0
AQUIFER TEST	8-Mar	5	12-Mar	0
ANALYSIS	2-Mar	55	17-May	0
DATA REDUCTION	29-Mar	55	14-Jun	0
TYP'	16-Jun	5	22-Jun	0
I' EVIEW	23-Jun	30	4-Aug	0
EL	6-Aug	21	3-Sep	0
INTERNAL REVIEW	7-Sep	30	19-Oct	0
EDITING	20-Oct	15	9-Nov	0
DRAFT REVIEW	10-Nov	45	18-Jan	0
EDITING	19-Jan	10	1-Feb	0
TYPING	2-Feb	3	4-Feb	0
FINAL REVIEW	7-Feb	8	16-Feb	0



===== Summary Task M Milestone

3.0 ELEMENT B: SAMPLE AND ANALYSIS PLAN

3.1.0 SELECTION PROCEDURES

3.1.1 SELECTION RATIONAL. At the MGBG a wide variety of wastes were buried. Some of these materials present special (chemical agents and radioactive materials) hazards. The MGBG was identified as a SWMU. A Phase II release assessment must be performed. The intent of a Phase II study is to evaluate the presence or absence of a hazardous waste release, and to characterize the hazardous waste and its constituents. The soils will be screened using a Foxboro OVA, a Eberline PG-2 survey device, and a M18A2 Test Kit. Geophysical investigation devices to be used are an electromagnetic device, a ground penetrating radar unit and a magnetometer. The resultant data will be used to select locations for both soil borings and monitoring wells. The soil and groundwater will be tested for chemical confirmation using SW-846 analytical methods, or other accepted methods when no SW-846 method is available. The use of these methods is described in the corrective actions portion of the permit. The particular procedures selected were determined by the site specific description of the waste. Waste descriptions were obtained from review of groundwater data and historical disposal documentation. US Army Corps of Engineers geotechnical procedures will be used to physically characterize the soil. These methods are found in U.S. Army Corps of Engineers publication EM 1110-2-1906 located in the on-site drilling trailer.

3.1.2 GEOPHYSICAL PROCEDURES. a) The Geonics EM-31 and EM-38 Terrain Conductivity Systems are inductive electromagnetic devices to be used. The EM equipment consists of a transmitter and receiver coil connected by a cable of variable length. The transmitter coil is energized with an alternating current to produce a time-varying magnetic field. The magnetic field induces small currents within conductive material below the ground surface. The induced currents produce secondary magnetic fields detectable by the receiver. The measured quantity is expressed as an apparent conductivity, the magnitude of which is dependent on the instrument's coil spacing, transmitter frequency, and the ratio of primary to secondary magnetic fields. The units of conductivity are the Mho per meter or, more conveniently, the millimho/meter. Values of apparent conductivity measured on a grid can be contoured for analysis.

There are two components of the induced magnetic field to be measured by the EM- 31. The first is the quadrature-phase component which gives the ground conductivity measurement. The second is the in-phase component, which is significantly more sensitive to large metallic objects and hence very useful when looking for buried metal containers. The EM-31 has an intercoil spacing of 12 ft and has an effective depth of exploration of about 20 ft (6 m). The EM- 31 meter reading is a weighted average of the earth's

conductivity as a function of depth. A thorough investigation to a depth of 13 ft is possible, but below that depth the effect of conductive anomalies becomes more difficult to distinguish as their depth increases. The instrument can be operated in both a horizontal and vertical orientation with correspondingly different effective depths of exploration. The instrument is normally carried such that the transmitter and receiver coils are oriented vertically, which gives the maximum penetration depth. It can be used in either a discrete or continuous read mode.

The EM-38 operates under the same principles as described for the EM-31, measuring the apparent conductivity of the ground in millimho per meter. The instrument has an intercoil spacing of 3 ft, and a maximum depth of investigation of 6 ft. Both quadrature-phase and in-phase readings can be taken to measure conductivity and change in metallic susceptibility, as with the EM-31. The EM-38 can also be operated in both the vertical and horizontal dipole mode coil configurations. In the vertical dipole mode, the relative sensitivity to near surface material is very low (being zero at the surface). The sensitivity increases with depth, becomes a maximum at about 1.3 ft, and decreases slowly thereafter. In the horizontal dipole mode of operation the relative sensitivity is greatest to material at the surface, and decreases thereafter with depth. The large difference in the response to near surface material in the two coil configurations allows a quick method for determining whether the near surface material is more or less conductive than is material at depth. Although the EM-38 has a much smaller depth of investigation than the EM-31, it has correspondingly greater horizontal resolution capability than the EM-31

An electromagnetic survey will be run at the MGBG using both EM 38 and EM 31 surveying devices. In-phase and quadrature-phase surveying will be done. The burial activities at the MGBG were varied. The depth of burial is uncertain. The two survey instruments will complement each other by assuring both shallow and deeper sensitive investigations.

b) The proton-precession magnetometer measures the absolute value of the total magnetic field intensity with an accuracy of 1 gamma (1 nano Tesla) in the earth's field of approximately 50,000 gammas. The total magnetic field intensity is a scalar measurement of the magnitude of the earth's field vector independent of the field's direction. The total field is a vector sum of the earth's main field and any local anomalous field component in the direction of the earth's main field.

Magnetic anomalies in the earth's magnetic field are caused by two different kinds of magnetism: induced and remnant (permanent) magnetization. Induced magnetization refers to the action of the field on subsurface material, wherein the ambient field is enhanced or diminished depending on the magnetic properties of the material. The resulting magnetization is directly proportional to the intensity of the ambient field and to the magnetic susceptibility of the material. The remnant or permanent magnetization is

often the predominant magnetization in many igneous rocks and iron alloys. Permanent magnetization depends upon the metallurgical properties and the thermal, mechanical, and magnetic history of the specimen. This type of magnetism is independent of the field in which it is measured.

A magnetic anomaly represents a local disturbance in the earth's magnetic field which arises from a localized change in magnetization, or magnetization contrast. The observed anomaly expresses the net effect of the induced and remnant magnetization and the earth's field which usually have different directions and intensities of magnetization. Depth of detection of a localized subsurface feature depends on its mass, magnetization, shape and orientation, and state of deterioration.

c) Ground penetrating radar uses high frequency electromagnetic waves from approximately 100 megaHertz (MHz) to 1000 MHz to acquire subsurface information. The data collection process involves moving a small antenna across the ground surface and transmitting high frequency radio waves into the subsurface. The signal is reflected off subsurface interfaces and back to the receiving antenna where variations in the return signal are continuously recorded. Analysis and filtering of the recorded signal produce a vertical profile of the shallow subsurface conditions. The depth of exploration using GPR is primarily dependent on the properties of the soil and rock at the site. The best results are attained in dry, sandy or gravelly subsurface material.

At the MGBG soil conditions are expected to be consistent and constant across the site. Any changes in the horizontal soil profile are expected to be the results of man's activities (excavation and burial). GPR is an excellent tool both for remotely locating buried objects and and identifying the nature of those objects.

3.1.3 <u>SAMPLE LOCATION</u>. Soil boring locations will be selected with a bias toward areas having the greatest probability of contamination. Those areas are in known disposal sites, trenches, and pits. The exact location for the individual borings will be selected in the field. At those sites the upper soil horizon, any existent or suspected contaminated layer, the base of fill layers, and the top of rock or top of the groundwater table interval will be sampled.

The 27 existing groundwater monitoring wells will be used initially to sample the groundwater (Figure 3.1.3). Two additional shallow monitoring wells and two monitoring well clusters are projected to be installed. The reason for the shallow monitoring wells is to further detail the groundwater plume. The clustered wells are to serve two purposes. One well, a twin to WES-1-81, is to be used to determine groundwater parameters of a possible second and third aquifers under the site. The well will be drilled to the Beech Creek Formation. Each groundwater zone below the surface zone, completed in WES-1-81, will be screened in a separate monitoring well. The second clustered well will be installed next to WES-02-81. This well will be used to detect contaminant migration along the base of the surface groundwater system. It is possible that the pollution has become partitioned in the water column. Heavier chemical compounds will separate from lighter compounds and sink in the water column. The particular location for this well was picked to be near an established contaminated groundwater well and to be near the probable source of the pollution.

3.1.4 **CHEMICAL ANALYTE SELECTION.** US EPA mandates that RCRA studies adhere to procedures and methods set out in "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods" SW-846, Third Edition. In the area various chemical wastes, chemical weapons, and radioactive materials were buried. Explosive wastes were reportedly not buried here. Various laboratory chemicals were dumped at the site. Groundwater monitoring has been performed. The detected contaminants were chlorinated solvents. The groundwater testing results from MGBG wells are listed in Appendix C.

To determine what contaminants are found in the soil, soil samples must be taken. It is expected that the principle contaminants at the site are organic and metal wastes. In each soil boring, two to four samples are planned. These sample sets will be one shallow subsurface sample, one sample from an evident or suspected contaminated zone, one sample from the base of fill material, and a sample from the top of rock or top of groundwater interval. The list of analytical test parameters shown in Table 3.1.4 were selected. The volatile (EPA Method 8240) contaminants have been detected (1982 to 1987) in the groundwater at the site. Semivolatile (EPA Method 8270) organics are common constituents of many of the compounds used at NWSCC. Thorium nitrate was buried at the site and it is highly water soluble.

Groundwater sampling will be done at the site using existing and proposed monitoring wells. The results of this analysis will be used to determine the contaminate plume's chemical make-up, its shape and lateral extent, and to develop monitoring parameters. The list of chemical tests and procedures shown in Table 3.1.4 were selected on the basis of their probability of occurring at the site. The 8240 organics were selected because of their presence in the groundwater. Semivolatile organics (EPA Method 8270) will be tested to determine if they are present in the groundwater. In previous testing, only scattered semivolatile organic compound analysis was done.

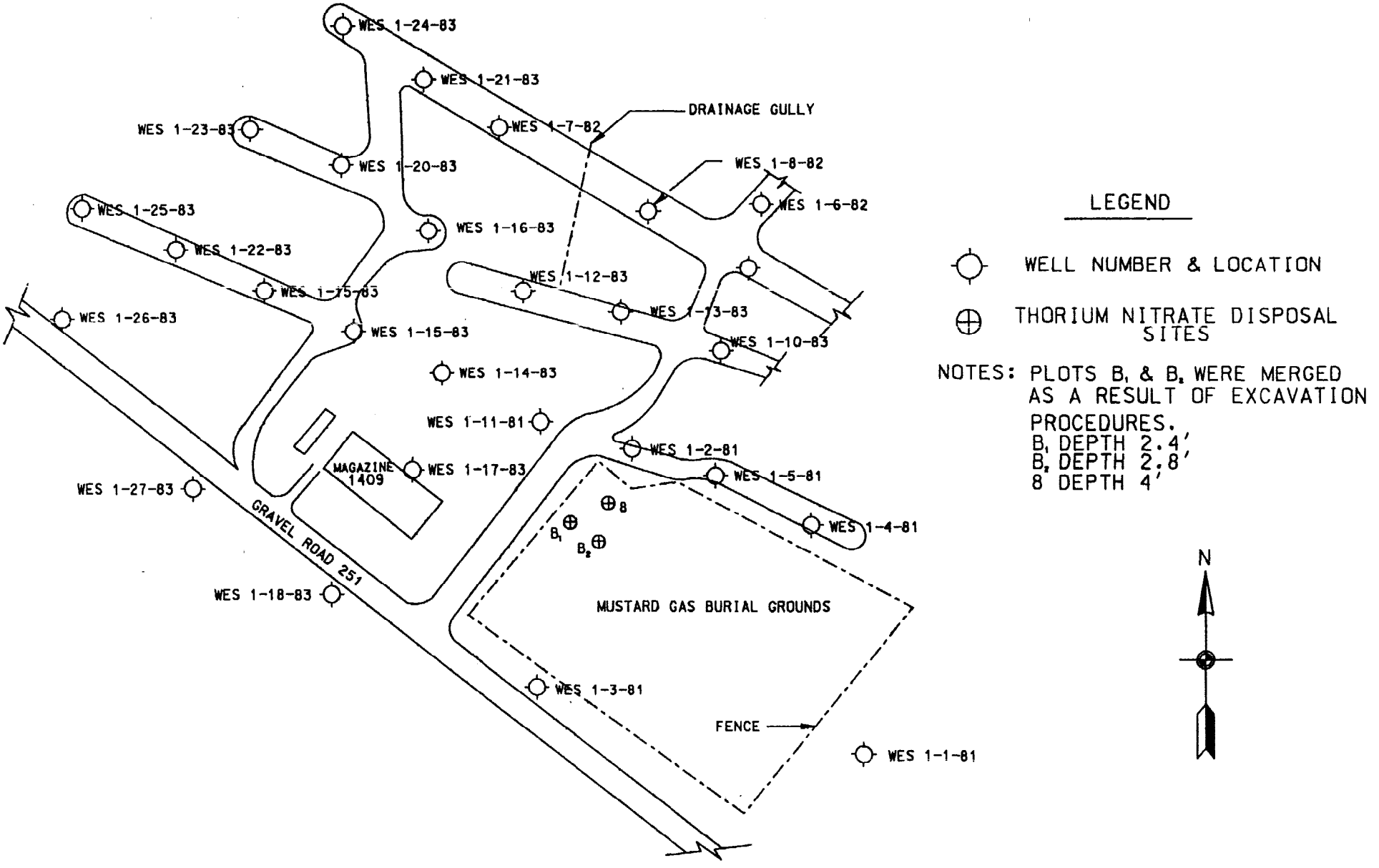


FIGURE 3.1.3 MUSTARD GAS BURIAL GROUND BORING LOCATIONS

TABLE 3.1.4
SUMMARY OF METHODS FOR
DETERMINATION OF COMPOUND DETECTION

METAL ANALYSIS	TECHNIQUE*	EXTRACTION**	ANALYSIS
Aluminum	ICP	3050 S 3005 W	6010
Antimony	ICP	3050 S 3005 W	6010
Arsenic	GF	3050 S 3005 W	7060
Barium	ICP	3050 S 3005 W	6010
Beryllium	ICP	3050 S 3005 W	6010
Cadmium	ICP	3050 S 3005 W	6010
Calcium	ICP	3050 S 3005 W	6010
Chromium	ICP	3050 S 3005 W	6010
Copper	ICP	3050 S 3005 W	6010
Iron	ICP	3050 S 3005 W	6010
Lead	ICP	3050 S 3005 W	6010
Magnesium	ICP	3050 S 3005 W	6010
Manganese	ICP	3050 S 3005 W	6010
Mercury	CV		7471
Nickel	ICP	3050 S 3005 W	6010
Potassium	ICP	3050 S 3005 W	6010
Selenium	GF	3050 S 3005 W	7740
Silver	ICP	3050 S 3005 W	6010
Sodium	ICP	3050 S 3005 W	6010
Thallium	ICP	3050 S 3005 W	6010
Vanadium	ICP	3050 S 3005 W	6010
Zinc	ICP	3050 S 3005 W	6010
Thorium	SC	NO EPA METHODOLOGY	
Chloride	CO1		9250
Specific Conductance		N/A	9050
ORGANIC ANALYSIS			
Volatiles	GC/MS		8240
Semivolatiles	GC/MS	3540/3550	8270
Total Organic Halide	Mt		9020
Mustard Agent	GLC		CRDEC

* Abbreviations: GF = Graphite Furnace, CV = Cold Vapor, Mt=Microcoulometric-titration, ICP = Inductively Coupled Plasma, SC = Scintillation Counter, Col=Colorimetric, GLC = Gas-Liquid Chromatography.

**Extraction process, when not noted, is included in the analytical method.

S = Soil and sediment

W = Water

Thorium nitrate was buried at the site and it is highly water soluble. The list of metals selected is a list of common industrial metals. Total Organic Halide (SW-846 Method 9020), Chloride (SW-846 Method 9250) and Specific Conductance was selected because in past sampling episodes these parameters seemed to be associated to the contamination.

3.1.5 **AQUIFER TESTING.** Slug testing is to be done to derive the aquifer characteristics. This test consists of introducing an artificial head pressure (changing the water level in the well casing) and recording the decay of that head pressure over time. The changes in groundwater surface elevations will be derived for information gathered from a pressure transducer installed in the test well. The transducer will be installed before the test is to be run. Surface elevation changes will be used to derive aquifer parameters. Measurements will be made with a pressure transducer.

3.1.6 **PHYSICAL PARAMETER SELECTION.** Soil samples will be characterized using standard USACE geotechnical methods. The soil samples will be described and classified in the field by the field crew (Figure 3.1.6). USCS classification will be done at the laboratory. The classification will consist of a visual description, a sieve and hydrometer analysis to determine grain size distribution of the sample, determination of natural water content, USCS classification, Atterberg limit, and organic content. The sieve analysis determines the gradation of grain sizes ranging from the number 4 sieve to the number 200 sieve. The hydrometer analysis determines the percentage of silt and clay sized particles in the sample. The Atterberg limit testing determines the plasticity of the soil.

Rocks will be examined and classified in the field and their descriptions logged in the field log book. Classification will be in accordance with EM 1110-1-1806 (located in field trailer). The classification and description of the rocks will include in the following order, as applicable:

1) Unit destination (Miami Dolomite, Clayton Formation, Chattanooga shale)
2) Rock type
3) Hardness
4) Degree of weathering
5) Texture
6) Structure
7) Color
8) Solution and Void conditions
9) Swelling properties
10) Slaking
11) Additional descriptions such as mineralization, size and spacing shale seams, etc.

BORING LOG
FIELD DATA

PROJECT: _____ SITE _____ DATE _____

LOCATION: _____ JOB NO. _____

DRILL RIG _____ INSPECTOR _____ OPERATOR _____ SURFACE EL _____ BORING NO. _____

SAMPLE NUMBER	DATE TAKEN	STRATUM		DRIVE		SAMPLE		TYPE OF SAMPLER	HYD PRESS.	CONT.	CLASSIFICATION & REMARKS
		FROM	TO	FROM	TO	FROM	TO				

FIGURE 3.1.6

3.2.0 GEOPHYSICAL PROCEDURES

3.2.1 ELECTROMAGNETIC SURVEYING. An EM survey using a Geonics EM-31 Terrain Conductivity System will be conducted over the site. The EM-31 is a reconnaissance instrument having a coil spacing of 12 feet and an effective depth of investigation of 15 feet. The purpose of the initial survey is to measure differences in terrain conductivity at the site and to determine locations and boundaries and identify anomalies associated with the trenches. The EM 31 system will be operated in continuous-read mode with no grid. Anomalous regions will be marked and then studied in more detail using the magnetometer and Geonics EM-38 Conductivity System on a grid. A grid station spacing of ten feet will be surveyed with the EM-38 and magnetometer in the cleared area within the fence. The EM-31 reconnaissance survey will first be conducted within the area of investigation. The 5-ft EM-38 grid will then be laid out within the area of investigation from information obtained in the reconnaissance phase of the survey. Modification of the station spacing required to sufficiently map the anomalies will be at the discretion of the project geophysicist. The EM-38 system will more accurately define the location and perimeter boundary of the burial trenches and their contents. The EM-38 system also provides more near-surface (shallow) information.

The EM 38 instrument is operated in both the vertical and horizontal orientations (see Paragraph c.(1) above) and the results compared as an indication of relative depth of anomalies detected by the surveys. If the vertical and horizontal data are similar, the anomalous features can be assumed to be quite shallow.

3.2.2 MAGNETOMETER SURVEYING. The magnetometer survey is conducted using a "looping" procedure. In looping, one grid point is established as the base and remains as such throughout the survey. The base station is reoccupied at approximately 30 min intervals. In this way, any drift in the earth's magnetic field can be identified and removed for data analysis. Magnetometer data are stored in the internal memory of the magnetometer and transferred to a portable field computer at the conclusion of each day. The nominal value of the earth's field, 50,000 nano Teslas (nT) is subtracted to provide a reference level for determining significant highs and lows in the survey readings. The data can be filtered by a computer process to reduce the effects of known magnetic anomalies such as fences. The process involves clipping values above and below a selected range relative to the mean value.

3.2.3 **GROUND PENETRATING RADAR.** A preliminary test is conducted with the radar unit at the test site. The purpose of the test is to determine which of the available antennas (typically 80 and 300 MHz) are most suitable for the soil conditions. As the main test proceeds, radar range settings are adjusted to obtain data at sufficient resolution to as great a depth as possible. Shape and size of the radar "targets", or reflectors, are clues to the characteristics and identity of the subsurface anomalies they represent. Hyperbolic-shaped reflectors are classified as narrow or wide. Narrow hyperbolic reflectors often indicate relatively small man-made objects such as canister, drums, ordnance or debris, or naturally occurring cobbles and boulders. Small reflectors associated with "ringing" of the data record are usually indications of shallow metal targets. Wide hyperbolic reflectors may indicate local changes in geologic conditions or deep man-made features. Dipping radar reflectors can represent the walls of a trench or can be caused by the radar antenna moving toward or away from a steel fence. Pre-survey reconnaissance for potential man-made anomalies is essential to permit proper interpretation of survey data.

Steel fences and electronic "noise" are factors which degrade the radar survey data. Effects of fences can be accommodated by pre-survey mapping of fence locations. Those records showing appreciable electronic noise will be rerun. Another factor in data quality deterioration is failure to maintain a constant survey speed. Care is taken to pull the radar "sled" along the ground surface at a uniform speed.

3.2.4 **DATA ANALYSIS AND PRESENTATION.** Aside from application of quantifiable filters and elimination of background levels of the electromagnetic field and the earth's magnetic field, interpretation of the survey data is by qualitative assessment of mapped and graphed magnetic and electromagnetic readings and of radar cross-section records. Depth to radar targets can be obtained from the GPR cross sections. An approximate range of depth can be estimated from the magnetometer and EM data. Contoured values are examined and anomalies identified. Anomalies are interpreted by evaluating their shape, location and magnitude in each of the three surveys so that data from all of the survey techniques contribute to the final interpretation. Anomalies identified in pre-survey reconnaissance as unrelated to the test purposes, such man-made features as fences and utilities, are eliminated from consideration. Ideally, target anomalies will be identified in more than one type of survey to increase the confidence and reliability placed in their interpretations.

Magnetometer and EM data will be presented as contour maps and block diagrams. GPR data are presented as cross-sections produced as direct output in the field during the GPR survey and then annotated. Interpretations of the data will be summarized in tabulated form.

3.3.0 SAMPLING PROCEDURES

3.3.1 GENERAL PRINCIPLES. Direct body contact with the samples must be avoided. To minimize the spreading of contamination between samples, samplers will wear disposable latex gloves. The outer pair of latex gloves are to be changed between each sampling event. All sampling equipment and drilling equipment will be decontaminated between usage.

An indefinite number of soil borings and samples are planned. Soil samples will be taken with a tube sampler. Each soil sample will be inspected for the presence of mustard gas and radionuclides. To establish a base line for metal content in the soil, three background borings are planned. They will be taken near WES-1-1-81, the groundwater monitoring control well. These samples will be tested using the same analytical methods established for the other samples. At each boring soil samples will be taken at the following depth, 6" to 12", from any zone of evident or suspected contamination, from the base of the filled zone, and the last 6" directly above the water table, or 6" directly above the top of rock whichever is encountered first. These sample intervals and their corresponding sample identification number are shown on Figure 3.3.1. Sample identification will include SWMU No., well or boring no., year sampled, and sample no., (i.e. 01/12-01-91-1). No soil samples are to be taken below the water table and no samples will be taken below the top of rock. The borings are to be taken to bedrock/ refusal, or a depth of 50' below the ground surface.

Monitoring wells will be installed in and around the MGBG to provide for the measuring of groundwater levels and piezometric surfaces, determining the subsurface geology and the stratigraghic positioning, and detection of chemical contamination. These samples will be collected using a Teflon bailer. An attempt will be made to move from the least-to-most contaminated wells (1,2,5,4,3,7,17,6,10,23,9,21,8,24,19,20,22,25,26,27,11,12,13,14,15,16,17 and 18). To insure that the samples represent the conditions existent in the aquifer, three casing volumes of water will be drawn prior to sampling. Any generated water not collected for sample analysis (e.g., purge water and excess sample) will be discharged to the ground surface no closer than 10 ft. from the well (unless contaminated).

3.3.2 GEOPHYSICAL SURVEYING. A grid will be established to encompass the area of interest. Survey grid positions are to be located from known points, such as survey bench markers or monitoring well casings which have been previously surveyed for map location (northings and eastings). Grid positions are marked with wooden stakes for reference during the geophysical surveying. Grid location will be made by chaining or by transit from the known well positions.

Prior to operating the EM system in the area of interest, a visual reconnaissance of the area is made by the operator to identify potential man-made or natural anomalous electromagnetic sources such as fences, power lines

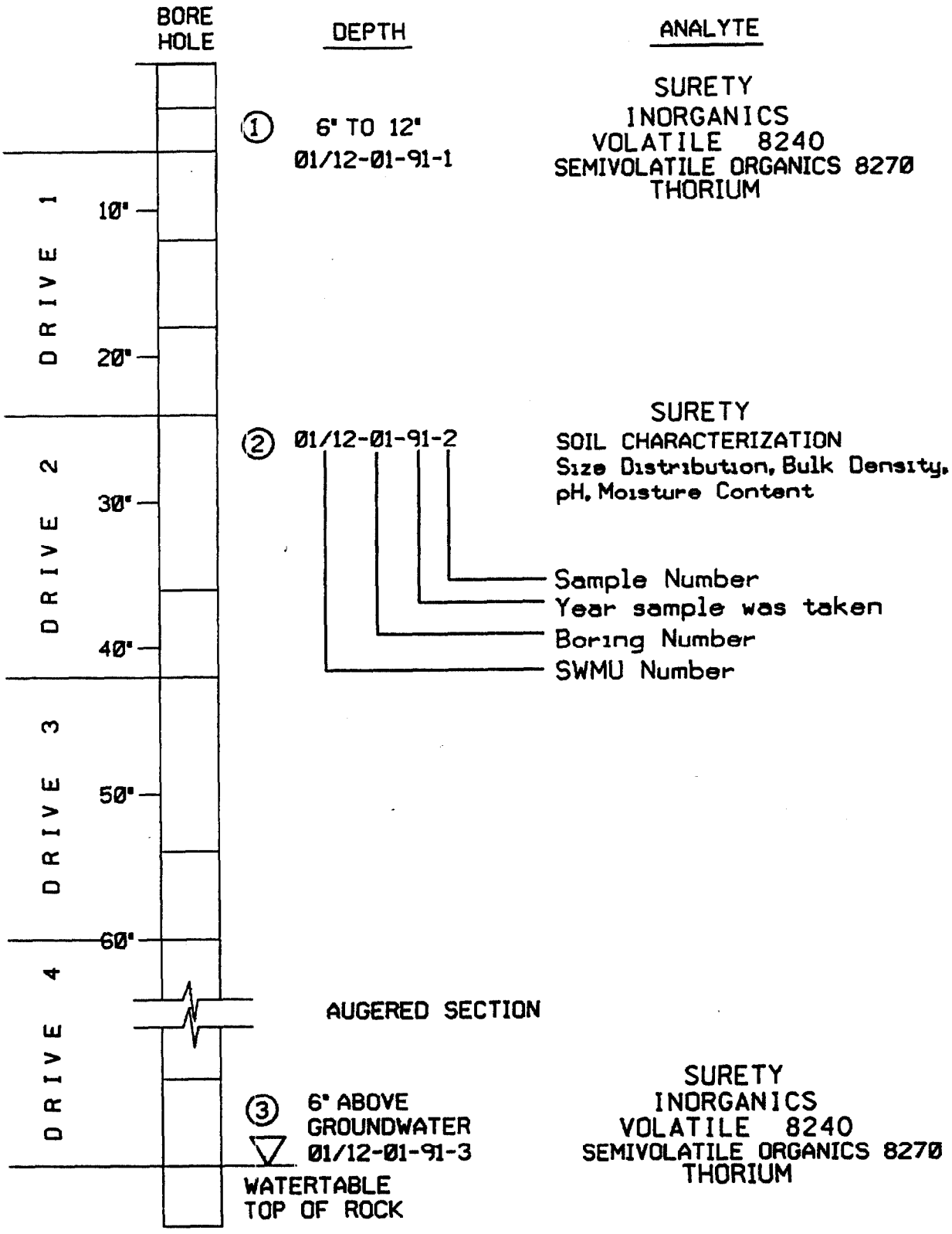


Figure 3.3.1
Diagram of Boring Log with Sample Points
NWSCC Phase II Soils

and other utilities. Utility maps of the area will be obtained and studied. The EM instrument is then nulled and readings taken either in continuous mode for reconnaissance or at specific grid nodes for detailed mapping. Measurements are recorded on a digital data logger and transferred to a portable field computer at the conclusion of each day. Filters can be employed during computer analysis of the data to enhance specific areas of interest and to reduce the effect of unwanted anomalies such as fences.

EM-31 and EM-38 data will be taken in both the quadrature-phase (conductivity) and in-phase (magnetic susceptibility) mode at each measurement station. EM-31 and EM-38 readings will be taken at 10 ft. intervals over the entire gridded area. The measurements will be recorded on a digital data logger and transferred to a portable field computer at the conclusion of a survey day.

Total magnetic field and magnetic gradient readings will be taken at each survey point. The data will be collected and stored in internal memory of the magnetometer and transferred to a portable field computer at the conclusion of a survey day.

The GPR survey will be run in a north-south direction following the long axis of the gridded site. Because of the size of the radar antenna sled (approximately 3 ft. by 3 ft.) the GPR survey coverage will be limited. Survey lines will be spaced 10 ft. apart. The radar antenna will be hand-towed along each survey line at a slow walking rate (approximately 1 to 2 miles per hour). Grid intersections will be established on the radar records by electronically impressing dashed, vertical reference lines on the graphic records as the antenna passed each flagged location.

3.3.3 SOIL SAMPLING. Soil borings will be placed using a truck mounted drilling rig. Samples will be taken at specified depths all above the water table and refusal. A Shelby Tube sampler will be used to collect the soil samples. The sampler will be advanced through a hollow stem auger. The hollow stem auger will be used because it will minimize cross contamination of samples. As the auger advances into the soil, protective casing is advanced. This casing will prevent the hole from caving. At the surface, the sampler will be opened and the sample extracted. The sample will be tested for the presence of Mustard Gas Agent and Radionuclides. The sample, after clearance, will be peeled and bottled in the shortest time possible. Peeling is the process that removes the portion of the sample which is in direct contact with the sampler. Ends of the sample will not be used. All samples will be extruded into wide-mouth glass jars or other containers with minimal disturbance of the sample. The size of the sample to be collected is dependent on the type of analysis to be run. Stainless steel tools will be used to put the peeled samples into the containers. The sample jars or bottles will then be sealed and placed in sealing plastic packets. Packing material will be used to separate the sample packets. The samples will be put into locked ice chests (coolers) for storage at a temperature of 4 degrees C.

Preservatives will not be required for the soil samples. The coolers containing the samples with their accompanying Chain of Custody forms will be transported to the analytical lab for analysis. Transport will be by air freight with an overnight carrier service. A seal will be placed on each cooler to ensure that the samples have not been disturbed during transport to the laboratory. These samples will be analyzed for the presence of Thorium, metals, and organics.

The hole will be drilled to the top of bedrock. The hole will be back filled using grout and bentonite cement. The cuttings from the disturbed portion of the hole, not removed for sampling, will be contained in drums. The drums will be marked and left on the site. Information describing the content of the drum, and the boring from which the cuttings were taken will be painted on the top and side of each drum. A drum inventory is to be kept by the site manager. NWSCC will take custody of the drums and will be responsible for the disposal of the material.

3.3.4 **GROUNDWATER SAMPLING.** Samples will be taken using a Teflon bailer lowered into the well with a stainless steel leader. Newly installed wells must be fully developed in accordance with the installation plan prior to sampling. The depth to the water table will be determined using a steel tape. Prior to sampling, the wells must be purged. This involves removing three well volumes of water from the well. The water is to be discharged to the ground surface no closer than 10ft from the well. Before purging the wells, groundwater parameters (water table depth, the pH, temperature, and water conductivity) will be determined and recorded. Groundwater parameters will have to be stable prior to sampling. The water sample will be poured from the bailer into the proper sample bottles. For volatile organic analysis, two 40 mL VOA vials are filled first. They should be completely filled with no headspace or bubbles. Samples for the other parameters will then be collected. Nitric acid (HNO_3) will be added to water collected for metal analysis. The pH of the sample should be lowered to <2 for proper preservation.

3.3.5 **STANDARD OPERATING PROCEDURES FOR SLUG TESTING.**

1. Open and check water level using steel tape.
2. Connect transducer to instrument and insert into well
   a. For 10 psi transducer, total head above transducer may not exceed 21 feet after displacement of water column during test.
   b. For 100 psi transducer, total head is generally not a concern unless the well is deeper than 150 feet.

STANDARD OPERATING PROCEDURES FOR SLUG TESTING (cont'd).

3. Initialize Hermit recorder (or other make recorder) with test#, well#, date, time, water level, units, sample interval, etc.
4. Establish water level/depth of transducer to initialize start point of test; allow transducer and well to stabilize a few minutes.
5. Quickly insert weight into well and start the recorder after the weight has displaced the water.
6. Record data until pressure head (increase in depth below ground surface) has returned to within 10% of the original water level, or 1 hour, whichever is shorter.
7. Transfer recorded data from the Hermit unit using Hermit DM software and field computer or PC.

Note: The sample interval will vary for each well, thus it will need to be determined in the field. Initially, a depth reading every 1 to 2 minutes is suggested, depending on the aquifer characteristics. An example of a test and plot is shown on Figure 3.3.5.

Jordan

~~FALLS~~ DAM INSTRUMENTATION
PIEZOMETER PERFORMANCE CHECK
PF-22

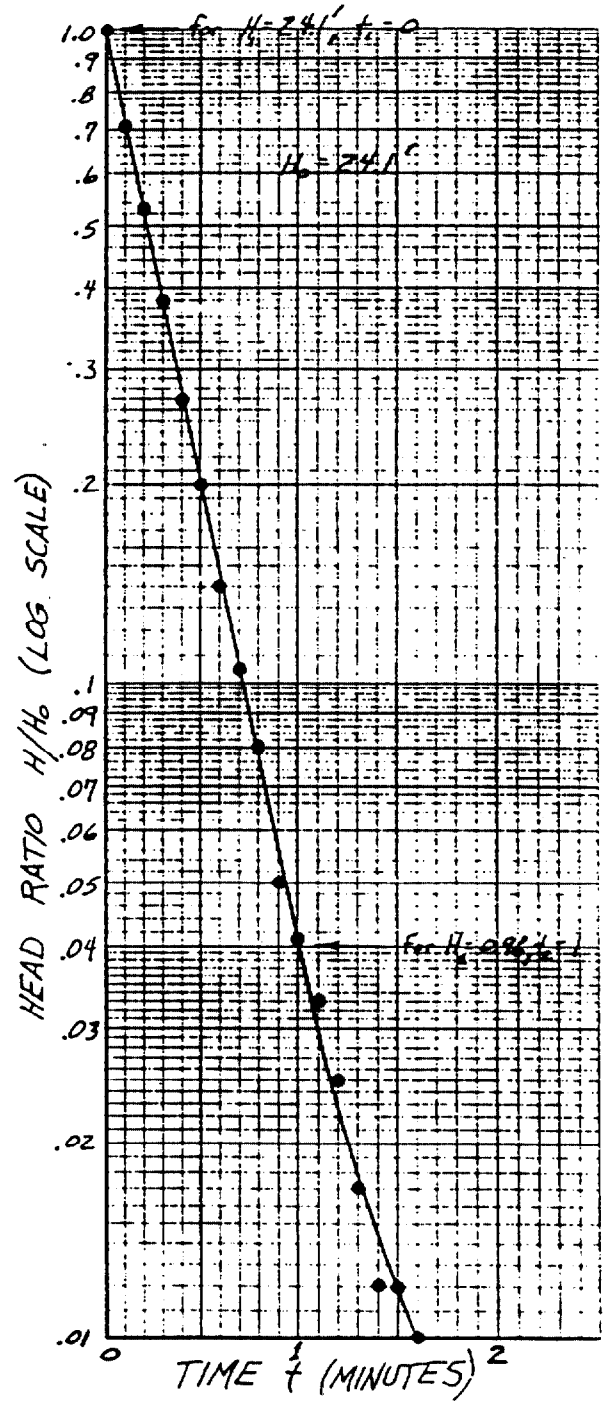
Jordan

~~FALLS~~ DAM INSTRUMENTATION
FALLING HEAD TEST
(PF-22)

TIME H:MM:SS	READING (FEET)	ELAPSED TIME(MIN)	ELAPSED TIME(SEC)	HEAD (FEET)	HEAD RATIO
1:52:00	0.00	0.00	0.00	24.10	1.000
1:52:30	7.00	0.50	30.00	17.10	0.710
1:53:00	11.40	1.00	60.00	12.70	0.527
1:53:30	15.00	1.50	90.00	9.10	0.378
1:54:00	17.50	2.00	120.00	6.60	0.274
1:54:30	19.30	2.50	150.00	4.80	0.199
1:55:00	20.70	3.00	180.00	3.40	0.141
1:55:30	21.60	3.50	210.00	2.50	0.104
1:56:00	22.20	4.00	240.00	1.90	0.079
1:56:30	22.80	4.50	270.00	1.30	0.054
1:57:00	23.10	5.00	300.00	1.00	0.041
1:57:30	23.30	5.50	330.00	0.80	0.033
1:58:00	23.50	6.00	360.00	0.60	0.025
1:58:30	23.70	6.50	390.00	0.40	0.017
1:59:00	23.80	7.00	420.00	0.30	0.012
1:59:30	23.80	7.50	450.00	0.30	0.012
00:00	23.85	8.00	480.00	0.25	0.010
2:00:30	23.90	8.50	510.00	0.20	0.008
2:01:00	23.90	9.00	540.00	0.20	0.008
2:01:30	23.95	9.50	570.00	0.15	0.006
2:02:00	24.00	10.00	600.00	0.10	0.004
2:02:30	24.00	10.50	630.00	0.10	0.004
2:03:00	24.00	11.00	660.00	0.10	0.004
2:10:00	24.10	18.00	1080.00	0.00	0.000

NOTES:

1. TEST PERFORMED BY SNIPES & ALIG ON 30 OCT 84.
2. TEST INDICATES THAT PIEZOMETER IS FUNCTIONING PROPERLY(SEE TIME LAG CURVE).



TIME LAG CURVE

Figure

COMPUTATION

Compute coefficient of permeability assuming rock at piezometer tip behaves as a homogeneous soil.

Use the following:

1. Rock thickness at tip L=7.0ft=84in.
2. Radius of PZ riser r=.25in.
3. Radius of hole at PZ tip R=2.75in.

Shape factor F=2*PI*L/(ln(L/R))=154.4in.

Coeff. of Permeability $K=A*\ln(H_1/H_2)/(F(t_2-t_1))$=.0041in/min or $1.7*10^{-4}$ cm/sec

Permeability of this magnitude indicates rapid response to water fluctuation

Ref. NAVFAC DM-7, March 1971, p. 7-4-8.

3.4.0 DECONTAMINATION PROCEDURES

3.4.1 GENERAL PROCEDURES. To prevent the spreading of contaminants from one location to another and from one level to another, the sampling and drilling equipment will be cleaned between uses. The sample containers will be pre-cleaned before being delivered to the site. All personnel involved in the equipment decontamination will wear protective clothing.

3.4.2 SAMPLING DEVICES. All sampling devices will be cleaned using the following steps.

#1. If mustard gas is detected, decontaminate the equipment with a HTH wash.
#2. Scrub equipment with a non-phosphoric detergent and potable water.
#3. Rinse with potable water.
#4. Rinse with 0.1 N (nitric acid).
#5. Rinse with deionized water.
#6. Rinse with methanol (pesticide grade).
#7. Air dry.
#8. Rinse with deionized water. Collect rinsate blanks now.
#9. Air Dry
#10. Wrap or cover sampling equipment with aluminum foil (shining side out) when not in use.

3.4.3 SAMPLE CONTAINERS. The sample containers will be obtained from a supplier (ICHEM Research INC.). The containers will be pre-cleaned. The containers will be shipped to the location in sealed packages. The sample jar types and sizes are given in Table 3.4.3. A verification of the decontamination procedure will accompany every container shipment.

TABLE 3.4.3
CHEMICAL ANALYSIS
SUMMARIZATION OF SAMPLE CONTAINERS

MATRIX	PARAMETERS	CONTAINERS
Water	Volatiles	Two 40 mL. glass vials
Water	Semivolatiles	One 1000 mL. amber glass jar
Water	Thorium & Metals	One 1000 mL. plastic jar
Water	Chloride, and Conductance	One 8 oz. glass jar
Water	Total Organic Halide	Two 40 mL. amber glass vials
Soil	Volatiles	Two 40 mL. glass vials
Soil	Semivolatiles	One 8 oz. glass jar
Soil	Thorium & Metals	One 8 oz. glass jar
Soil	Surety	One 8 oz. glass jar

3.4.4 **DRILLING EQUIPMENT.** Drilling equipment will be decontaminated before moving to the location. A decon pad will be constructed on the site. The complete rig and all drilling tools will be cleaned before moving to a new SWMU. Only the drilling equipment, the drilling pipe, the coring device and the auger tools, will be cleaned between boring/drilling site or aquifers. The equipment will be steamed cleaned and scrubbed with detergent water. This water will be collected and drummed. The drums will be left at the site as described in Section 3.6.0.

3.4.5 **RINSATE DISPOSAL.** Wastewater generated during the cleaning and decontaminating of the sampling equipment will be collected. Decontamination will be done on site. Decontamination water will be segregated into detergent wash, acid wash water, and organic wash water. These waters will be put into drums and left at the site as describe in Section 3.6.0.

3.5.0 SAMPLE DOCUMENTATION PROCEDURES

3.5.1 GENERAL PROCEDURES. Field parameters will be recorded in a field logbook. These parameters will be transferred to Data Sheets, Chain of Custody Forms, Drilling Logs, and Sample Tags. Final documentation will be made from a consolidation of those notes, data sheets, and laboratory data. Photographic documentation of field activities will be taken and included in the report.

3.5.2 CHAIN OF CUSTODY. A Chain of Custody program will be initiated in the field upon collection of the sample. A Chain of Custody record will accompany each shipment of samples at all times. Figure 3.5.2 is an example of a Chain of Custody record.

3.5.3 SAMPLE LABELING. At the time of sample collection the sample will be placed in a pre-labeled, pre-cleaned sample container. The sample label is to contain the following information:

1. Site name.
2. Field station number.
3. Date and time of sample collection.
4. Sample type (grab or composite).
5. Sample location description.
6. Signature
7. Sample preservation used.
8. Analyses type.

Figure 3.5.3 is an example of a sample label.

3.5.4 FIELD LOG BOOK. The inspector will keep a log book. It will contain a detailed record of particulars about each sample, and sampling condition. This log book will contain certain operational information: environmental conditions, equipment conditions, soil conditions, boring locations, equipment calibrations, personnel changes, etc.

Sampling information will also be kept in the log book. This information is to include: sampling dates, sample numbers, sample descriptions, sample depths, groundwater conditions, and other pertinent sampling information. When sampling groundwater pertinent information should include: identification of well, well depth, static water level depth and measurement technique, presence of immiscible layers and detection method, well yield-high or low, time well purged, collection method for immiscible layers and sample identification numbers, well evacuation procedure/equipment, sample withdrawal procedure/equipment, date and time of collection, well sampling sequence, types of sample containers used and sample identification numbers,

U.S. Army Corps of Engineers

Chain of Custody Record

(ER 1110-1-26)

Proj. No.	Project Name														
Sampler : *(Signature)*															
Date	Time	Pres.	Grab	Comp	Site Code/Sample Number	Number of Containers									Remarks:

Sampler Relinquished by:	Date/Time	Received by: (Sig.)	Date/Time	Hazards Associated with Samples
Relinquished by: (Sig.)	Date/Time	Received by: (Sig.)	Date/Time	
Relinquished by: (Sig)	Date/Time	Received for Laboratory by: (Sig.)	Date/Time	Remarks at time of receipt:
Custody Seal No.		Lab case No.:		

ENG Form 5021-R, Oct 90

Proponent: CEMP-RT

CHAIN OF CUSTODY

U. S. ARMY CORPS OF ENGINEERS
WATERWAYS EXPERIMENT STATION
P.O. DRAWER 631
VICKSBURG, MS 39180

UNITED STATES ARMY
CORPS OF ENGINEERS
...Serving the Army
...Serving the Nation

a

U. S. ARMY CORPS OF ENGINEERS

STATION NO.	DATE	TIME	SEQUENCE NO.
STATION LOCATION			_____ GRAB _____

		REMARKS/PRESERVATIVE:
_____ BOD	_____ METALS	
_____ SOLIDS	_____ OIL & GREASE	
_____ COD	_____ D.O.	
_____ NUTRIENTS	_____ BACT.	
	_____ OTHER	
SAMPLERS:		

SERIAL TAG NO. _____

b

FIGURE 3.5.3 EXAMPLE OF CHAIN-OF-CUSTODY SAMPLE TAG
(a) FRONT (b) BACK

preservatives used, parameters requested for analysis, field analysis data and methods, sample distribution and transporter, field observations on sampling event, name of collector, climatic conditions including air temperature, and internal temperature of field and shipping (refrigerated) containers.

Other information to be found in the log book includes Chain of Custody data, sample shipment information, decontamination documentation, and personnel changes. The log book will contain a detailed inventory of all waste drums generated by the operation. This inventory will describe the drum contents, and the boring number from which it was derived. The wastes generated during the decontamination of the sampling equipment will be marked by boring number. Decontamination pad wastes will be identified as such. The field log book will be submitted to the Navy at the time of project completion. A copy of the field notes will be added as an appendix to the report.

3.5.5 **DAILY WORK SCHEDULES**. Each day a summary sheet is to be compiled. Information will be copied from various log books. Figure 3.5.5A and B are copies of the work summary sheets. Information found in the work summaries include: weather conditions, levels of protection, work performed, sampling efforts, field analysis, problems and corrective action, and QA/QC activities. The sheets will be kept in the field office and will become part of the final record at the end of the job. Sheets will be filled out in ink or typed. These sheets will be kept in a loose leaf notebook.

3.5.6 **DRUM INVENTORY**. Labels will be attached to the drums. The label will consist of the SWMU No., boring/well no., drum no., contents and date filled. An inventory of all waste material drums will be kept by the site manager. This inventory list will contain a description of the drum, its location, its content, and the date filled. The inventory will be used later to determine the drum content for disposal. This list will be kept as a part of the operational records. A spread sheet will be maintained and included in the report (Figure 3.5.6). It will list location, contents, date filled, description, SWMU no., boring/well no., and drum no.

DAILY QUALITY CONTROL REPORT (DQCR)
NAVAL WEAPONS SUPPORT CENTER, CRANE INDIANA
PROJECT NO. IN5 170 023 498

SWMU: _____

DATE: _____ AUTHOR: _____

WEATHER:

HEALTH AND SAFETY - LEVELS OF PROTECTION AND PROBLEMS/SOLUTIONS:

WORK PERFORMED:

SAMPLING PERFORMED:

Figure 3.5.5A

FIELD ANALYSIS PERFORMED:

PROBLEMS ENCOUNTERED AND CORRECTIVE ACTIONS:

QUALITY CONTROL ACTIVITIES INITIATED:

Site Coordinator Signature: _____ Date: _____

Figure 3.5.5B

DRUM INVENTORY SHEET

SITE: MGBG SWMU 01/12

DRUM NO.	SWMU NO.	BORING /WELL NO.	DESCRIPTION	CONTENTS	LOCATION	DATE FILLED

FIGURE 3.5.6

3.6.0 WASTE CONTAINMENT

3.6.1 GENERAL. All soil cutting and groundwater generated by the drilling, sampling, and well development processes will be collected and put into drums. A drum inventory is to be kept by the site manager. NWSCC will take custody of the drums and will be responsible for the disposal of the contained material. The disposal of the contained material will be dependent on the results of the analytical findings. The drums will be properly closed, marked and covered with clear plastic to provide some measure of weather protection. The drums will be left at the site.

3.6.2 WATER. Waste generated (including the decon pad construction material) from the drilling, well installation, decontamination, and sampling operations will be collected and stored in drums. The drums will be closed, marked, and left at the site. The contents of the drums will be marked on the top and side of the drums. The drum contents will be recorded in the daily log book and on the drum inventory list.

3.6.3 SOIL. The cuttings from the disturbed portion of the hole, not removed for sampling, will be contained in drums. The drums will be marked and left on site. Information describing the contents of the drum, and the boring from which the cuttings were derived will be painted on the top and side of each drum. The drum contents will be recorded in the daily log book and the drum inventory list.

4.0 ELEMENT C: WELL CONSTRUCTION PLAN

4.1.0 INSTALLATION PROCEDURES

4.1.1 WELL LOCATION RATIONALE. The 27 existing groundwater monitoring wells will be used initially to sample the groundwater. Two additional shallow monitoring wells and two monitoring well clusters are projected to be installed. The reason for the shallow monitoring wells is to further detail the groundwater plume. The clustered wells are to serve two purposes. One well, a twin to WES-1-1-81 (Groundwater Monitoring Control Well), is to be used to determine groundwater parameters of a possible second and third aquifers under the site. The well will be drilled to the Beech Creek Formation. Each groundwater zone below the surface zone, completed in WES-1-81, will be screened separate.

4.1.2 DRILLING TECHNIQUES. Two drilling methods coring and augering (U.S. Army Corps of Engineers publication EM 1110-1-1804, located in drilling trailer) are to be used. At locations needing rock coring, the following procedures are to be used. The soil zone will be drilled using a hollow stem auger down to refusal. Where possible these auger holes will serve as soil borings. Where the soil thickness is greater than 11 feet, core samples will be taken with a HQ wireline system. If the depth to refusal is less than approximately 11 feet, (the depth needed to start coring with the HQ wireline core barrel), then a 2-foot-long NX core barrel will be used to sample to 11 feet. The core samples will be placed in order of removal, into plywood boxes (filling boxes from the lower right and continuing to the upper left) for future reference. Detailed geologic logs will be prepared. The core boxes shall be "permanently labeled" and transferred to the core storage area. Cores shall be transferred at the completion of each well or at the completion of site drilling. The "cuttings" from the cores shall be thin spread over the boring area and not containerized like the soils. The core storage area is (will be) magazine 1970 on Highway 333, west of the demo ridge, down from the sedimentation pond. This work requires the services of a professional geologist.

4.2.0 CONSTRUCTION PROCEDURES

4.2.1 WELL CONSTRUCTION. A 6-inch annulus must be obtained to provide enough space for the filter pack and bentonite grout. A system of 2-inch diameter pipe and screen will be used to install the monitoring wells. The screen length is dependent on the aquifer thickness. The screen will not be greater than 10ft without Navy approval. The screen will extend upward to a point approximately 5 feet above the previously measured water level in each aquifer zone. The screens are all to be made from PVC, continuous horizontal slots 0.010-inch wide and spaced approximately a quarter of an inch apart. The upper portion of the riser pipe will be 2-in. I.D. flushed, threaded, Schedule 40 PVC pipe. The upper portion of the riser pipe will consist of PVC extending from the PVC connection to approximately 2.5 feet above the ground

surface. The bottoms of the well screens will have non-slotted PVC traps extending 1-foot below the screens. All material will be steamed cleaned prior to installation.

Once the pipe system is installed in the boring, the annulus of the screened section and the total aquifer zone will be packed with a graded filter pack material. The filter material will be poured in from the top of the well slowly by hand and periodically checked for depth with a tape measure. The filter pack will be brought up to the next higher aquiclude. The screened groundwater zone must be isolated from the remaining well annulus above the well screen. It is to be capped with a 3 to 5-foot thickness of bentonite grout which will act as a sealing medium. It is to be pumped into the annulus of the well from the bottom through a 1-inch diameter pipe. The top of each well has a vented PVC cap.

4.2.2 **WELL PROTECTION**. The riser pipe is to be protected at the surface by 3-inch diameter steel pipe with locking caps. Three 4"-diameter steel posts will be equally spaced around the well and embedded in individual concrete pads separate from the main concrete pad around each well. A permanent tag that clearly identifies the well number, date constructed, screen interval, well depth and top of inside casing elevation will be affixed on the well. A typical well installation diagram is shown in Figure 4.2.2A.

Wells will be developed no sooner than 48 hours after grouting is completed. This general installation procedure will be used for all the new wells. It will be modified for the wells which are to test the base of the and possible deeper aquifers. In the case where a shallower aquifer is to be drilled through, the shallow aquifer will be closed off behind pipe. Figure 4.2.2B is a diagram of a telescoping well.

4.2.3 **WELL DEVELOPMENT**. A bailing and surging procedure will be used to develop the new wells. The surge tool is a length of stainless steel rod with rubber washers attached at the end. The washers are to be slightly smaller than the inside diameter of the well pipe. The bailer is a 5-foot-long stainless steel or Teflon bucket with a diameter that is slightly less than the inside diameter of the casing. The tools are alternately lowered into the well on a stainless cable and pulled briskly up and down within the screened zone. This bailing/surging procedure creates a surging action within the screened zone. This action is to flush the finer particle out of the screen and packing material allowing better flow of groundwater into the well or until the water forced out at the top becomes relatively clear. The developing tools will be flushed with clean water between each well setup.

Compressed air well development will not be used because oil can be introduced into the aquifer from the compressed air used in the development process. It has been found that even with inline oil filters, oil can still escape into the formation.

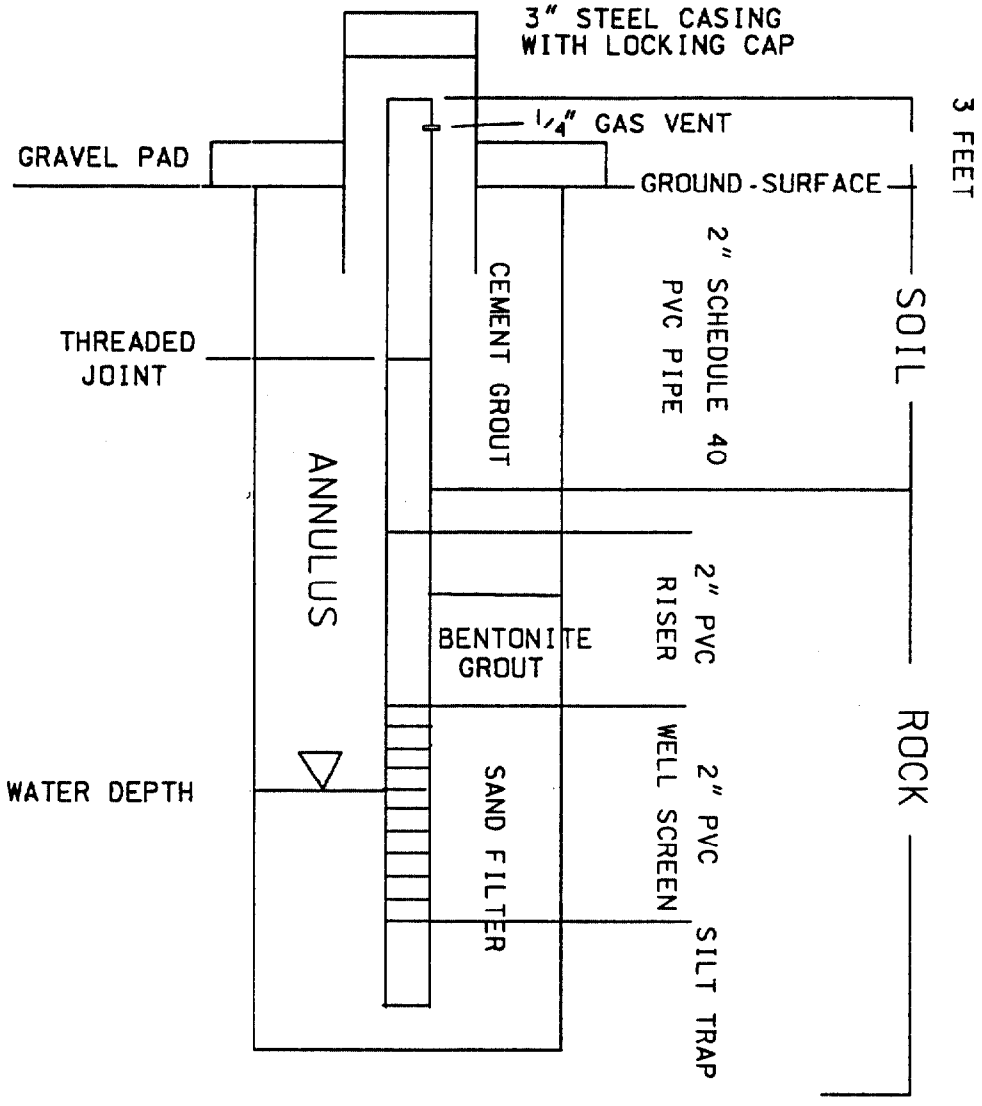


FIGURE 4.2.2A
MONITORING WELL IN ROCK

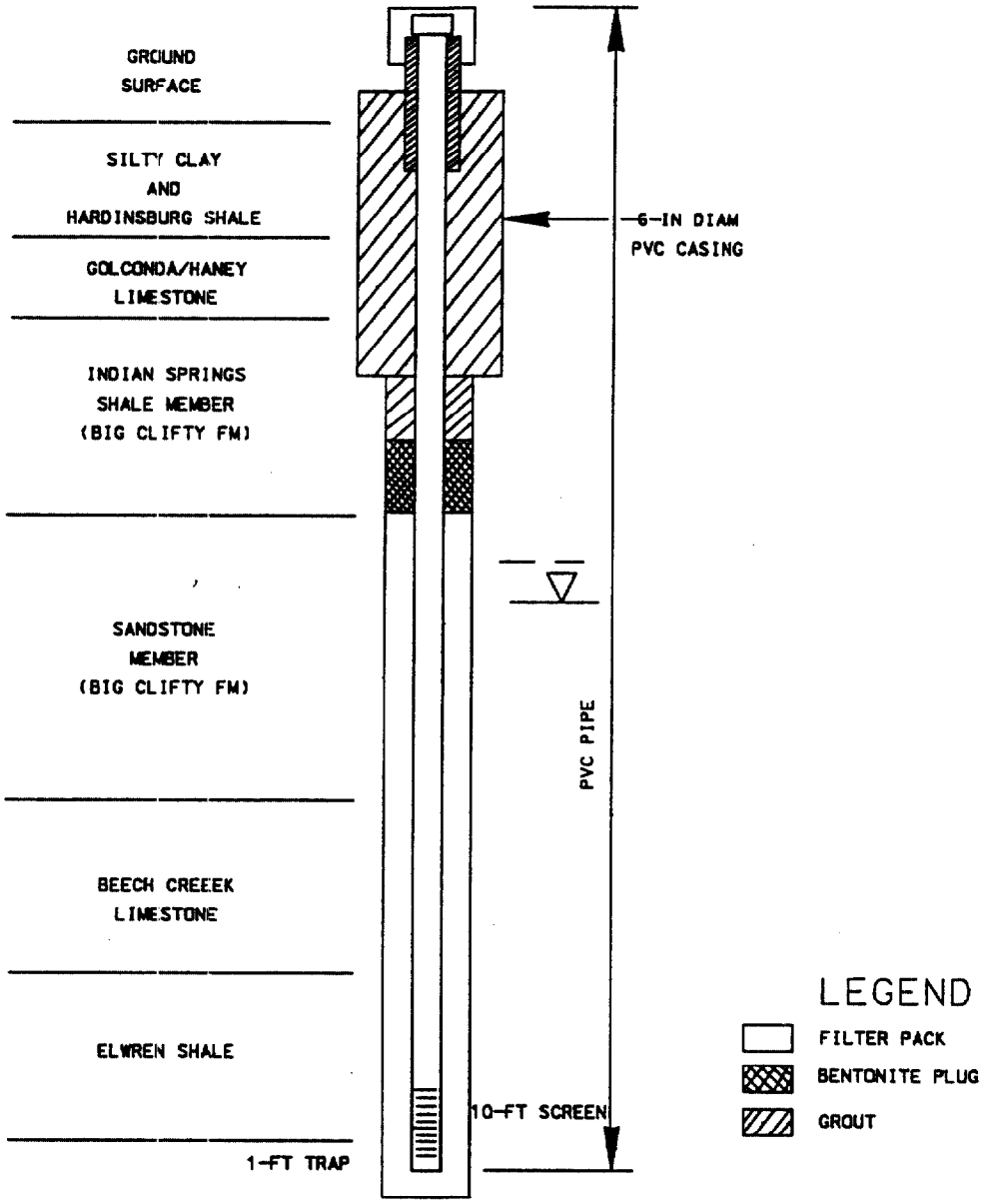


FIGURE 4.2.2B
TELESCOPING WELL

The water generated by the development (unless contaminated) should be discharged to the ground surface downgradient, at least 10ft. from the well. Contaminated water will be collected and placed in drums. These drums will be marked and left at the drill site. The marking and disposal of the drummed material is discussed in Section 3.6.0.

5.0 ELEMENT C: HEALTH AND SAFETY PLAN

SEE APPENDIX A

6.0 DATA MANAGEMENT PLAN

6.1.0 GENERAL. A RFI Work Plan is made up of five elements. The purpose of the Work Plan is to guide the investigative work through those separate elements. The Data Management Plan is the final element of the Work Plan. It is the part of the Work Plan that explains the movement of the data to final report form. Chemical and Physical Data is reduced from its raw form into final form by the laboratory personnel. The final data is then put into a report format. The data will be presented in various text, tabular, and graphic formats. Concurrent with the work on the individual sites, progress reports for the overall soil investigation program, bimonthly reports of progress will be issued. These bimonthly progress reports are separate from the individual SWMUs' studies and are covered under the generic work plan for the RFI soils investigation.

6.2.0 DATA RECORD. Recorded data will consist of site (SWMU) locations, sampling station (boring) numbers and location, sample number and depth sampled, date sampled, names of sampling personnel, sample descriptions and other boring log data, Chain of Custody information, parameters measured, laboratory results, and analysis of results. Locations will be recorded on map positions on base maps.

Chemical results will be presented in laboratory report format and NEESA required EPA Contract Laboratory Program forms. Physical laboratory results will be presented as computer printouts generated by the analyzing laboratory and will include parameters such as the sample number, parameter measured, amount detected, date analyzed, units used, a lab ID number for each sample. The data will be presented in Appendixes to all the drafts and the Final Report.

6.3.0 TABULAR DISPLAYS. Summary tables of data will include field data (sample station number, number of samples per station, depths sampled, date sampled, etc.) and laboratory data for chemical and physical testing results.

6.4.0 GRAPHICAL DISPLAYS. Data will be presented in various graphical formats. Sample boring locations will be presented on base maps. Contaminant plume maps will be made to display the contaminate spread. Cross sections of the soil profile will be made to display the vertical distribution of soil type. Bar and line graphs will be used to show contamination levels. Pertinent photographs will be included in the report to refine a point or add emphasis to a finding. Other displays are possible.

6.5.0 REPORT FORMAT. An internal draft, a draft, and a final report will be submitted. A period of time for commenting will occur between the internal draft report, the draft report, and the final report. This comment period will allow for important perspectives to be considered. The contents of the reports shall be arranged in accordance with the suggested RFI format

as presented in RFI Guidance Manual (USEPA, OSWER Directive 9502.00-6c, April 1987). The report shall consist of 8 1/2" X 11" pages with drawings to be folded, if necessary, to this size. There will be an Executive Summary and Conclusions section in the report. In the the initial draft, and the draft report there shall be a statement listing the persons who had significant and specific input into the report's preparation. This statement will include the individual's name, job title, and telephone number. A decimal paragraphing system shall be used, with each section and paragraph of the reports having a unique decimal designation. Large displays will be presented as Plates found at the end of the report but referred to within the text. To reduce the number of drawings, data, and ideas should be combined on drawings. But drawing details will not be cluttered or poorly organized. The data must not reduce the drawings effectiveness. All drawings shall be of engineering quality in drafted form with sufficient detail to show interrelations of major features and/or thoughts on the installation site map. A decimal paragraphing system shall be used, with each section and paragraph of the reports having a unique decimal designation. The report covers shall consist of durable 3-ring binders and shall hold pages firmly while allowing the easy removal, addition, or replacement of pages. Only in the appendix of the draft report should there be a statement listing the persons who had significant and specific input into the report's preparation. This statement will include the individual's name, job title, and telephone number.

7.0 ELEMENT D: QUALITY ASSURANCE PROJECT PLAN

SEE APPENDIX B

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ACRONYMS

ALG	Analytical Laboratory Group
CAR	Corrective Action Requirements
CRDEC	Chemical Research Development & Engineering Center
EPA	Environmental Protection Agency
IAS	Initial Assessment Study
IRP	Installation Restoration Program
MGBG	Mustard Gas Burial Ground
NACIP	Navy Assessment and Control of Installation Pollutants
NAVSEASYSCOM	Naval Sea Systems Command
NEESA	Naval Energy & Environmental Support Activity
NGVD	National Geodetic Vertical Datum
NRC	Nuclear Regulatory Commission
NWSCC	Naval Weapons Support Center Crane
OESO	Ordnance Environmental Support Office
QA/QC	Quality Assurance/Quality Control
RASO	Radiological Affairs Support Office
RCRA/HSWA	Resource Conservation and Recovery Act/ Hazardous and Solid Waste Amendments
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
SARA	Superfund Amendments and Reauthorization Act

SWMU	Solid Waste Management Unit
TAL	Target Analyte List
USACE	United States Army Corps of Engineers
USACEWES	United States Army Corps of Engineers Waterways Experiment Station
USCS	Unified Soil Classification System
VOA	Volatile Organic Compound Analysis

APPENDIX A

SITE SPECIFIC SAFETY AND HEALTH PLAN
RFI Phase II Work Plan
FOR MUSTARD GAS BURIAL GROUND NWSCC

(DRAFT COPY)

SITE-SPECIFIC SAFETY and HEALTH PLAN
for NWSC, CRANE, IN
for
MUSTARD GAS BURIAL GROUND

MARCH 16, 1991

PREPARED FOR

U.S ARMY CORPS OF ENGINEERS (WES)

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APPENDIX B EMERGENCY CONTINGENCY PLAN, LOG/RECORD
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APPENDIX D SOP/SAFEY, WELL DRILLING PROCEDURES IN POTENTIALLY CONTAMINATED AREAS OF THE EDGEWOOD AREA>

1.0 PURPOSE

The Site-Specific Safety and Health Plan (SSHP) establishes procedures that are to be followed in order to protect Corps of Engineers' employees from potential safety and health hazards arising from the collection of soil samples from the Mustard Gas Burial Grounds (MGBG) area of the Naval Weapons Support Center (NWSC) Crane Indiana.

2.0 LOCATION and SITE DESCRIPTION/HISTORY

The NWSC is located in the northern half of Martin County, in southwestern Indiana , approximately 75 miles southwest of Indianapolis and 71 miles northwest of Louisville, Kentucky. The nearest major metropolitan area is Bloomington Indiana approximately 40 miles northeast on State Highway 45. NWSC occupies approximately 100 sq. miles zone (62,463.46 acres) which includes 1,006 acres of improved grounds, 49,611 acres of unimproved grounds, and 800 acres of water. The area is divided into facility operations, safety buffer and security zones and surrounding farmland (Figure 1,). The area is extremely isolated,(High Security) and is not accessible to the public.

The exact site location is designated as the MGBG site and is located in the NE 1/4 of section 24, T4N, R4W. NWSC (Figure 2,3). The area is accessed using Crane Road H-251 off of Crane Road H-161. The area is located on a ridge crest in a heavily forested portion of the facility. The topographical setting of the site is shown on Figure 4. Note, the MGBG is fenced and marked with appropriate hazard warning signs.

The MGBG was established in the late 40's and early 50's. Historical documentation relative to the total amount and types of material disposed at the site is inconclusive. However, it is known that the site was used to dispose of some chemical weapons, radioactive material and waste chemicals. Quantities of radioactive waste material (Thorium Nitrate) and chemical weapons (dichlorodiethylsulfide) were buried at the site in the mid 1950's. The disposal of assorted laboratory chemicals has been documented at the site.

Documentation has shown that an effort to exhume the weapons was conducted in 1974 and 1980. During these two separate excavation procedures, sixteen bombs and a quantity of Thorium Nitrate was unearthed. Note, fifteen of the sixteen items (bomb cases) were empty except for mud. In addition, no trace of agent (dichlorodiethylsulfide) was found in the soil surrounding the bomb cases.

Various non-intrusive magnatometer studies have been carried out at the site. The intent of the studies was to locate chemical and radioactive burial sites. In addition, three groundwater investigative projects conducted in 1981, 82, and 83 have been completed. The results show that the groundwater contaminants are comprised mainly of chlorinated solvents. The groundwater contaminants are the following: 1,2-Dichloroethane, 1,1,2-Trichlorethane, 1,1,2,2-Tetrachlorethane,Bromoform,Dibromochloromethane, Tetrachloroethylene, Trichloroethylene.

3.0 Weather Extremes . The climate in the region of NWSC is a temperate climate with broad seasonal variations. Characterized by a mean January

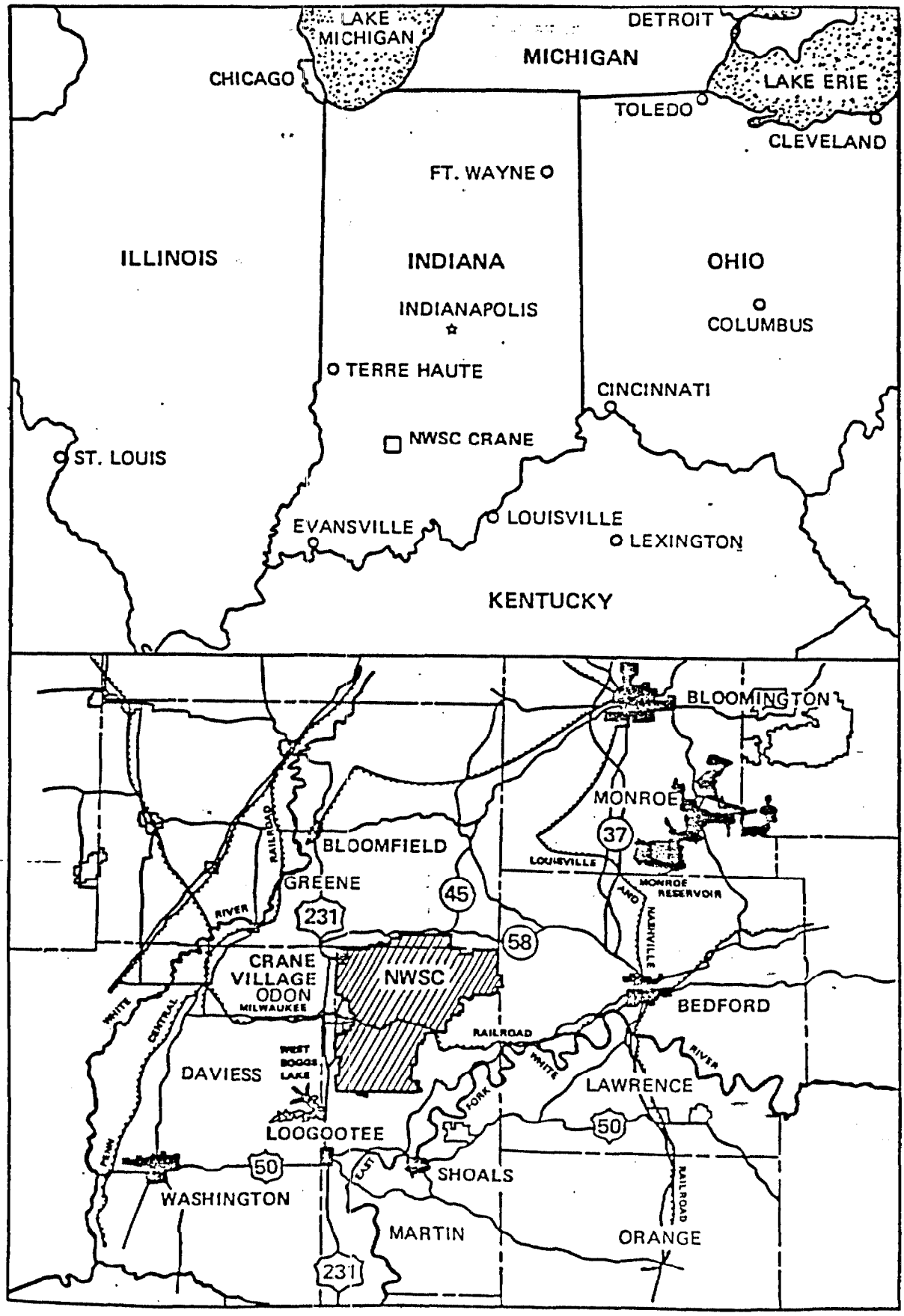
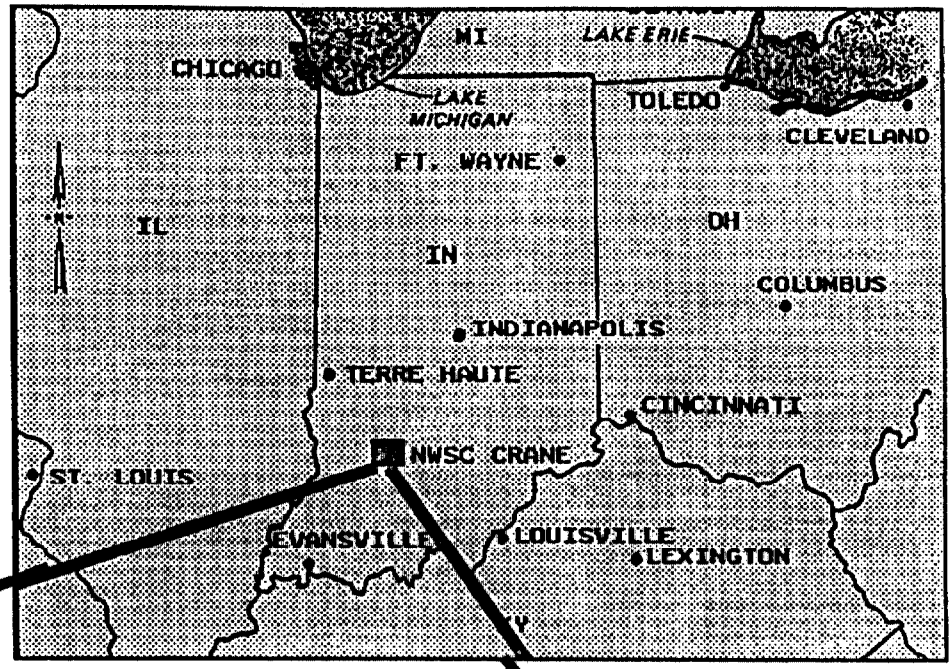


Figure 1. NWSC and Vicinity

Figure 2



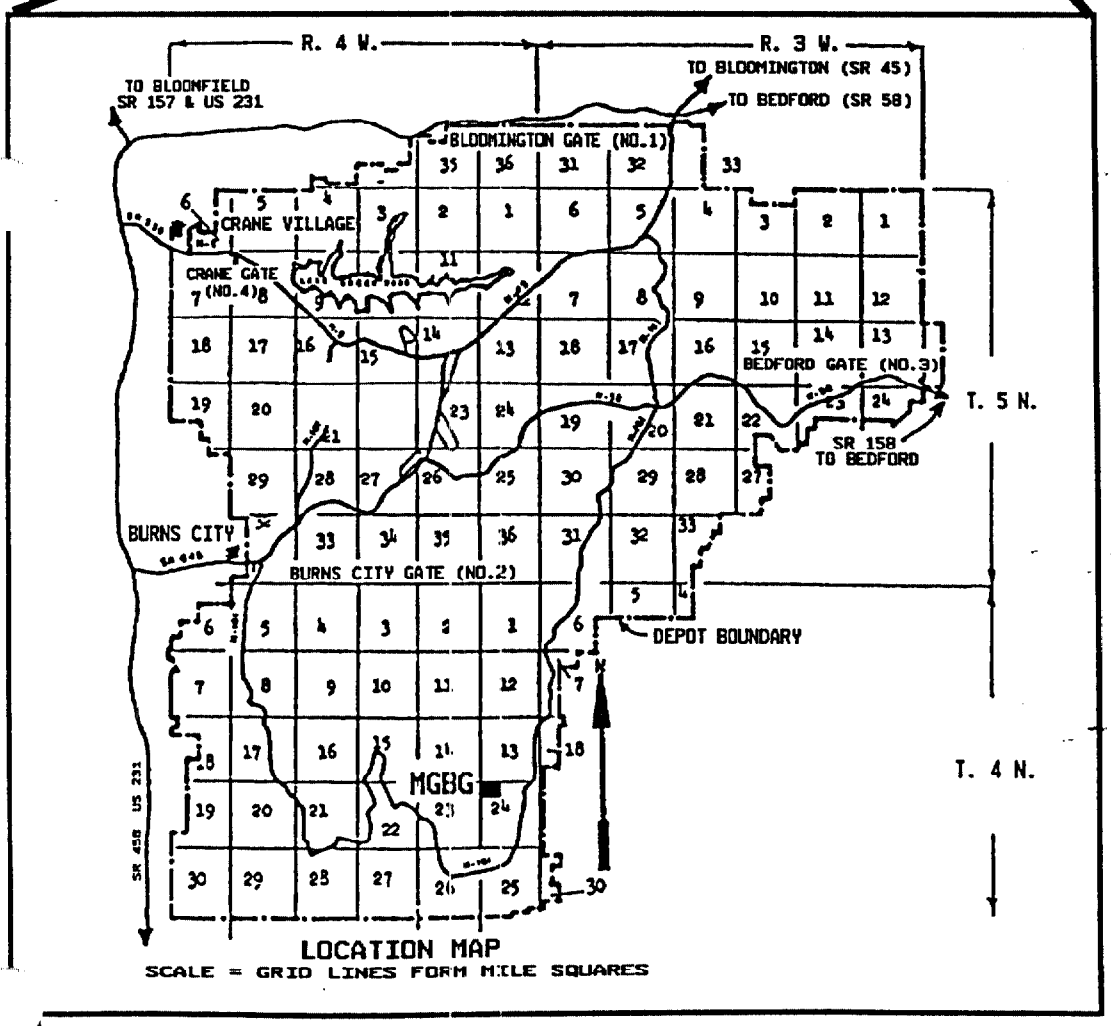


Figure 3

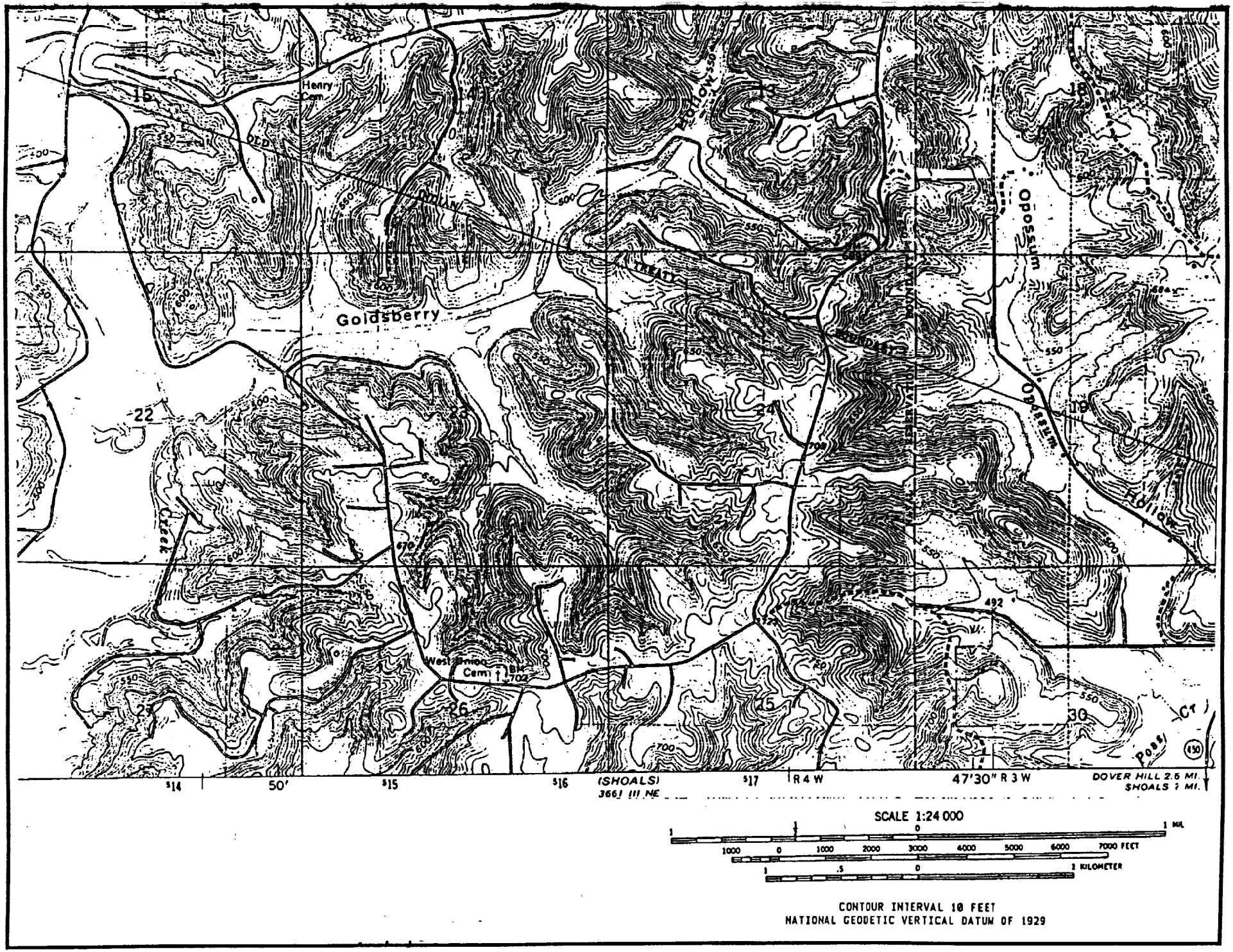


Figure 4 Topographical Setting, MGBG

temperature of 26 degrees F and a mean July temperature of 89 degrees F. Precipitation averages approximately 44 inches annually, with 42 inches of rainfall and 15 inches of snowfall. Humidity averages 40 to 90 % in the summer and 60 to 90 % in the winter. Both heat stress and cold stress are significant potential hazards and severe weather with thunderstorms are also a possible feature of the area (Appendix A).

4.0 Investigation Activities and Associated Hazards

4.1 Drilling. Drilling will be performed at the site for the collection of soil samples for chemical analysis. Some of the bore holes will penetrate material known or suspected to contain hazardous material. The sampling and drilling have limited potential for exposing employees to parts per million (ppm, mg/m3) levels of organic vapors, chemical agent or low levels of radioactivity. Primary exposure routes during drilling operations will be skin absorption, ingestion and inhalation due to vapors and contaminant volatilization from the drill cuttings. Drilling will take place in and adjacent to the possible source of contamination. Health hazards risks due to drilling and sample handling are considered, _____.

All work shall comply with all Federal, State and Local health and Safety requirements, including the Occupational Safety an Health Administration's (OSHA) requirements (29 CFR 1910 and 1926), the U.S. Environmental Protection's Agency's (EPA) hazardous waste requirements (40 CFR 260-270), the U.S. Army Corps of Engineers Safety and Health Manual (EM 385-1-1, April 1981, Revised October 1987 and all NWSC CRANE and U.S. Army Corps of Engineers safety directives and policies and Safety and Health requirements as prescribed by Technical Escort (TEC) Guidelines for well drilling in Potentially Contaminated Areas (Appendix D).

All drill sites will be cleared with local utilities to ensure that there are no underground utilities present. All known underground utilities will be located and marked.

5.0 Hazard Assessment and Contaminant Characterization

5.1 Physical

5.1.1 Heat and Cold Stress Appendix A.

5.1.2 Heavy Equipment. A truck-mounted drilling operations present inherent noise and equipment hazards, a Job Hazard Analysis is attached (Appendix A).

5.1.3 Chemical. A description of contaminants found in monitoring wells and a listing of possible contaminants (TLV's,STEL's,PEL's) is provided in (Table 1). Pertinent information of contaminants is found in Appendix C.

5.1.4 Radiological. Contact with radiological contaminants is not anticipated. Based on the results of previous WES testing. Note, radiological contamination procedures are included.

Table 1

Contaminant Concentration Ranges of Contaminants
at the Mustard Gas Burial Grounds

CONTAMINANT	TLV-TWA	PEL	STEL	IDLH
Trichloroethylene	50ppm 269mg/m3		200ppm for 30min	1000ppm
NIOSH-Reduce to lowest Possible				Ca
1,2-Dichloroethane	10ppm 49mg/m3		200ppm for 5 min	1000ppm
synonym(Ethylene Dichloride)			during any 3hr period	Ca
NIOSH-Reduce to Lowest Possible				
Bromoform	0.5ppm		NO DATA	
synonym(tribromomethane;methyl)				
(SKIN,HAZARD)				
Dibromochloromethane	Hazard: Irritant and Narcotic		NO DATA	
1,1,2,2-Tetrachloroethane	1ppm 7mg/m3		150ppm	NO DATA
1,2-Dichloroethylene	200ppm 793mg/m3		NO DATA	4000ppm
synonym(Acetylene dichloride)				
1,1-Dichloroethane	200ppm 810mg/m3		250ppm 1010mg/m3	1000ppm
synonym(Ethylidene chloride)				
1,1,2-Trichloroethane	10ppm 45mg/m3		NO DATA AVAILABLE	500ppm
synonym(Vinyl tichloride)				
(SKIN HAZARD)				
Tetrachloroethylene	50ppm 339mg/m3	25ppm	200ppm	500ppm
synonym(Perchlorethylene)				
				Ca
Dichlorodiethyl sulfide	HAZARD: Vessicant war gas, causes conjunctivitis and blindness. Note, can be decontaminated by chloramines or bleaching powders. Vapor is extremely poisonousand is absorbed via SKIN.			
synonym(Mustard Gas)				

ACGIH-TLV/TWA Threshold Limit Value-Time Weighted Average, An airborne concentration of substance under which it is believed that nearly all workers may be repeatedly exposed day after day (8hr ,40hr workweek) without adverse effects.

" Skin " Notation. Listed substances followed by skin, refer to the potential contribution to the overall exposure by the cutaneous route including mucous membranes and eye, either by airborne or more particularly, by direct contact with the substance.

Ca Confirmed or Suspect Carcinogen. Note, if high values occur, no cartridge filter respirators are approved protection.

STEL Defined as a 15 min TWA exposure which should not be exceeded at anytime during a work day even if the 8hr TWA is within the TLV-TWA.

IDLH Immediately Dangerous to Life and Health. No exposure at all, allowed at this level.

NIOSH-Lowest Possible Exposure Recommended exposure below ACGIH TWA.

5.1.5 Biological. Biological Hazards include insects (ticks, mosquitoes) and two species of poisonous snakes (Appendix A).

6.0 Site Investigation Personnel. The following US Army Corps of Engineer personnel sampling (drill crew) under the direction of a Corps of Engineers supervisor will perform the investigation activities.

PROJECT MANAGER _____
ON-SITE TEAM LEADER _____
ALTERNATE _____
SITE SAFETY COORDINATOR (SSC) _____
PUBLIC INFORMATION OFFICER _____
SECURITY OFFICER _____
RECORD KEEPER _____
FIELD TEAM LEADERS (DRILLERS) _____
FIELD TEAM HELPERS _____
OTHER AGENCY REPRESENTATIVES (TEC) _____
_____
CONTRACTOR (S) _____

7.0 Responsibility

7.1 On Site Team Leader

Responsible for managing field operations coordinating permission for site access, briefing site workers on specific assignments, arranging safe secure storage of drill cuttings and water brought to the surface and enforcing site control.

7.2 Site Safety and Health Officer

The Site Safety and Health Officer (SSHO) or Site Safety Coordinator (SSC), has the responsibility and qualifications to implement the site specific safety and health plan on this project. This is to include the authority to cease the operation if he/she determines any unsafe conditions exist or if the Site Safety and Health Plan is not being implemented correctly. The SSC will monitor or inspect site conditions, equipment, protective clothing and other safety plan requirements. The SSC is responsible for safety meetings and the monitoring of personnel for signs of environmental stress (i.e heat/cold).

The SSC will modify the SSHP as required due to additional information discovered during on-site work.

7.3 Public Information Officer

Responsible for releasing any information to news media and the public concerning site activities.

7.4 Security Officer

In conjunction with a high level of security at the Crane to restrict public access, the security officer will help establish safe working zones (Exclusion Zone) and restrict access to unauthorized personnel.

7.5 Recordkeeper

Records all field activities, including monitoring results, and visiting personnel.

7.6 Field Team Leader (Driller)

Responsible for Drill Crew operation and safety. Following the job hazard analysis attached and managing the drilling, sampling and well installations. All drilling sites will be inspected for health and safety hazards by the Site Safety Coordinator or Driller, prior to entering the site with drilling equipment. The SSC will then take all corrective measures necessary to safely work at the site. This inspection and all corrective measures will be documented and communicated to all site workers.

7.7 Field Team Members (Helpers)

Responsibility to comply with all aspects of the Site-Specific Safety and Health Plan, and to notify the SSC or supervisor of any unsafe conditions.

8.0 Worker Protection Requirements

8.1 Training Requirements. All personnel who will be engaged in hazardous waste operations must first present to the SSC certification of completion of a 40 hr hazardous waste site investigation course and 8 hrs of annual update training as required. This training must comply with OSHA regulations found in 29 CFR 1910.120(e). At least two members of each crew will have a valid certification in First Aid and CPR. Personnel not safety trained will not be allowed within the control zone (a 30 foot radius) of any field investigations being conducted at the site.
Besides initial training, all personnel involved in field investigations will be required to have site-specific training. Topics to include, in site training sessions for on-site personnel include:

1. Biological, Chemical, and Physical Hazards. The biological, chemical and physical hazards at the site and their respective properties will be discussed. Including possible mustard gas (agent) exposure and contamination.
2. Toxicology. The potential routes of exposure to chemicals, the possible toxic effects, the IDLH (Immediately Dangerous to Life and Health) and TLV (Threshold Limit Value) values of chemical hazards at the site, and the level of personal exposure which can be anticipated will be discussed.
3. Personal Hygiene. Personal cleanliness and the prohibiting on the eating, drinking, and smoking on the site will be discussed. Note, all eating, drinking, smoking is prohibited in the exclusion zone.
4. Rights and Responsibilities of Workers under OSHA. Applicable provisions of the Occupational Safety and Health Act (29 CFR 1910,1926 the US Environmental Protection Agency's Hazardous waste requirements (40 CFR 260-270) and the Corps of Engineers Safety and Health Program (EM 385-1-1) will be discussed.
5. Monitoring Equipment. The functions, capabilities, limitations use and maintenance of monitoring equipment will be discussed. A hands-on review will be held with persons assigned to use the equipment.
6. Site-Specific Safety and Health Plan. The full SSHP will be reviewed, and a field SSHP will be available to each on-site worker.

7. Standard Operating Procedures. SOP's for this work will be reviewed. These SOP's are included in the appendices.
8. Personal Protective Equipment. The use, care, and disposition of the specific PPE selected for this work will be discussed. The PPE will be available for hands-on familiarity and practice donning, as needed. Individual respirator fit testing will be conducted at this time, if needed.
9. Medical Program. Handling of medical emergencies will be discussed. The names, locations and telephone numbers of an available physician, ambulance, and hospital will be posted and available.
10. Decontamination. The decontamination procedures established for this work will be discussed.
11. Emergencies. The Emergency Contingency Plan contained in the SSHP will be reviewed.
12. Public Relations. The SSC and Public Affairs Officer will be provided with instruction in communicating with the press and local community.

8.2 List of Trained Personnel

The following is a list of all trained personnel, training content (initial, supervisory, refresher, etc., date received, trainer and location, for the specific HTW operation.

PERSONNEL	TRAINING	DATE	TRAINER/LOCATION
_____	40 hr	_____	_____
	8hr Ref.	_____	_____
	8hr Sup.	_____	_____
	First Aid	_____	_____
	CPR	_____	_____
_____	40 hr	_____	_____
	8hr Ref.	_____	_____
	8hr Sup.	_____	_____
	First Aid	_____	_____
	CPR	_____	_____
_____	40 hr	_____	_____
	8hr Ref.	_____	_____
	8hr Sup.	_____	_____
	First Aid	_____	_____
	CPR	_____	_____
_____	40 hr	_____	_____
	8hr Ref.	_____	_____
	8hr Sup.	_____	_____
	First Aid	_____	_____
	CPR	_____	_____
_____	40 hr	_____	_____
	8hr Ref.	_____	_____
	8hr Sup.	_____	_____
	First Aid	_____	_____
	CPR	_____	_____

_____	40 hr	_____	_____
	8hr Ref.	_____	_____
	8hr Sup.	_____	_____
	First Aid	_____	_____
	CPR	_____	_____

9.0 Medical Monitoring Requirements. All site personnel will participate in a medical monitoring program. The respective components and divisions of this plan are shown in Table 2. All examinations are implemented by a licensed physician who is board-certified/board-eligible in occupational medicine. All personnel who will be engaged in hazardous waste operations must first present to the SSC certification of completion of the comprehensive medical monitoring examination within 12 months prior to the beginning of site activities. The medical monitoring program complys with OSHA regulations found at 29 CFR 1910.120(f) and Corps of Engineers requirements.
The COE provides their employees with an annual indepth physical examination, including blood chemistry with complete blood count and differential; urinalysis; medical history; required chest X-ray; audiograms; pulmonary function testing; and a physician's interpretation of the employee's ability to wear a respirator. The examination may include testing for heavy metals, i.e. lead, arsenic, mercury and pesticides (i.e DDT,DDE).

The following signatures from each individual on the site verifies completion of requirements and Date of latest examination received:

PERSONNEL	DATE
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

10.0 Site Inspections Meetings. To ensure that the SSHP is followed, the SSC shall conduct safety meetings before and after each day's work. All individuals will attend these meetings. The purpose of these meetings is to:

- Coordinate site work activities.
- Describe any changes in the SSHP.
- Obtain worker feedback on conditions affecting health and safety.
- Obtain feedback on how well the HSP is working, and discuss needed changes
- Reinforce proper work habits (i.e use of "Buddy System).

10.1 Site Inspections. The SSC will inspect daily site conditions, facilities , equipment, and activities to determine whether the SSHP is adequate and being followed. In order to make inspections effective, the SSC shall:

Table 2. Medical Monitoring Program

1. Pre-employment Screening
   a. Medical history.
   b. Occupational history
   c. Physical examination
   d. Determination of fitness to work wearing protective equipment.
   e. Baseline monitoring for specific exposures.

2. Periodic Medical Examinations
   a. Yearly update of medical and occupational history; yearly physical examination ; testing based upon (1) examination results, (2) exposures, and (3) job class and task.
   b. More frequent testing based on specific exposures.

3. Record-keeping and Review
   a. Maintain and provide access to medical records in accordance with OSHA and state regulations.
   b. Report and record occupational injuries and illnesses.
   c. Review health and safety plan periodicallly to determine if additional testing is needed.
   d. Review medical monitoring program periodically in light of current site hazards, exposures, and industrial hygiene standards.

- Have a checklist applicable for each site and activity, listing the items to be inspected.
- Review results of these inspections with supervisors and workers in the safety meetings.
- Inspect again any identified problems to ensure that they have been corrected.
- Document all inspections and subsequent follow-up actions. Retain these records until site activities are completed and turn them in to the Geotechnical Branch at the conclusion of the work.

The frequency of inspections shall be made more or less commensurate with the characteristics of the site the equipment used on the site, and the progress of the work on the site.

10.2 Personnel Protection.

10.2.1 Division of Work Area. Considering the isolated area and the low levels of contaminants revealed in earlier sampling, no formal division of the work area will be made at the start of sampling. However, if air monitoring indicates the need to minimize the transfer of hazardous substances from the work site and to ensure proper protection of personnel, three zones will be established. The three contiguous work zones are (1) Zone 1: Exclusion Zone, (2) Zone 2: Contamination Reduction Zone, and (3) Zone 3: Support Zone (Figure 4).

10.2.1.1 Exclusion Zone. Contamination does or could not occur in this zone. All people entering the Exclusion Zone must wear Modified Level D protection as a minimum. An entry and exit point for personnel and equipment will be established at the periphery of the Exclusion Zone to regulate the flow of personnel and equipment by the Site Safety Coordinator.
The outer boundary of Zone 1, the Hotline, will initially be established as a 30-ft radius circle surrounding the drill rig or completed hole when bore samples are gathered. This Hotline will be defined in the field by a printed hazard ribbon or equal. Factors that will be considered in extending this boundary will be air monitoring data, the physical area necessary to conduct site operations, and the potential for contaminants to be blown from the area, but in no case will the circular boundary have a radius of less than 30-ft.

10.2.1.2 Contamination Reduction Zone. Between the Exclusion Zone and the Support Zone will be the Contamination Reduction Zone which will provide a transition between the potentially contaminated zone and the clean zone. Zone 2 will serve as a buffer to further reduce the probability of the clean zone becoming contaminated. It will provide additional assurances that the physical transfer of contaminating substances on people equipment, or in the air will be limited through a combination of decontamination, zone restrictions, and work functions. Exit from the Exclusion Zone will be through this Contamination Reduction Zone.

10.2.1.3 Support Zone/Command Post The Support Zone will be considered a non-contaminated area. The location of support facilities in the Support Zone and readily accessible to the nearest road. Support facilities (i.e command post. equipment trailer, first aid station,) will be located in this zone. Since normal work clothes are appropriate within this zone, potentially contaminated personal clothing, equipment, and samples are not permitted in

this zone. The on-site support zone/command post have been established at_____ _____. The prevailing wind conditions are _____ _____. This location is upwind from the Exclusion Zone.

10.2.1.4 Work Zone Integrity. The integrity of the division of the work zone during duty hours shall be maintained by control of access and egress. Before crossing into another zone, a person will be admitted by the Site Safety Coordinator or Security Officer only after having given proper identification, authorization and certification of required training and medical examinations. The Site Safety Coordinator will record each person's:

- Name
- Status (in or out)
- Time of entry
- Anticipated exit time
- Areas to be entered
- Task to be performed
- PPE worn if applicable

Access to any divisions of the work zone during off-duty hours shall be controlled by security at NWSC. They will be appraised of the work at the site and its hazards and will be instructed in contacting emergency services.

10.2.2 Personal Protective Equipment

Note, TEC will define PPE if possible Agent contamination

10.2.2.1 Proposed Levels of Protection. Personal protective equipment will be worn or used as required by this SSHP. No downward changes to the level of protection is allowed without the approval of the SSC. In addition, a first aid kit, fire extinguishers and some form of emergency will be available on site.

Based on the evaluation of potential hazards, the Modified Level D is prescribed for all activities on this activity, Level C PPE will be available on the site. Except for the Support Zone, where no level of protection beyond general safety PPE (i.e Hardhat/boots) will be required.

Modified Level D protection includes:
- Tyvex disposable coveralls
- Gloves latex, Gloves chemical resistant
- Chemical-resistant safety boots with steel toes and shanks
- Disposable boot covers
- Hard hat
- Safety glasses or chemical splash goggles
- Hearing protection (ear plugs, ear canal caps or muffs)
- Splash Gear (rubber gloves, boots and rainsuit or apron)

Monitoring will be periodically performed with a photoionization detection in the breathing zone during all investigation activities to ensure that the level of protection is proper. Upon detection and identification of contaminants by air monitoring surveillance the Site Safety Coordinator will, if necessary, upgrade the level of protection to Level C.

Level C protection includes:
- Full-face respirator

- HEPA particulate filter cartridges
- HEPA organic vapor/acid gas cartridges
- Splash gear
- Steel toes boots, Boot Covers
- Hearing protection
- gloves, chemical resistant
- Boots, chemical resistant
- Gloves, latex
- Disposable coveralls
- Hard Hat

10.2.2.2 PPE Inspection. All PPE will be inspected by the Site Safety Coordinator prior to being issued to workers on the job. The exception will be individually issued items such as respirators, which are previously fit tested by each individual. The Site Safety Coordinator will:

- Inspect and operational testing of newly received equipment
- Inspection of equipment prior to issue to workers
- Inspect multiple-use equipment after use or training and prior to maintenance
- Periodically inspect stored safety equipment
- Insure all site workers have been trained in the use of PPE

Equipment inspection will follow procedures specified by PPE manufacturers.

The SSC will maintain records of all inspection procedures. Individual identification numbers shall be assigned to all multiple-use pieces of equipment, and records will be maintained by that number. Inspections, will record the ID number, date, inspector's name and findings. Damaged or otherwise objectionable equipment shall be repaired or removed from the job.

10.2.2.3 Donning PPE. A routine will be established for donning PPE. Once the equipment has been donned, fit will be evaluated by the SSC.

10.2.2.4 Work Mission Duration. Before the workers actually begin work in their PPE ensembles, the anticipated duration of their work mission will be established. Several factors will be considered in determining mission length. These include:

- Suit/ensemble permeation and penetration by chemical contaminants.
- Ambient temperatures

10.2.2.5 In-use Monitoring. During equipment use, workers will be encouraged to report any perceived difficulties to their supervision. These difficulties include, but are not limited to:

- Degradation or permeation of PPE
- Perception of odors
- Skin irritation
- Unusual residues on PPE
- Discomfort
- Resistance to breathing (if respirators are worn)
- Fatigue due to respirator use
- Interference with vision or communication
- Restriction of movement

- Personal response such as rapid pulse, nausea, and chest pain

10.2.2.6 Temperature Stress. Site training will address the topics of heat stress and cold stress as presented in (Appendix A).

10.2.2.7 Storage. PPE will be stored properly to prevent damage or malfunction due to exposure to dust, moisture, sunlight, damaging chemicals, extreme temperatures and/or impact. The SSC shall be responsible for proper storage of PPE.

10.2.3 Air Monitoring. A program will be established for the periodic surveillance to detect changes in the areas of investigation sites so as to continually ensure the accuracy of the division of the work area and the adequacy of worker protection. During investigation activities, the Site Safety Coordinator will monitor the work site for (1) combustible gas concentrations (2) organic vapors and (3) radiological contamination.

10.2.3.1 Combustible Gas Concentrations. During drilling, the SSC will monitor the work area to detect, measure, and document any explosive concentrations of contaminants. Explosion potential measurements will be made using a combination combustible gas/oxygen (CGM) (Neotronics Meter, Exotox Model 40-OFH) and hydrogen sulfide meter. Drill crews shall use the CGM while drilling to determine if any explosive potential exists within the working area. Readings taken at the barrel or opening of the boring are indicative of vapor-gas escape, but may be inaccurate or inconclusive. Readings taken approximately one foot above the source indicate a greater

10.2.3.2 Organic Vapors/Photoionization Indicating Device (PID) The SSC shall use a photoionization detector (HNU Systems Model 101, Hazardous Waste Detector) to monitor the levels of ionizable vapors at the investigation site. Depending on the investigation activity, 1-min measurements will be made in the bore hole, at ground level, and at the worker's breathing zone. The PID will be calibrated relative to benzene concentration or to standards traceable to benzene. In the event that the PID detects a contaminant(s), a 0.5a Draeger tube for benzene will be used to confirm the presence of benzene and its concentration. Benzene will be specifically monitored for each drilling. If benzene is detected, but its concentration is below 5ppm in the breathing zone, work will stop, and the IH or Safety Office will be notified to inquire about donning respirators. If the benzene level exceeds 5ppm in the breathing zone, all personnel will evacuate the Exclusion Zone until bore hole readings return to background values, and the SSC will call the designated Safety Office or IH for further instruction.

If benzene is not detected, the protection level will be based on total organic concentration levels for a 1-min detector reading in the breathing zone. The following protection levels will be used for concentration measurements in the breathing zone:

Concentration	Protection Level or Action
0-5 units above background	Modified Level D PPE will be worn

5-50 units above background	The SSC will suspend work and consult the IH or Safety Office about donning respirators (Level C PPE) and dividing the work area into zones.
>50 units above background	Evacuation of Exclusion Zone

10.2.3.3 Radiological Contamination

With a Ludlum Model 3 portable survey meter, the Site Safety Coordinator will screen samples, equipment and personnel for alpha, beta, and gamma contamination. The survey meter will be operated according to its manufacturer specifications regarding use and limitations. If elevated radioactivity levels are detected in a work area, the investigation site will be evacuated and the Site Safety Coordinator will notify the Wilmington District Safety and Occupational Health Office for further instruction. Following exposure to elevated radioactivity levels, workers will submit a bioassay to be analyzed for Thorium 232. Along with instrument monitoring, each worker will wear a thermoluminescent dosimeter badge.

10.2.3.3 Agent (dichlorodiethylsulfide) Contamination

Refer to SOP,Well Drilling Procedure For Soil Sampling In Potentially Contaminated Areas Of Edgewood Area (attached).

10.2.4 Decontamination Note, Decontamination for Agent will be conducted as prescribed in SOP, Well Drilling Procedure For Soil Sampling In Potentially Contaminated Areas Of The Edgewood Area. Supplied by TEC Personnel, and will supersede the following or add to decontamination procedures.

10.2.4.1 Standard Procedures. All personnel, clothing and equipment leaving the Exclusion Zone (if applicable) must be decontaminated to remove any contaminants. Decontamination activities will be conducted in the Contamination Reduction Zone. The location of the Contamination Reduction Zone is shown in Figure 5 Site Work Zone, and its layout is shown in Figure 6 . For personnel, the following steps will be taken for decontamination:

Station 1. Deposit equipment (tools, sampling devices and containers, monitoring instruments, clipboard etc.) on plastic drop cloths.
Station 2. Scrub outer boots, outer gloves, and splash suit with decon solution or detergent water. Rinse thoroughly with water.
Station 3. Remove outer boots and gloves. Deposit in a canister lined with a plastic liner.
Station 4. If a worker leaves the Exclusion Zone to change a canister or mask, this is the last step in the decontamination procedure. Obtain a new canister, don new outer gloves and boot covers, tape joints, and return to work.
Station 5. Remove boots, chemical-resistant splash suit, and inner gloves and deposit in separate containers lined with plastic.
Station 6. Remove facepiece/shield, and deposit it on a plastic sheet.
Station 7. Wash hands and face thoroughly. Shower as soon as possible.

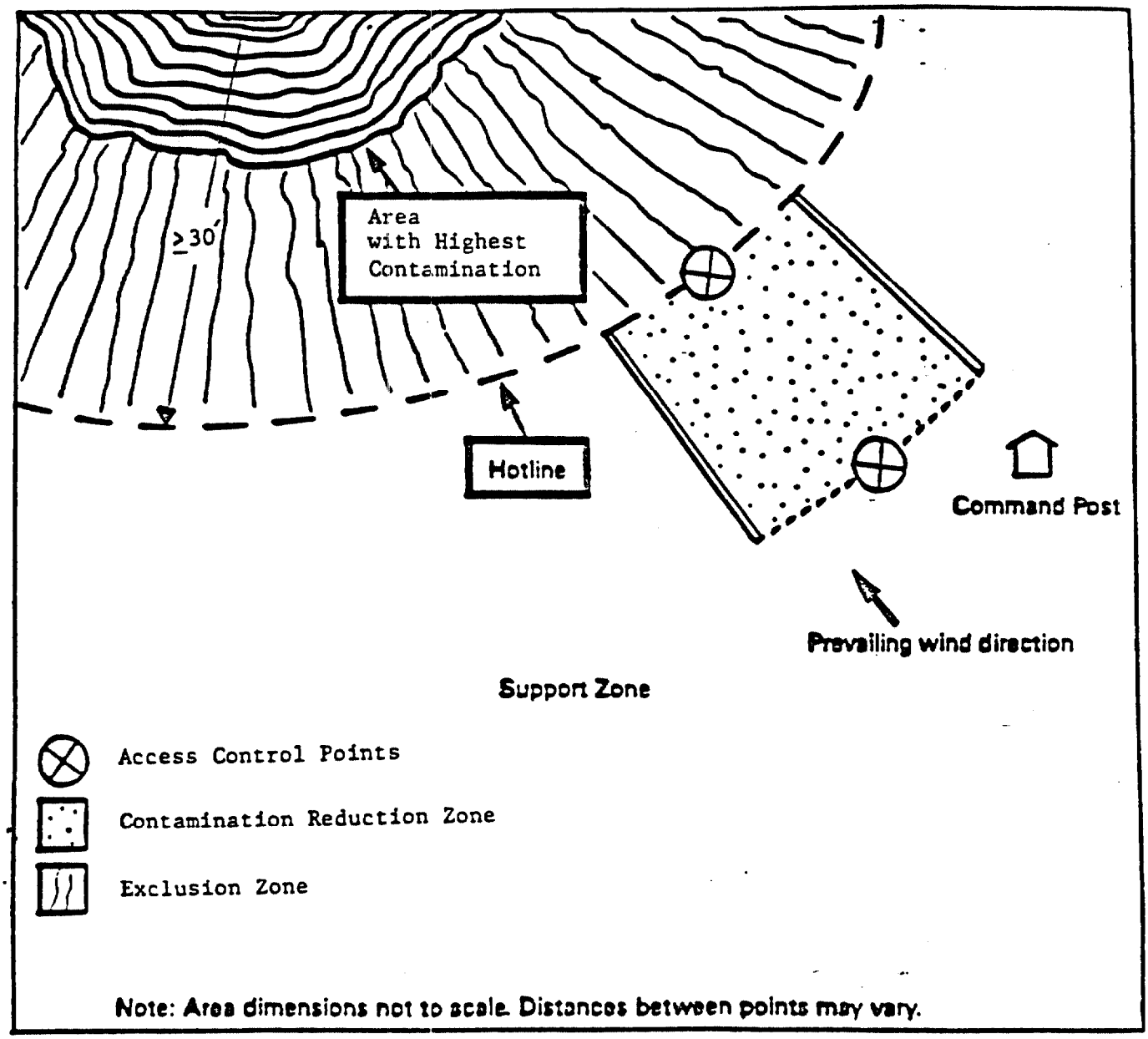


Figure 5 Site Work Zones

Decontamination solutions and rinses shall be contained collected and stored until they shall be analyzed to determine suitable disposal methods.

10.2.4.2 Emergency Decontamination. If immediate medical treatment is required to save a life, decontamination will be delayed until the victim is stabilized. If decontamination can be performed without interfering with essential first aid , decontamination will be performed immediately.

10.2.4.3 Emergency Decontamination For Mustard Exposure.

a. Eye and mucous membrane contamination-speed in decontamination of the eyes is absolutely essential. The procedure is very effective for mustard in the first few seconds after exposure but is of very little value in later exposure Remove personal from the liquid source and flush eyes immediately, with water by tilting the head to the side, pulling the eye lids apart with the fingers and pouring water slowly into the eyes. Note, do not cover the eyes with bandages but, if necessary, protect the eyes by means of dark or opaque glasses. Transfer the individual to a medical facility.

b. Skin contamination- Remove person from agent source immediately. Flush skin and clothes with 5% sodium hypochlorite solution for one minute. Cut and remove contaminated clothing, flush contaminated skin area with 5% sodium hypochlorite solution, then wash contaminated skin area with soap and water. If shower facilities are available, wash thoroughly and transfer to medical facility. (If thickened agent is involved, remove by scraping with something dull instrument such as a putty knife or trowel.

11.0 Contingency Plan

11.1 Line of Authority. The SSC or TEC will be responsible for all decisions relating to site safety. This includes overseeing all the worker protection requirements. The SSC will ensure that all participants conduct their work in accordance with the SSHP, and will direct any employee to leave the site if the employee fails to observe safety requirements or in any way creates a safety hazard. The SSC will be backed up by a specified alternate. Other personnel who may be involved in emergency response will be identified and their respective roles defined, at least two emergency response personnel on the job shall be certified in CPR and First Aid.

11.2 Pre-emergency Planning. The SSC will contact the local hospital emergency room, the local poison control center, and the NWSC security, fire and ambulance services before activities begin. The SSC will inform the hospital emergency and ambulance service of probable emergencies. At the investigation site, the SSC shall ensure that adequate emergency equipment is at the investigation site, and designated emergency signals audible and universal hand signals are understood,in case of radio failure.

- Three vehicle horn blasts is an emergency signal to leave Exclusion Zone
- Hands gripping throat (Out of AIR), Grip Partners Wrist (Leave Area NOW) Hands on Head (Need Assistance), Thumbs Up(OK, Allright), Thumbs Down(No)

Emergency equipment shall include:

The equipment needed to perform the decontamination steps as follows:

Station 1. Containers of variable sizes
Plastic liners
Plastic drop cloths
Station 2. Containers (20-30 gallons)
Decon solution
Rinse water
2 to 3 long-handled, soft-bristled brushes
Station 3. Container (20-30 gallons)
Plastic liners
Bench or stools
Station 4. Masks and cartridges
tape
Boot covers
gloves
Station 5. Containers (20-30) gallons
plastic liners
Bench or stools
Station 6. Plastic sheets
Wash basin or bucket
Bench and stools
Station 7. Water
Soap
Tables
Wash basin or bucket

For equipment, the following steps will be taken for decontamination:

1. Remove any solid particles from the equipment by brushing and then rinsing with tap water. For drilling equipment , steam cleaning is necessary.
2. Wash equipment with a detergent solution.
3. Rinse with tap water by submerging or spraying.
4. For organic contaminants, an optional rinse with a solvent (methanol or acetone) may be used to dissolve and remove contaminants.
5. Rinse thoroughly with distilled water.
6. Air dry equipment or rinse with methanol.

To protect delicate instruments prior to use in the Exclusion and Contamination Zones, they shall be placed in a clear plastic bag, and the bag shall be taped and secured around the instrument. Openings are made in the bag for sample intake. The plastic bag shall be discarded appropriately in lieu of decontamination.

The supplies needed to decontaminate equipment follows:

- Decontamination solutions.
- Cleaning liquids: detergent solutions, tap water, distilled water, and methanol.
- Chemical-free paper towels.
- Cleaning brushes.
- Cleaning containers; plastic buckets and galvanized steel pans.
- Waste storage containers: drums and plastic bags.

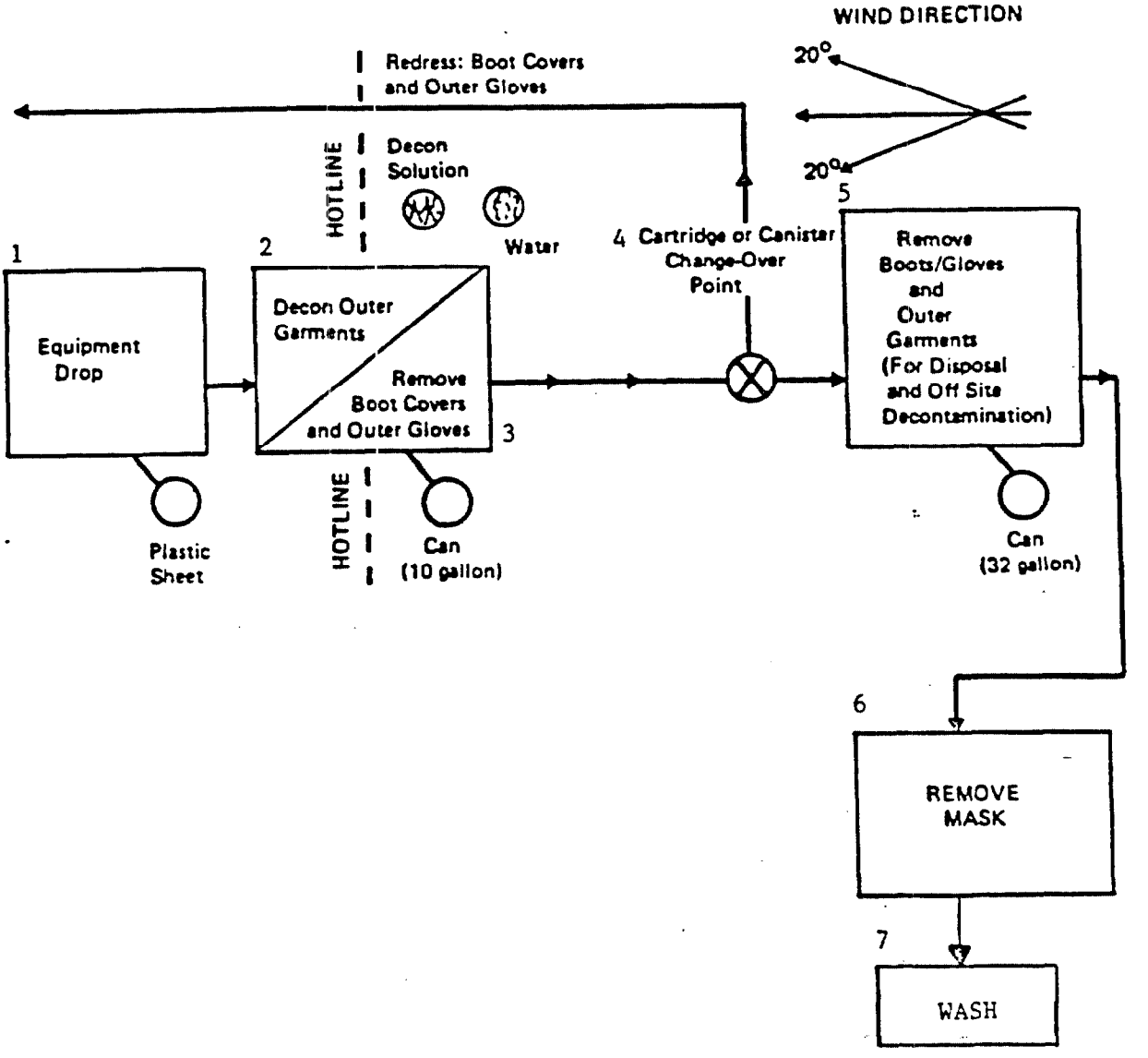


Figure 6 Contamination Reduction Zone Layout

- Mobile telephone/Radio Communication (optional) And in this project not authorized, Phone Number _____
- First Aid Kits
- Portable Eyewash and shower
- Blankets
- Stretchers
- Water in portable containers
- Fire-fighting equipment and supplies
- Level B PPE, available from NWSC

11.3 Fire and Accident Procedures. All employees will be made aware of the fire and accident response procedures by site-specific training prior to start of work. And the available support from the local Crane Spill Response Team (Appendix B, Spill/Emergency Contingency Plan).

11.3.1 Fire Response

1. Report fire
2. Secure equipment and vehicles.
3. Only attempt to extinguish small controllable fires which can be easily controlled with portable fire fighting equipment (i.e 5 lb ABC, Co2) until help arrives, unless imminent danger exists. Evacuation will be necessary whenever an uncontrollable fire threatens health and safety at the site. Notify the NWCS fire department immediately following evacuation.

11.3.2 Accident Response

1. Remove the injured or exposed worker(s) from the immediate danger.
2. If decontamination can be done, first wash, rinse and/or cut off protective clothing and equipment next render first aid as needed, and then call for transport to the hospital.
3. If decontamination cannot be done, first wrap the victim in blankets or plastic to reduce contamination of other personnel. Next alert emergency and off-site medical personnel of potential contamination and instruct them of specific procedures if necessary.
4. Evacuate other personnel from the immediate affected area to a safe location until the Safety Coordinator determines that the site is safe for work to resume.

11.4 Emergency Information

11.4.1 Site Maps. Site maps showing topographic features, prevailing wind direction, work zones, and evacuation routes shall be posted conspicuously at the work site in locations known to all personnel. Site

personnel must verify these numbers upon arrival to the site and prior to beginning any activities.

11.4.2 Emergency Telephone Numbers The following list of emergency telephone numbers will be posted conspicuously. And all site personnel will be told their locations. (attached)

EMERGENCY SERVICE/CONTACTS	TELEPHONE NUMBER
- USEPA Environmental Response Team	201/321-6460
- US Coast Guard Environmental Response Team	800/424-8802
- Association of American Railroads Response Team	202/293-4048
- Project Manager Robert Magee	919/251-4709
- Health & Safety Officer _____	
- Fire Department NWSC CRANE	812/845-1235 or 854-1333
- Police/Security Department NWSC CRANE	812/854-3300
- State Police INDIANA STATE POLICE	812/332-4411
- Hospital NWSC CRANE	854-1220
BEDFORD MEDICAL CENTER	854-1339
- Ambulance On-Site/Off-Site NWSC CRANE	854-1100
LAWRENCE CO	279-6545
- Poison Control Center	800/382-9097

****

Name of Hospital: BEDFORD MEDICAL CENTER

Telephone Number: 812/275-1200

Hospital Address: 2900 WEST 16th ST.
BEDFORD IN. 47432

Route to Hospital Take left at Bedford Gate South, directly to city of Bedford, take first left onto 16th St.

Distance to Hospital: approx. 20 miles

11.5 Emergency Documentation. All incidents involving personal injury shall be investigated and documented so that preventive measures may be taken to avoid similar incidents. At a minimum, the following steps shall be taken:

- Notify the Safety and Occupational Health Office
- Prepare the Accident Report, Eng 3394, in accordance with Corps of Engineers regulations.
- Prevent the work area from being disturbed until the accident investigation is completed.
- Notify NWSC personnel in accordance with their regulations.

12.0 Logs, Records, and Reports The following logs, reports, and records shall be developed, retained and made available to entitled regulatory agencies upon request: (1) Training logs; (2) Medical records; (3) Daily safety meeting reports; (4) Daily air monitoring logs; and (5) Daily safety inspection logs. The daily records for safety meetings, air monitoring, and inspections will be kept in a separate safety and health log book, Appendix B contains blank record forms.

13.0 Field SSHP Appendix C contains a condensed version of this SSHP for consultation by Corps of Engineer employees at the work site. Copies of the field SSHP will be made available to each worker and also to the Site Safety Coordinator in addition to the full version of the SSHP.

14.0 Changes to the SSHP The Site Safety Coordinator will submit changes to the SSHP for approval by the District Safety and Occupational Health Office prior to implementing the changes.

15.0 Plan Approval

District Safety Officer

Name	Signature	Date

Other Approval

16.0 Statement of Understanding

All site personnel have read the above plan or field copy and are familiar with its provisions. The following signature certifies that they have read, understand and comply with the guidelines set forth in this Safety Plan.

Site Safety Officer:

Name	Signature	Date

Project Team Leader: _____

Site Personnel _____

17.0 References

(1) U.S Army Corps of Engineers (USACE), Safety and Health Requirements Manual, EM 385-1-1, October 1987.

(2) Occupational Safety and Health Administration (OSHA), Construction Industry Standards, 29 CFR 1926, and General Industry Standards, 29 CFR 1910; 29 CFR 1910.120 " Hazardous Waste Site Operations and Emergency Response ",
Federal Register, Vol. 54, NO. 42, dated 6 March 1990.

(3) NIOSH/OSHA/USCG/EPA, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities", October 1985.

(4) EPA " Standard Operating Safety Guides", July 1988.

(5) Hawley's , Condensed Chemical Dictionary, 11 Edition, Van Nostrand Reinhold Company, NY. 1987.

(6) Sax, Dangerous Properties of Industrial Materials, Fifth Edition, Van Nostrand Reinhold Company, NY,79.

(7) ACGIH, Threshold Limit Values and Biological Exposure Indices for 1989-1990, 2nd Edition, Cincinnati, Ohio.

(8) NIOSH, NIOSH, Pocket Guide To Chemical Hazards, 1990. DHHS Publication No. 90-117.

APPENDIX A
STANDARD OPERATING PROCEDURES

SOP	TITLE	PAGE
A	SEVERE THUNDERSTORMS/TORNADOES	A-1
B	DRILLING JHA	A-2
C	SNAKE BITE	A-3
D	TEMPERATURE STRESS	A-4

STANDARD OPERATING PROCEDURE A

SEVERE THUNDERSTORMS AND TORNADOES

Meteorological conditions shall be closely watched, especially in the spring, when severe thunderstorms and tornadoes are most likely. Often they occur late in the afternoon on hot spring days, but they can occur at any time of the day in any season of the year. Usually, tornadoes are preceded by severe thunderstorms with frequent lightning, heavy rains, and strong winds.

A severe storm watch or a tornado watch announcement on radio or television indicates that a severe thunderstorm or tornado is possible. No work is permitted in the Exclusion Zone during thunderstorms, severe thunderstorm watches or tornado watches.

A severe thunderstorm warning or a tornado warning signify that a severe thunderstorm or a tornado has been sighted or detected by radar and may be approaching. All work on site shall stop during the time of a severe thunderstorm warning or tornado warning.

Personnel on site during a tornado shall take the following steps:

- Leave office trailers or vehicles.
- If outdoors, lie flat in a nearby ditch.
- Beware of lighting hazards. Stay away from power poles, electrical appliances, and metal objects.
- Do not try to outrun a tornado.

ACTIVITY HAZARD ANALYSIS

ACTIVITY Earth drilling operations ANALYZED BY REVIEWED BY DATE

PRINCIPAL STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
General	Lack of knowledge in safety requirements and safe use of equipment.	Training in safety requirements (EM 385-1-1); training in manufacturer's literature (e.g., operator,s manual); review of activity hazard analyses.
	Pre-existing physical condition; physically unqualified.	Pre-employment and follow-up physical examinations.
	Unfamiliar with project rules and procedures.	Project safety and health orientation; make accident prevention plan available to employees.
	Exposure to the elements.	Meet minimum clothing requirements.
Traveling	Collision.	Know dimensions/capacities of rig; trained and licensed operators.
	Persons riding rig.	Prohibit persons riding on rig in other than proper seating arrangements.
	Running over objects.	Require use of spotter.
	Moving equipment w/mast up.	Prohibit moving equipment with mast up; interlock to prevent movement of equipment with mast up; warning device to sound when equipment is moved with mast up.
	Traveling on rough terrain.	Survey terrain prior to travel; if necessary, smooth terrain prior to operation; move equipment parallel to slope; use of spotter to identify terrain hazards.
Set-up	Contact w/overhead electrical lines.	Use of proximity warning devices; warning signs; training.
	Unstable ground.	Check ground stability prior to set-up.
	Machinery out of level.	Extend and level outriggers; use of warning device.

ACTIVITY Earth drilling operations ANALYZED BY REVIEWED BY DATE

PRINCIPAL STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
	Defective equipment.	Pre-operation check of fluids, pressures, clearances, gauges, warning devices, safety devices, operation of controls, belts, hoses, nuts/bolts, drilling fluid levels, etc.
	Two-blocking of hoist.	Anti two-blocking device and alarm.
	Operation of hoists beyond capacities.	Know capacities and loads; use hoists only for their designed intent, not for lifting other materials and personnel.
Drill operations	Personnel caught in machinery during start-up and operation.	Sound alarm to warn persons prior to starting/engaging equipment; proper machine guarding; lubrication points shall be located in safe positions; use long-handled shovels to move auger cuttings away from the auger; clean augers only when the rotation mechanism is in neutral and the auger stopped.
	Contact w/hazardous chemicals agents in soil.	Pre-work surveys to identify previous use of land; soil sampling, if necessary to determine type and concentrations of hazards; use protective clothing.
	Contact with hazardous drilling fluids.	Train workers in hazards of fluids (MSDS); proper protective cothing.
	Defective equipment.	Periodically inspect (same as above).
	Hoisting hazards.	Use slings/chains - don't wrap hoist line around object.
	Clothing/equipment caught in reciprocating equipment.	Don't wear loose clothing, jewelry; keep body parts, rags, tools, etc. away from equipment.
	Tripping (housekeeping) hazards.	Keep work area clean and equipment properly stored/secured
	Striking head, head struck.	Use of hard hats.
	Object falling on foot.	Use of steel-toed safety boots.

ACTIVITY Earth drilling operations ANALYZED BY REVIEWED BY DATE

PRINCIPAL STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
	Hands cut by equipment.	Use of work gloves.
	Dust.	Use of wet drilling techniques or other dust control procedures.
	Foreign object in eye.	Use of goggles.
	Hazardous noise.	Use of hearing protection devices; enrollment, if necessary, in hearing conservation program.
	Hazards of on-line maintenance and repair.	Stop and lockout/block energized equipment; lower mast for repairs. grease/lubrication fittings located at safe positions.
	Contact w/underground utilities.	Contact utilities/review existing site plans to identify ungerground utilities.
	Climbing/falls from rig.	Use safe means of access; fall protection devices if necessary; clean mud and grease from shoes prior to climbing rig.
	Uncovered boreholes (tripping hazards).	Cap/flag boreholes.
	Operation during electrical storm.	Monitor weather if necessary; cease operations when thunderstorms are impending.
	Hazards w/rod slipping device.	Do not run/rotate drill rods through device; do not hoist more than 1 ft. of drill rod column above the top of the mast; do not hoist a drill rod column which has loose tool joints; do not make up, tighten, or loosen tool joints while the rod column is supported by a rod slipping device.
	Improperly secured/-stored rod sections.	Ensure drill rod columns which are not being used are properly stored and secured.
	Hazardous air due to operation in enclosed areas (incl. trenches).	Air monitoring; compliance with confined space procedures.
	Operator leaving station during rig operation.	Operators required to remain at station at all times of operation.

ACTIVITY Earth drilling operations

ANALYZED BY REVIEWED BY DATE

PRINCIPAL STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
	Hazards in using hoists (incl. cathead) and wire rope.	Keep the cathead clean and lubricated; periodically inspect rope and keep rope clean; periodically check cathead for rope wear groves; compliance with hoist and wire rope requirements.
	Rope grabbing on cathead.	Release rope and warn others to back away and keep clear of rig; shut down engine and take safe measures to release hoisted load.
	Objects pulled into cathead.	Rope handler shall maintain at least 3 ft. clearance from cathead; keep rope free and untangled.
	Starting/guiding auger.	Use auger guide on hard surfaces; apply adequate down pressure on drill rod to penetrate ground surface prior to starting auger; start auger slowly and watch to ensure a controlled penetration into the ground; if auger head slides out of alignment, stop and repeat process.
	Rotary and core drilling - hydraulic equipment.	Compliance with requirements for hydraulic equipment.
	Rotary and core drilling - general.	Inspect and maintain water swivels, hoisting plugs, and drill rod chuck jaws.

STANDARD OPERATING PROCEDURE C

TEMPERATURE STRESS

- Heat Stress. Wearing PPE puts a hazardous waste worker at considerable risk of developing heat stress. Because heat stress is probably one of the most common illnesses at hazardous waste sites, regular monitoring and other preventative precautions are vital.

To monitor heat stress, the Site Safety Coordinator will have workers count their pulse during a 30-second period as early as possible in a rest period. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, the Site Safety Coordinator will shorten the next work cycle by one-third and keep the rest period the same. If the heart rate still exceeds 110 beats per minute at the next rest period, the Site Safety Coordinator will shorten the following work cycle by one-third.

The frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and the level of physical work (See Table 1.).

STANDARD OPERATING PROCEDURE B

SNAKE BITES

Normally, the noise of a person approaching a snake habitat is sufficient to frighten the snakes off. However, extreme caution is necessary when exploring areas where snakes might be found, such as behind rocks, under bushes, or in holes, crevices, and abandoned pipes.

The rules to follow if bitten by a snake are:

- Do not cut the bite area as it will exacerbate the effect of the venom.
- Do not apply suction to the wound as it is minimally effective in removing venom.
- Do not apply a tourniquet since venom is most dangerous when concentrated in a small area.
- Do not allow the victim to run for help as this allows accelerates circulation.
- Do seek immediate medical attention.
- Do keep the victim calm and immobile.
- Do have the victim hold the affected extremity lower than the body while waiting for medical assistance.

The Site Safety Coordinator will take the following preventative steps:

- Adjust work schedules as required in the following ways:

  Modify work/rest schedules according to physiological monitoring results.

  Mandate work slowdowns as needed.

  Alternate job functions to minimize overexertion at one task.

- Perform work during cooler hours of the day, if possible.

- Provide cooled shelter or shaded areas to protect personnel during rest periods.

- Maintain workers' body fluids at normal levels.

- Provide cooling devices to aid natural body heat exchange during prolonged work or severe heat exposure. Cooling devices include:

  Field showers or hose-down areas to reduce body temperature and/or to cool off protective clothing.

  Cooling jackets, vests, or suits.

- Train workers to recognize and treat heat stress. As part of on-site training, identify the signs and symptoms of heat stress (See Table 2.).

Table 1

Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers

ADJUSTED TEMPERATURE[b]	NORMAL WORK ENSEMBLE[c]	IMPERMEABLE ENSEMBLE
90°F (32.2°C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5°–90°F (30.8°–32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5°–87.5°F (28.1°–30.8°C)	After each 90 minutes of work	After each 60 minutes of work
77.5°–82.5°F (25.3°–28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5°–77.5°F (22.5°–25.3°C)	After each 150 minutes of work	After each 120 minutes of work

Source: Reference [13].

[a]For work levels of 250 kilocalories/hour.

[b]Calculate the adjusted air temperature (ta adj) by using this equation: ta adj °F = ta °F + [13 × % sunshine]. Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distinct shadow; 0 percent sunshine = no shadows.)

[c]A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

Table 2

Signs and Symptoms of Heat Stress

- Heat rash may result from continuous exposure to heat or humid air.
- Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:
  - muscle spasms
  - pain in the hands, feet, and abdomen
- Heat exhaustion occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:
  - pale, cool, moist skin
  - heavy sweating
  - dizziness
  - nausea
  - fainting
- Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained. Signs and symptoms are:
  - red, hot, usually dry skin
  - lack of or reduced perspiration
  - nausea
  - dizziness and confusion
  - strong, rapid pulse
  - coma

Table 3

Wind Chill Factor Chart*

Estimated Wind Speed (in mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°F)											
calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	*LITTLE DANGER* In < hr with dry skin. Maximum danger of false sense of security				*INCREASING DANGER* Danger from freezing of exposed flesh within one minute.				*GREAT DANGER* Flesh may freeze within 30 seconds.			
	Trenchfoot and immersion foot may occur at any point on this chart.											

* Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

Table 4

Symptoms of Cold Exposure

Stages of Frostbite

1. Whitening of skin
2. Waxy skin
3. Skin firm to touch
4. Tissues cold, pale, and solid

Stages of Hypothermia

1. Shivering
2. Apathetic, sleepy, lowered body temperature
3. Glassy stare, slow, pulse, slow breathing, unconsciousness
4. Freezing of extremities
5. Death

- Cold Stress. Cold injury (frostbite and hypothermia) and impaired ability to work are dangers at low temperatures and when the wind-chill factor is low. If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work shall be modified or suspended until adequate clothing is made available or until weather conditions improve. Specifically, for exposed skin, continuous exposure should not be permitted when the air speed and temperature results in an equivalent chill temperature of -25°F (See Table 3.), and at air temperatures of 34.6°F or less it is imperative that workers who become immersed in water or whose clothing becomes wet be immediately provided a change of clothing and be treated for hypothermia.

If work is performed continuously in the cold at an equivalent chill temperature (ECT) below 20°F, heated warming shelters shall be made available nearby; the frequency of use of these shelters shall depend on the severity of the environmental exposure. The onset of intense shivering, frostnip, the feeling of excessive fatigue, drowsiness, irritability, or euphoria, are indications for immediate return to the shelter. When entering the heated shelter, the outer layer of clothing shall be removed and the remainder of the clothing shall be loosened to permit sweat evaporation, or a change of dry work clothing shall be provided. A change of dry work clothing shall be provided as necessary to prevent workers from returning to their work with wet clothing. Dehydration occurs insidiously in cold environments and may increase the susceptibility of the worker to cold injury due to a significant change in blood flow to the extremities. Warm sweet drinks and soups should be provided at the work site to provide caloric intake and fluid volume. The intake of caffeinic beverages shall be prohibited because of diuretic and circulatory effects.

As part of on-site training, workers will be instructed in:

- Proper warming procedures and appropriate first aid treatment.

- Proper clothing practices.

- Proper eating and drinking habits.

- Recognition of impending frostbite.

- Recognition of signs and symptoms of impending hypothermia or excessive cooling of the body (See Table 4.).

APPENDIX B

SPILL CONTINGENCY PLAN

NAVAL WEAPONS SUPPORT CENTER, CRANE, INDIANA 47522

EPA IDENTIFICATION NUMBER - IN5170023498

AMENDED OCTOBER 1988

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I. Background:

40 CFR 264.50 and 329 IAC 43 regulations require the preparation of a Spill Contingency (SC) Plan outlining in detail the emergency procedures to be effected if a spill or release of hazardous material occurs which could threaten human health or the environment. OPNAVNOTE 6240 (20 February 1980) and OPNAVINST 5090.1 (26 May 1983) directed all Navy facilities to prepare and submit a Spill Contingency Plan along with a Spill Prevention, Control and Countermeasures (SPCC) Plan and a Hazardous Waste Management Plan.

II. Purpose and Scope:

The purpose of this SC Plan is to provide response procedures for a spill or release of hazardous material and/or waste within the boundaries of the Naval Weapons Support Center Crane (NWSCC), Crane, Indiana. This plan is intended to enable the NWSCC to meet the requirements of Federal and State regulations and Navy instructions concerning hazardous material spills. This plan will be modified as necessary to meet any future requirements.

This plan will be implemented in case of incident within the boundaries of NWSCC wherever hazardous material is spilled or released in an unplanned manner and presents any threat to human health or the environment.

III. Mission

The NWSCC is situated on a 62,463-acre tract of land in southwest Indiana. It is located in the northern portion of Martin County and extends into neighboring Daviess, Greene, and Lawrence Counties.

Crane's mission is to "Provide quality and responsive engineering, technical and material support to the Fleet for combat subsystems, equipment and components; Microelectronic Technology, Microwave Components, Electronic Warfare, Acoustic Sensors Test, Electrochemical Power Systems, Conventional Ammunition Engineering Pyrotechnics, Small Arms, Electronic Module Test and Repair, Electronic Warfare, as assigned by the Commander, Naval Sea Systems Command." Under the Single Service Management Program, a segment of the Center's mission includes support of the Crane Army Ammunition Activity (CAAA). This Army activity is tasked with the production and renovation of conventional ammunition and related items; the performance of manufacturing, engineering, and product quality assurance to

support production; and the storage, shipment, and/or demilitarization and disposal of conventional ammunition and related components.

Approximately 4348 people are employed at NWSCC. Of these, about 747 personnel work for the Army. The Center engages these people in a variety of processes and functions to accomplish the missions of the Navy and Army. A tremendous assortment and volume of hazardous materials are used for this purpose.

IV. Who are the Environmental Emergency Coordinators?
329 IAC 3-43-3(d) and 3-43-6

The primary and alternate Environmental Emergency Coordinators (EEC) listed in this section are available at all times, either on-site or on-call, to coordinate emergency spill response measures. If they are unavailable, the Fire Division shift captain will act as On-Scene Commander (OSC) until the Environmental Protection Branch Manager or alternates arrives on the scene. In cases where a fire involved, the OSC will remain in charge until the fire is controlled. At that time, the OSC can transfer command to the EEC.

Three Indiana Page Beepers have been assigned to the Environmental Protection Branch (Code 0924) so that Code 0924 personnel can be reached in transit to and from work and during off-work hours.

Process for using the Beepers is:

-Dial number assigned to the beeper Wats 701_____

-It will ring 2 times and then you will hear 3 computer beeps.

-Key in the phone number you want the person to call and follow up with the # sign.

-It will then beep and you will get a busy signal. Hang up.

-It is then in the computer and the beeper will be notified.

Each person listed below is thoroughly familiar with this plan as well as operations and activities of the regulated units listed in Appendices I, II, and III. Each person has the authority to commit the resources necessary to carry out this plan.

Primary Contact: NWSCC Environmental Protection Branch Manager, Jim Hunsicker (Code 0924), work phone 812-854-1132 or 3114. Home address: 408 12th St., Huntingburg, IN 47542, home phone 812-683-3323. To make contact by beeper dial 7-0-1-278-2447.

Alternate: NWSCC Environmental Protection Assistant, Phil Keith (Code 09247), work phone 812-854-3114 or 1132. Home address: 2526 North 14 1/2 Street, Terre Haute, IN 47804, home phone: 812-466-7592. To make contact by beeper dial 7-0-1-278-2441.

2nd Alternate: NWSCC Environmental Protection Assistant, Jerry McCracken, (Code 09241), work phone 812-854-3114 or 1132. Home address: R.R.#1, Box 55, Bloomfield, IN 47424, home phone: 812-384-3073.
To make contact by beeper dial 7-0-1-278-2445.

3rd Alternate: NWSCC Fire Division Shift Captain, work phone 1235. Below is a list of potential shift captains.

Name	Title	Address	Phone # (Area Code 812)
David Anderson	Asst. Fire Chief	Box 71 Sandborn, IN 47578	694-8879
Larry Wools	Asst. Fire Chief	P.O. Box 118 Linton, IN 47441	847-9593
C. Scott Wolfe	Fire Captain	R. R. #1 Loogootee, IN 47558	295-3694
James W. Wires	Fire Captain	R. #3, Box 36 Orleans, IN 47452	849-4195
Sam Wilcoxen	Fire Captain	R. R. #1, Box 205 Milltown, IN 47145	633-7525
Phillip Burger	Fire Captain	R. R. #2, Box 218 Bloomfield, IN 47424	384-4000

V. Duties of Emergency Coordinators:
329 IAC 3-43-6 and 3-43-7

The primary duty of the EEC is to coordinate and supervise all spill response efforts. This includes:

A. Notifying and organizing the spill response team and other needed personnel.

B. Enacting further spill containment procedures.

C. Identifying the type/chemical composition of the spill.

D. Evacuating and securing the area of the spill as necessary.

E. Notifying or Reporting spill to the DUTY OFFICER AND COMMANDING OFFICER. The EEC will also contact the NATIONAL SPILL RESPONSE CENTER, INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT and outside authorities in the community (State Police, local hospitals and Local Emergency Planning Commissions) as necessary. Telephone numbers for aforementioned personnel and Agencies is found in Appendix IV.

F. Initiation of spill cleanup and equipment decontaminatio.

VI. Spill Response Team (SRT):

A. Drills: Routine drills and exercises in spill containment procedures involving key personnel will be performed periodically.

B. The regular members of the SRT will include the following:

1. Environmental Protection Branch Manager, who serves as the EEC (extension 3114/1132);

2. Hazardous Waste Handlers (extension 1192 or page by dialing extension 3125, then dial 236 or 240 after beeping tone stops);

3. Environmental Protection Assistants;

4. Public Works shops personnel, Codes 04, 104, EOD, 10, Disaster Preparedness Team, or other personnel will be notified according to the discretion of the OSC and/or the EEC.

VII. Authorization Statement: 329 IAC 3-43-6

The EEC and the OSC have the authority to call in any personnel (EOD, Public Works, Industrial Hygiene, Safety, etc.) needed in an emergency situation. In situations where the EEC and the OSC have assessed that a release, fire or explosive threatens human health or the environment outside the facility, the Captain should be advised of the situation simultaneously as outside officials are being notified. If a spill cleanup contractor is to be called in, the Captain, Technical Director, and Public Works Officer should be notified and advised of the decision, and the contractor contacted. If the Captain, Technical Director or the Public Works Officer are not available, the OSC or EEC will proceed with contacting and requesting the services of a contractor.

VIII. Identification of Hazardous Materials: 329 IAC 3-43-7(b)

A. If there is a release, fire, or explosion, the EEC will immediately identify the character, exact source, amount and areal extent of any released materials to the extent possible with respect to the release circumstances.

B. If the identity of the spill material is not known or relayed by the report of the spill, the EEC may be able to determine the identity on the basis of the location of the material and knowledge of the related processes in its vicinity. The Environmental Protection Branch has data files of processes and storage areas involving hazardous wastes/materials throughout the Center. This information file will also be of assistance in determining the exact source of the spill. Identification of spilled material can also be made by actual observation or production records to determine what materials are being used by process. Samples may be taken to verify the identity of the released material. Analysis could be received back if analyzed: on-Center - 24 hours; off-Center - 48 hours.

C. A member of the Center's spill response team will be dispatched by the EEC to determine or verify the reported volume of the spill, as well as to investigate the cause of the release, through observation and discussions with key personnel in the area. If a spill occurs locally during transit of a hazardous waste/material, logs and/or manifests and label information will provide data on the identity, volume and source of the spill.

IX. Assessment: 329 IAC 3-43-7(c) and (e)

A. Concurrently while identifying the character, exact source and areal extent of any released materials the EEC will assess possible hazards to human health and the environment due to emergency incident. This assessment would be developed through consultation and coordination with representatives from NWSCC's Safety, Medical, Fire, and Security Departments and the Explosive Ordnance Disposal detachment. The assessment should address:

1. Direct and indirect results from the release, fire, or explosion;

2. Effects of any toxic, irritating or asphyxiating gases that are generated;

3. Effects of any hazardous surface water run-off from water or chemical agents used for fire control.

B. The following resources would be reviewed by the assessment group to complete the hazards assessment:

1. Material Safety Data Syeets for material involved in incidents, to determine decomposition by-products;

2. Chemical reference documents such as Sax Dangerous Properties of Industrial Materials, Merck Index, Condensed Chemical Dictionary, Lange's Handbook of Chemistry, and Emergency Handling of Hazardous Materials;

3. Analytical data that is available for material spilled.

C. The assessment group would also have to evaluate means of egress and direction for any spill or gas/smoke cloud to leave the facility to determine what areas would have to be evacuated. After reviewing the situation and determining that a release (spill, fire or explosion) has occurred which can affect human health and the environment outside facility boundaries, the following notifications would be made:

1. Outside notification of state or local police, local hospitals in Bloomington, Linton, Vincennes, Jasper, Washington, or Bedford, will be made by the OSC or EEC. The hospitals will be advised by the Center's medical staff of any related injuries resulting in transportation of injured parties to the hospital for treatment;

2. If areas outside the Center must be evacuated, and traffic rerouted, the state police will be advised of such by the EEC, as well as the nature of the hazards involved;

3. The EEC will immediately notify either the government official designated as the on-scene coordinator for that geographical area, (in the applicable contingency plan under 40 CFR Part 300) or the National Response Center, the Indiana Department of Environmental Management's 24-hour emergency number and the Martin County Sheriff's Department and will seek outside assistance from these agencies as necessary. The key telephone numbers for emergency spill response are found in Appendix IV.

X. Emergency Plan for Off-Center Spill Incidents:

Appendix V is a formal Center instruction establishing an emergency action plan for off-Center incidents involving hazardous materials shipped by a government vehicle, or a private carrier dispatched by the Supply Department, or where the Center is the nearest government activity and assistance is requested.

XI. Notification: 329 IAC 3-43-7(a)

If an imminent or an actual situation should occur, the EEC will immediately: Activate or cause to be activated internal alarms and/or communications systems in order to notify operating personnel and will notify or cause to be notified appropriate contingency response agencies if their help is needed. As soon as possible, the Indiana Department of Environmental Management and the National Response Center will be notified. Their phone numbers are found in Appendix IV.

The following information should be available at time of call:

A. Type of material spilled;
B. Time of spill;
C. Waterway/stream affected;
D. Amount spilled;
E. Count facility located in.

XII. Evacuation Plan: 329 IAC 3-43-3(f)

Appendix IX contains a map of the facility and Primary Evacuation Routes. Site specific evacuation plans are posted in every occupied building on Center.

XIII. Control Procedures: 329 IAC 3-43-7(e)

The operations at NWSCC are so varied and complex that it is difficult to be all inclusive in one plan, therefore, site specific plans are included in Appendix I. The provisions of this plan will be carried out immediately whenever there is a fire, explosion, or release of hazardous waste, hazardous material, or hazardous waste constituents at any of the units listed in Appendices I, II, or III, which could threaten human life or the environment. The EEC will take all measures necessary to contain the incident within the affected area, and will notify the appropriate personnel. Furthermore, a Disaster Preparedness Oil and Hazardous Substances Spill Contingency Plan and Oil and Hazardous Substances Response Plan for NWSCC is enclosed as Appendix X. Descriptions of control and containment procedures of some potential incidents follow:

A. Explosion: In the event of an explosion, operation of the affected unit will be ceased immediately and the Fire Department and Explosive Ordnance Disposal Group Two Detachment (EOD) will be notified of the incident. Operation will not resume until the cause of the explosion has been determined; all repairs, if any, have been completed; and approval to resume operations has been obtained.

B. Fire: In the event of a fire, NWSCC [illegible] the EEC will be notified immediately. The Fire Chief will be considered On-Scene Commander (OSC) until the fire is brought under control and spill cleanup/containment can begin. The EEC or his alternate will advise the OSC during the fire what action is needed to contain the spill. Such actions as building dams downstream from the fire will be done to collect runoff generated while fighting the fire. Once the fire is out the OSC will transfer authority for cleanup of the area to the EEC. At the discretion of the OSC, non-essential personnel may be evacuated from the immediate area. No operations will be resumed until inspection and approval is obtained from the EEC and/or OSC.

C. Spill: A spill of hazardous waste at any of the buildings listed in Appendices I, II, and III, or along a haul road used to move wastes could occur. However, due to posted speed limits, hazardous waste handling procedures, and safety precautions, spills are unlikely. If a spill does occur, the following procedure would be initiated:

1. Immediately notify the NWSCC Fire Department. The OSC will transfer command to the EEC once it is determined that an imminent threat to human health or safety no longer exists;

2. Notify the EEC immediately after notifying the NWSCC Fire Department;

3. Assess the extent of surface contamination to determine if a hazardous situation exists. The EEC will assess possible hazards to human health or the environment due to the emergency incident. The assessment will consider the short-term and long-term effects of the event. Examples of long-term effects could include effects of toxic gases generated or effects of run-off generated by fire fighting;

4. If the EEC determines that the incident could be harmful to personnel, he may order evacuation of the affected area. Personnel will not return to affected ?

5. Some of the hazardous wastes are in solid form and do not migrate after the spill. A solid waste spill would be cleaned up, and a report documenting the event and cleanup measures would be submitted by the EEC the next day. The operation would not restart until the EEC or his alternate has determined that the spill has been properly cleaned and has given approval for restart of operation;

2. If possible, stop the leak by plugging the hole. For a leaking drum, place the drum on its side with hole or leaking area up, put down absorbent (oil dry) or absorbent pads;

3. Select a compatible container to transfer leaking material into. For waste streams handled on a continuous basis Code 0924 knows what drums are compatible. This information is also available from MSDSs, Bureau of Explosives, Tariff No. BOE-6000, and Dangerous Properties of Industrial Materials by N. Irving Sax and Richard J. Lewis, Sr.;

4. Decontamination and/or neutralization of the area where the spill occurred. As examples, in some cases you may use soap and water to decontaminate or caustic soda;

5. Any contaminated material which cannot be decontaminated will be removed and disposed of as hazardous waste;

6. Certification that the area is clean and can be used again.

E. Major Malfunction of Process Equipment: If a major process equipment item should malfunction, that item would immediately be shut down according to SOP's, and the EEC would be notified. If no threat to human health or the environment exists, and if there is otherwise no reason to remain in a shut-down condition, the proper craftsmen would be notified and remedial action would begin. Operation of the item would not resume until certified safe by the EEC and the Safety Department. Examples of malfunctions could include leaking pumps, ruptured pipes, leaking tanks, etc.

F. Severe Weather Conditions: Occasional severe weather may threaten safe cleanup operations. If severe weather should threaten, waste handling operations would be discontinued.

If any of the aforementioned potential incidents occur, the EEC would monitor for leaks, pressure buildup, gas generation, or ruptures in equipment whenever appropriate. During an emergency, the emergency coordinator will take all reasonable measures necessary to ensure that fires, explosions, and releases do not occur, recur, or spread to other hazardous wastes at the facility. These measures will include, where applicable, stopping processes and operations, collecting and containing released waste, and removing or isolating containers.

XIV. Storage and Treatment of Release Material: 329 IAC 3-43-7(g)

All recovered wastes, contaminated soil, water, or other substances affected by the emergency incident will be collected to the extent possible, placed in compatible containers, and eiter treated or stored as appropriate in NWSCC's permitted hazardous waste facility.

XV. Disposal: 329 IAC 3-43-7(g)

Waste material generated in a spill cleanup will be turned over to Code 0924 for disposal via the Center's Hazardous Waste Disposal Contractor. All hazardous wastes are stored at Building 2993 while awaiting pickup by contractor for disposal.

XVI. Incompatible Waste: 329 IAC 3-43-7(h)(1)

A. In the case of an emergency incident which results in the recovery of wastes, contaminated soil or water, decontamination solution, or other collected materials, such collected materials will be stored, treated or disposed of with respect to compatibility.

XVII. Prevention of Recurrence or Spread of Fires, Explosions, or Releases: 329 IAC 3-43-7(e), (f), (g), and (h)

During an emergency, the EEC will take all reasonable measures necessary to ensure that fires, explosions, and releases do not occur, reoccur, or spread to other hazardous waste at the building. These measures will include, where applicable, stopping processes and operations, collecting and containing releasedwaste, and removing or isolating containers.

The follow-up actions for the EEC are:

A. Investigate the cause of the emergency and submit a formal report to Command within 48 hours;

B. Fire and Accident reports will be submitted;

C. Ensure that proper restoration actions are instituted as soon as possible after decontamination and clean up procedures have been completed. All decontaminationand clean up records will be submitted to the EEC;

D. Ensure that equipment repaired or replaced as a result of an incident is recertified, as necessary, prior to being placed in service;

E. Within 15 days notify Naval Facilities Engineering Command, the Naval Sea System Command, as well as the Commissioner of the Indiana Department of Environmental Management (IDEM) and the EPA Regional Administrator;

F. The EEC must notify the Commissioner of IDEM and appropriate local authorities that the facility is in compliance with, 329 IAC 3-43-7(h) and (i), and 40 CFR 264.56(h) and (i), before operations are resumed in the affected area(s) of the facility;

G. Immediately after an emergency, the EEC and/or OSC will provide for collection, storage, treatment and disposal of recovered waste, contaminated soil and any other material that results from the incident. This waste will be handled as hazardous waste until a chemical analysis can be obtained that proves otherwise. Emergency/Spill residue will be placed in compatible containers and either treated or stored in a permitted/interim status NWSCC hazardous waste storage facility. Any hazardous waste from emergency situations requiring disposal will be sent by NWSCC to and off-site RCRA permitted TSD facility;

H. If waste from an emergency situation is found by analysis to be considered a Special Waste, approvals for disposal and recommended disposal sites will be sought by NWSCC from the IDEM.

XVIII. Post-Emergency Equipment Maintenance: 329 IAC 3-43-7(h)(2)

Any emergency equipment used in response to an emergency incident covered by this Contingency Plan will be cleaned and certified fit for its intended use by the EEC before operations are resumed. This will be accomplished by:

A. Having Industrial Hygiene prescribe procedures for cleaning all respirators and breathing apparatus. After equipment (respirators etc.) have been decontaminated, Industrial Hygiene will be asked to visually inspect each item and certify if it is fit for intended use;

B. Having all boots, coats, etc. decontaminated and inspected for wear and damage;

C. Having all rubber gloves, Tyveks, etc. collected and handled as hazardous waste;

D. Having pumps, shovels, lifting mechanisms, and other equipment decontaminated, inspected by Safety and the EEC and put back in service.

NWSCC Safety and Industrial Hygiene Departments will play a large role in certifying emergency equipment fit for reuse. If there

is any question about a piece of equipment being fit for reuse, it will be discarded or sent back to the manufacturer (if possible) for recertification.

XIX. Materials and Equipment: 329 IAC 3-43-3(e)

Each department on-Center which handles hazardous material in their programs must have equipment to use for immediate response. This equipment and material, as a minimum, should include a transfer pump (of chemically compatible material), absorbent, and empty container(s) on hand to hold spilled material or contaminated absorbent. Safety eye washes and showers and alarm systems should be checked at least weekly to determine if they are functional. Industrial Hygiene can provide protective gear for personnel, and the Public Works' Environmental Protection Branch (Code 0924) has protective gear for use in material handling. Disaster Preparedness has available a large inventory of protective gear to be used if authorized. This equipment includes respirators, coveralls, boots, and gloves. The EEC, EOD Team and Industrial Hygiene have chemical-resistant Tyvek suits suitable for use in handling toxic, skin-absorbed materials or corrosive materials. See Appendix IV for phone numbers.

A variety of equipment for containment, control, cleanup, and decontamination is available. The Public Works Department has loaders, bulldozers, dump trucks, pumps, and tank trucks. Disaster Preparedness has decontamination apparatuses available, trucks, and decontamination chemicals for use if authorized. Code 0924 has a variety of pumps available for cleanup of spills as well as tank patch kits. Absorbent is available from Storeroom 2 or Code 0924. For a complete listing of items, see Appendix VI of this plan.

Facilities are available from the EEC or Disaster Preparedness personnel for decontamination. Showers (portable) and cleaning equipment can be assembled on site, if needed.

The OSC will use the Disaster Preparedness mobile communications van with self-contained generators for 110-volt power as needed. The van is equipped with two-way radios on the frequencies used for mobile communications on-Center, citizens band, and shortwave. Many vehicles assigned to the departments are equipped wity two-way radios, and portable hand-held units are available in Public Works and other departments and can be used for reporting observations in areas remote from a road.

XX. Coordination Agreement: 329 IAC 3-43-3(c) and 3-42-7

As necessary, for major spill incidents, the Center will seek the assistance of community groups (local fire departments, state police, and hospital services). Mutual aid agreements entitled, "Mutual Aid Fire-Fighting Assistance Agreement", have been established between NWSCC and the following:

Martin County (Indiana) Civil Defense, Fire and Rescue
Crane (Indiana) Volunteer Fire Department
Indiana Division of Forestry
Richland-Taylor Township (Indiana) Volunteer Fire Department
Perry Township (Indiana) Volunteer Fire Department
Loogootee (Indiana) Volunteer Fire Department
Odon (Indiana) Volunteer Fire Department
Owensburg (Indiana) Fire Fighters, Inc.
Daviess County Sheriff's Department
Greene County Sheriff's Department
Lawrence County Sheriff's Department
Martin County Sheriff's Department
Indiana State Police Department

A copy of NWSCC's Spill Contingency Plan has been provided to each of the following organizations/hospitals:

Martin County Sheriff's Department
Good Samaritan Hospital, Vincennes, Indiana
Greene County General, Linton, Indiana
Bedford Medical Center, Bedford, Indiana
Bloomington Hospital, Bloomington, Indiana
Daviess County Hospital, Washington, Indiana
Memorial Hospital and Health Care, Jasper, Indiana
Dunn Memorial Hospital and Health Care, Bedford, Indiana

Documentation concerning these agreements, arrangements, letter to Hospital and responses is found in Appendix VII.

At the present time NWSCC does not have agreements with any specific contractor(s) for cleanup of spills. Appendix VIII is a list that would be used to locate or hire a cleanup contractor.

XXI. Required Reports: 329 IAC 3-43-7(j)

The EEC will note in the operating record the time, date, and details of any incident that requires implementing the contingency plan. Within fifteen (15) days after the incident he must submit in a written report on the incident to the commissioner. The report must include:

A. Name, address, and telephone number of the owner or operator;

B. Name, address, and telephone number of the facility;

C. Date, time, and type of incident, e.g. fire, explosion;

D. Name and quantity of material(s) involved;

E. The extent of injuries, if any;

F. An assessment of actual or potential hazards to human health or the environment, where this is applicable; and

G. Estimated quantity and disposition of recovered material that resulted from the incident.

XXII. Amendments to the Contingency Plan: 329 IAC 3-43-5

The EEC will be responsible for reviewing and immediately amending the Contingency Plan, if necessary, whenever:

A. The facility RCRA permit is revised;

B. The plan fails in an emergency;

C. The facility changes in its design, construction, operation, maintenance, or other circumstances in a way that substantially increases the potential for fires, explosions, or releases of hazardous waste or hazardous waste constituents, or changes in the response necessary in an emergency;

D. The list of emergency equipment changes (minor permit modification); or

E. The list of Emergency Coordinators changes (minor permit modification).

XXIII. Documentation and Cost Accounting:

A. The OSC will maintain a log of all activities related to the spill with times and locations noted in detail. A hand-held recorder (available from Code 0924) will be used for noting details under field conditions where hand writing of notes is slow and cumbersome and may cause loss of pertinent details.

B. Cost accounting will be handled by the Center charge number and accounting system. This system provides separate accounting of labor and material.

Site: ______________________________

Activity:
____Drilling ___Soil/Gas ___Groundwater Sampling___ Other (explain)

____

Instrument:
(P) - Photoinization Meter, Type______ Unit/Model______ Calibration______
(C) - Combust Gas/O_2 Meter, Type______ Unit/Model______ Calibration______
(HS)- Hydrogen Sulfide, Type______ Unit/Model______ Calibration______
(DT)- Detector Tubes, Type______ Unit/Model______ Calibration______

Monitoring Requirements: ______________________________

____

General Comments: ______________________________

____

READINGS:

Time	Instr.	Reading	Location	Comments

Prepared by ______________________________

Site: ____

Activity:
____Drilling ___Soil/Gas ___Groundwater Sampling___ Other (explain)

____

Instrument:
(P) - Photoinization Meter, Type_______ Unit/Model______ Calibration_____
(C) - Combust Gas/O_2 Meter, Type_______ Unit/Model______ Calibration_____
(HS)- Hydrogen Sulfide, Type_______ Unit/Model______ Calibration_____
(DT)- Detector Tubes, Type_______ Unit/Model______ Calibration_____

Monitoring Requirements: ____

____

General Comments: ____

____

READINGS:

Time	Instr.	Reading	Location	Comments

Prepared by ______________________________

Site: ______________________________

Activity:
____Drilling ___Soil/Gas ___Groundwater Sampling___ Other (explain)

____

Instrument:
(P) - Photoinization Meter, Type_______ Unit/Model______ Calibration______
(C) - Combust Gas/O_2 Meter, Type_______ Unit/Model______ Calibration______
(HS)- Hydrogen Sulfide, Type_______ Unit/Model______ Calibration______
(DT)- Detector Tubes, Type_______ Unit/Model______ Calibration______

Monitoring Requirements: ______________________________

____

General Comments: ______________________________

____

READINGS:

Time	Instr.	Reading	Location	Comments

Prepared by ______________________

Site: ____________________

Activity:
___Drilling ___Soil/Gas ___Groundwater Sampling___ Other (explain)

____

Instrument:
(P) - Photoinization Meter, Type______ Unit/Model______ Calibration______
(C) - Combust Gas/O_2 Meter, Type______ Unit/Model______ Calibration______
(HS)- Hydrogen Sulfide, Type______ Unit/Model______ Calibration______
(DT)- Detector Tubes, Type______ Unit/Model______ Calibration______

Monitoring Requirements: ____________________

General Comments: ____________________

READINGS:

Time	Instr.	Reading	Location	Comments

Prepared by ____________________

APPENDIX C
Table of Contents

Appendix C contains information on the chemicals/compounds previously identified or suspected of being present in the area to be investigated. The tables in the appendix contain physical and chemical property data, hazard information, and toxicological data for the chemical/compound.

1. Trichloroethylene
2. Ethylene Dichloride
3. Tetrachloroethylene
4. 1,1,2-Tetrachloroethane
5. Tetrachloroethylene
6. Bromoform
7. 1,1,2-Trichloroethane
8. Dichlorodiethyl sulfide

Explosion Hazard: U.
Disaster Hazard: Dangerous; see chlorides; can react with oxidizing materials.
To Fight Fire: Foam, CO_2, dry chemical.

1,4-DICHLORO-2-BUTENE. Colorless liquid. $C_4H_6Cl_2$, mw: 125, mp: 1°–3°, bp: 156°, d: 1.183 @ 25°/4°.
Acute tox data: Oral LD_{50} (rat) = 89 mg/kg; inhal LC_{LO} (rat) = 62 ppm for 4 hrs; dermal LD_{50} (rabbit) = 620 mg/kg. [*3*]
THR = HIGH via oral and inhal; MOD via dermal routes. An exper carc via sc and cp routes. [*81*]

1,4-DICHLORO-2-BUTENE (*trans*).
Acute tox data: Inhal LC_{50} (rat) = 86 ppm for 4 hrs. [*3*]
THR = HIGH via inhal route. An exper neo. [*3*]

2,4-DICHLORO-6-*o*-CHLOROANILINE)-*s*-TRIAZINE. See dyrene.

DICHLORO-(2-CHLOROVINYL) ARSINE. Syns: *β-chlorovinyl dichlorarsine, lewisite.* Liquid, faint odor of geranium. $C_2H_2AsCl_3$, mw: 207.32, bp: 190° decomp, fp: −13°, d: 1.888 @ 20°/4°, vap. press: 0.4 mm @ 20°, vap. d: 7.15.
THR = A blistering type military poison. Has a delayed action similar to distilled mustard gas. This gas exhibits a systemic poisoning effect. To decontaminate, use 2,3-dimercapto-1-propanol (BAL). In case of poisoning give BAL intramuscularly. Lewisite is absorbed through skin. As little as 2 ml can cause death. A recognized carc. [*14*]
Disaster Hazard: Dangerous; see arsenic.

3,3′-DICHLORO-4,4′-DIAMINO DIPHENYL ETHER. $C_{12}H_{10}ON_2Cl_2$, mw: 269.1, mp: 129°.
THR = An exper carc [*14, 108*] in rats via sc route.

3,3′-DICHLORO-4,4′-DIAMINO DIPHENYL METHANE. Syn: *4,4′-methylene-bis-(2-chloroaniline).* $C_{13}H_{12}N_2Cl_2$, mw: 267.2.
THR = An exper (+) neo and carc. [*3, 10, 23*]

2,2′-DICHLORO-4,4′-DIAMINO STILBENE.
THR = An exper carc. [*23*]

3,3′-DICHLORO-4,4′-DIAMINO STILBENE.
THR = An exper carc. [*23*]

2,7-DICHLORODIBENZO-*p*-DIOXIN. Syn: *DCDD.* Colorless crystals. $C_{12}H_6O_2Cl_2$, mw: 253, mp: 209°–210°.
Acute tox data: 1% DCDD fed to 50 male and 50 female mice ⟶ 1 male death and 2 female deaths in 17 weeks. Using 35 male and 35 female rats ⟶ no deaths. Against 0.5% DCDD as above ⟶ 0 male and 1 female death in mice and no deaths in rats. [*81*] Oral single dose (female rat) = 100–2000 mg/kg ⟶ no deaths. 100 mg/kg day were not teratogenic or embryotoxic.
THR = HIGH via oral and ip routes. See also chlorinated dibenzo-*p*-dioxins.

DICHLORODIETHYLDIAMMINE COBALT PERCHLORATE. $C_4H_{14}O_4N_2Cl_3Co$, mw: 319.4.
THR = Is heat = (300°) and impact-sensitive. [*19*]

DICHLORODIETHYLSILANE. See diethyldichlorosilane.

β,β′DICHLORODIETHYLSULFIDE. Syns: *mustard gas, HD.* Colorless (if pure), to light yellow, oily liquid. $S(CH_2CH_2Cl)_2$, mw: 159.1, bp: 228°, fp: 14.4°, flash p: 221°F, d: 1.2741 @ 20°/4°, vap. d: 5.4, vap. press: 0.09 mm @ 30°.
Acute tox data: Dermal LD_{50} (guinea pig) = 20 mg/kg; iv LD_{50} (rabbit) = 1.1 mg/kg; dermal LD_{50} (dog) = 20 mg/kg; sc LD_{50} (rat) = 3.2 mg/kg. Inhal LC_{LO} (humans) = 23 ppm for 10 min; dermal LC_{LO} (humans) = 64 mg/kg. [*3*]
THR = HIGH irr to skin, eyes and mu mem and via oral, sc, inhal and dermal as well as iv routes. A "blistering" gas. High irr to eyes, skin and lungs. Pulmonary lesions are often fatal. However, effects upon eyes and skin are likewise serious. There can also be severe gastric disturbances. Only slight evidence for systemic damage. This material penetrates deeply and injures blood vessels which can result in a severe inflammatory reaction and tissue necrosis. Exposure, even to minute traces, can lead to intense inflammation after some hours. It produces marked leucopenia with involution of the lymph nodes; secondary infections are common.
Treatment of local lesions is mainly by cleanliness and emollients, similar to that of burns. Oils protect the skin only slightly. Immediately after exposure, the poison may be partly removed by scrubbing the victim with kerosene, but penetration is so rapid that this treatment is not successful if delayed for 15 to 30 min. An exper (S) human carc of the lungs and larynx. [*3, 8, 23*] An exper mutagen. [*3, 23*]
Fire Hazard: Slight, when exposed to heat or flame; can be ignited by a large explosive charge.
Disaster Hazard: Dangerous; when heated to decomp or on contact with acid or acid fumes, emits highly toxic fumes of oxides of sulfur and chlorides; will react with water or steam to produce toxic and corrosive fumes; can react vigorously with oxidizing materials.
To Fight Fire: Water, foam, CO_2, dry chemical.

DICHLORODIETHYLSULFONE. Colorless crystals. $(CH_2CH_2Cl)_2O_2S$, mw: 191.08, mp: 52°, bp: 179°–181° @ 14–15 mm, vap. d: 6.6.
THR = HIGH irr to skin, eyes and mu mem and via oral and inhal routes.

Chemical name, structure/formula, CAS and RTECS Nos., and DOT ID and guide Nos.	Synonyms, trade names, and conversion factors	Exposure limits (TWA unless noted otherwise)	IDLH	Physical description	Chemical and physical properties: MW, BP, SOL Fl.P, IP, Sp.Gr, flammability	Chemical and physical properties: VP, FRZ UEL, LEL	Incompatibilities and reactivities	Measurement method (See Table 1)
1,1,2,2-Tetrachloroethane $CHCl_2CHCl_2$ '14-5 75000 1702 55	Acetylene tetrachloride, Symmetrical tetrachloroethane 1 ppm = 7.00 mg/m³	NIOSH Ca See Appendix A 1 ppm (7 mg/m³) [skin] OSHA 1 ppm (7 mg/m³) [skin]	Ca [150 ppm]	Colorless to pale-yellow liquid with a pungent, chloroform-like odor.	MW: 167.9 BP: 296°F Sol: 0.3% Fl.P: NA IP: 11.10 eV Sp.Gr(77°F): 1.59 Noncombustible Liquid	VP(86°F): 9 mm FRZ: -33°F UEL: NA LEL: NA	Chemically-active metals, strong caustics, fuming sulfuric acid [Note: Degrades slowly when exposed to air.]	Char(pet); CS_2; GC/FID; III [#1019]
Tetrachloroethylene $Cl_2C{=}CCl_2$ 127-18-4 KX3850000 1897 74	Perchlorethylene, Perchloroethylene, Perk, Tetrachlorethylene 1 ppm = 6.89 mg/m³	NIOSH Ca See Appendix A Minimize workplace exposure concentrations; limit number of workers exposed. OSHA 25 ppm (170 mg/m³)	Ca [500 ppm]	Colorless liquid with a mild, chloroform-like odor.	MW: 165.8 BP: 250°F Sol(77°F): 0.02% Fl.P: NA IP: 9.32 eV Sp.Gr: 1.62 Noncombustible Liquid	VP: 14 mm FRZ: -2°F UEL: NA LEL: NA	Strong oxidizers; chemically-active metals such as lithium, beryllium & barium; caustic soda; sodium hydroxide; potash	Char; CS_2; GC/FID; III [#1003, Halogenated Hydrocarbons]

Personal protection and sanitation (See Table 3)	Recommendations for respirator selection — maximum concentration for use (MUC) (See Table 4)	Health hazards: Route	Symptoms (See Table 5)	First aid (See Table 6)	Target organs (See Table 5)
Clothing: Any poss Goggles: Any poss Wash: Immed contam Change: N.R. Remove: Immed non-imperv contam Provide: Eyewash, quick drench	NIOSH ¥: SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFOV/SCBAE	Inh Abs Ing Con	Nau, vomit, abdom pain; tremor fingers; jaun, enlarged tend liver; derm; monocy; kidney damage	Eye: Irr immed Skin: Soap wash prompt Breath: Resp support Swallow: Medical attention immed	Liver, kidneys, CNS
Clothing: Repeat Goggles: Reason prob Wash: Prompt contam Change: N.R. Remove: Prompt non-imperv contam	NIOSH ¥: SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFOV/SCBAE	Inh Ing Con	Irrit eyes, nose, throat; nau; flush face, neck; verti, dizz, inco; head, som; skin eryt; liver damage; [carc]	Eye: Irr immed Skin: Soap wash prompt Breath: Resp support Swallow: Medical attention immed	Liver, kidneys, eyes, upper resp sys, CNS
Clothing: Repeat Goggles: Reason prob Wash: Prompt contam Change: N.R. Remove: Prompt non-imperv contam	NIOSH/OSHA 12.5 ppm: SA:CF[t]/PAPROV[t] 25 ppm: CCRFOV/GMFOV/SCBAF/SAF/PAPRTOV[t] 1000 ppm: SAF:PD,PP §: SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFOV/SCBAE	Inh Abs Ing	Irrit eyes, resp sys; CNS depression; liver damage	Eye: Irr immed Skin: Soap wash prompt Breath: Resp support Swallow: Medical attention immed	Skin, liver, kidneys, resp sys, CNS
Clothing: Repeat Goggles: Reason prob Wash: Prompt contam Change: N.R. Remove: Prompt non-imperv contam	NIOSH ¥: SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFOV/SCBAE	Inh Abs Ing Con	Nau, vomit, abdom pain; tremor fingers; jaun, enlarged tend liver; derm; monocy; kidney damage	Eye: Irr immed Skin: Soap wash prompt Breath: Resp support Swallow: Medical attention immed	Liver, kidneys, CNS
Clothing: Repeat Goggles: Reason prob Wash: Prompt contam Change: N.R. Remove: Prompt non-imperv contam	NIOSH ¥: SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFOV/SCBAE	Inh Ing Con	Irrit eyes, nose, throat; nau; flush face, neck; verti, dizz, inco; head, som; skin eryt; liver damage; [carc]	Eye: Irr immed Skin: Soap wash prompt Breath: Resp support Swallow: Medical attention immed	Liver, kidneys, eyes, upper resp sys, CNS
Clothing: Repeat Goggles: Reason prob Wash: Prompt contam Change: N.R. Remove: Prompt non-imperv contam	NIOSH ¥: SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFOV/SCBAE	Inh Abs Ing Con	Nau, vomit, abdom pain; tremor fingers; jaun, enlarged tend liver; derm; monocy; kidney damage	Eye: Irr immed Skin: Soap wash prompt Breath: Resp support Swallow: Medical attention immed	Liver, kidneys, CNS
Clothing: Repeat Goggles: Reason prob Wash: Prompt contam Change: N.R. Remove: Prompt non-imperv contam	NIOSH ¥: SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFOV/SCBAE	Inh Ing Con	Irrit eyes, nose, throat; nau; flush face, neck; verti, dizz, inco; head, som; skin eryt; liver damage; [carc]	Eye: Irr immed Skin: Soap wash prompt Breath: Resp support Swallow: Medical attention immed	Liver, kidneys, eyes, upper resp sys, CNS

Chemical name, structure/formula, CAS and RTECS Nos., and DOT ID and guide Nos.	Synonyms, trade names, and conversion factors	Exposure limits (TWA unless noted otherwise)	IDLH	Physical description	Chemical and physical properties: MW, BP, SOL Fl.P, IP, Sp.Gr, flammability	Chemical and physical properties: VP, FRZ UEL, LEL	Incompatibilities and reactivities	Measurement method (See Table 1)
Bromoform $CHBr_3$ '5-25-2 PB5600000 2515 58	Methyl tribromide, Tribromomethane 1 ppm = 10.51 mg/m³	NIOSH/OSHA 0.5 ppm (5 mg/m³) [skin]	Unknown	Colorless to yellow liquid with a chloroform-like odor. [Note: A solid below 47°F.]	MW: 252.8 BP: 301°F Sol: 0.1% Fl.P: NA IP: 10.48 eV Sp.Gr: 2.89 Noncombustible Liquid	VP: 5 mm FRZ: 47°F UEL: NA LEL: NA	Lithium, sodium, potassium, calcium, aluminum, zinc, magnesium, strong caustics, acetone [Note: Gradually decomposes, acquiring yellow color; air & light accelerate decomposition.]	Char; CS_2; GC/FID; III [#1003, Halogenated Hydrocarbons]
1,1,2-Trichloroethane $CHCl_2CH_2Cl$ 79-00-5 KJ3150000 2831 74	beta-Trichloroethane, Vinyl trichloride 1 ppm = 5.55 mg/m³	NIOSH Ca See Appendix A 10 ppm (45 mg/m³) [skin] OSHA 10 ppm (45 mg/m³) [skin]	Ca [500 ppm]	Colorless liquid with a sweet, chloroform-like odor.	MW: 133.4 BP: 237°F Sol: 0.4% Fl.P: NA IP: 11.00 eV Sp.Gr: 1.44 Noncombustible Liquid	VP: 19 mm FRZ: -34°F UEL: NA LEL: NA	Strong oxidizers & caustics; chemically-active metals such as aluminum, magnesium powders, sodium & potassium	Char; CS_2; GC/FID; III [#1003, Halogenated Hydrocarbons]
Trichloroethylene $ClCH{=}CCl_2$ 79-01-6 KX4550000 1710 74	Ethylene trichloride, Triclene, Trichloroethene 1 ppm = 5.46 mg/m³	NIOSH Ca See Appendix A 25 ppm OSHA 50 ppm (270 mg/m³) ST 200 ppm (1080 mg/m³)	Ca [1000 ppm]	Colorless liquid (unless dyed blue) with a chloroform-like odor.	MW: 131.4 BP: 189°F Sol(77°F): 0.1% Fl.P: 90°F IP: 9.45 eV Sp.Gr: 1.46 Class IC Flammable Liquid, but burns with difficulty.	VP: 58 mm FRZ: -99°F UEL(77°F): 10.5% LEL(77°F): 8%	Strong caustics & alkalis; chemically-active metals such as barium, lithium, sodium, magnesium, titanium & beryllium	Char; CS_2; GC/FID; III [#1022]
Clothing: Repeat Goggles: Reason prob Wash: Prompt contam Change: N.R. Remove: Prompt non-imperv contam	NIOSH ¥: SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFOV/SCBAE	Inh Abs Ing Con	Irrit nose, eyes; CNS depres; liver, kidney damage; [carc]	Eye: Irr immed Skin: Soap wash prompt Breath: Resp support Swallow: Medical attention immed	CNS, eyes, nose, liver, kidneys
Clothing: Repeat Goggles: Reason prob Wash: Prompt wet Change: N.R. Remove: Prompt non-imperv wet	NIOSH ¥: SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFOV/SCBAE	Inh Ing Con	Head, verti; vis dist, tremors, som, nau, vomit; irrit eyes; derm; card arrhy, pares; [carc]	Eye: Irr immed Skin: Soap wash prompt Breath: Resp support Swallow: Medical attention immed	Resp sys, heart, liver, kidneys, CNS, skin

TRICHLOROETHYLENE

TCL

Common Synonyms
Trichloroethylene
Triclene; Algylen
Chlorylen
Gemalgene
Trethylene
Trichloran; Trilene

Watery liquid — Colorless — Sweet odor

Sinks in water. Irritating vapor is produced.

Stop discharge if possible. Keep people away
Avoid contact with liquid and vapor.
Call fire department.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
POISONOUS GASES ARE PRODUCED IN FIRE.
Wear goggles and self-contained breathing apparatus.
Extinguish with dry chemical, carbon dioxide, or foam.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause nausea, vomiting, difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
If swallowed, will cause nausea, vomiting, difficult breathing, or loss of consciousness.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Halogenated hydrocarbon
3.2 **Formula:** $CHCl=CCl_2$
3.3 **IMO/UN Designation:** 9.0/1710
3.4 **DOT ID No.:** 1710
3.5 **CAS Registry No.:** 79-01-6

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Chloroform-like; ethereal

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Organic vapor-acid gas canister; self-contained breathing apparatus for emergencies; neoprene or vinyl gloves; chemical safety goggles; face-shield; neoprene safety shoes; neoprene suit or apron for splash protection.
5.2 **Symptoms Following Exposure:** INHALATION: symptoms range from irritation of the nose and throat to nausea, an attitude of irresponsibility, blurred vision, and finally disturbance of central nervous system resulting in cardiac failure. Chronic exposure may cause organic injury. INGESTION: symptoms similar to inhalation. SKIN: defatting action can cause dermatitis. EYES: slightly irritating sensation and lachrymation.
5.3 **Treatment of Exposure:** Do NOT administer adrenalin or epinephrine; get medical attention for all cases of overexposure. INHALATION: remove victim to fresh air; if necessary, apply artificial respiration and/or administer oxygen. INGESTION: have victim drink water and induce vomiting; repeat three times; then give 1 tablespoon epsom salts in water. EYES: flush thoroughly with water. SKIN: wash thoroughly with soap and warm water.
5.4 **Threshold Limit Value:** 50 ppm
5.5 **Short Term Inhalation Limits:** 200 ppm for 30 min.
5.6 **Toxicity by Ingestion:** Grade 3; LD_{50} = 50 to 500 mg/kg
5.7 **Late Toxicity:** Data not available
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** 50 ppm
5.11 **IDLH Value:** 1,000 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** 90°F C.C.; practically nonflammable
6.2 **Flammable Limits in Air:** 8.0%-10.5%
6.3 **Fire Extinguishing Agents:** Water fog
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Toxic and irritating gases are produced in fire situations.
6.6 **Behavior in Fire:** Not pertinent
6.7 **Ignition Temperature:** 770°F
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** Not pertinent
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 36

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 660 mg/l/40 hr/daphnia/kill/fresh water
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** Data not available
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Technical; dry cleaning; degreasing; extraction
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-X-Y

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** ORM-A
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	1
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	2
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	1

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	1
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 131.39
12.3 **Boiling Point at 1 atm:** 189°F = 87°C = 360°K
12.4 **Freezing Point:** —123.5°F = —86.4°C = 186.8°K
12.5 **Critical Temperature:** Not pertinent
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** 1.46 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 29.3 dynes/cm = 0.0293 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** 34.5 dynes/cm = 0.0345 N/m at 24°C
12.10 **Vapor (Gas) Specific Gravity:** 4.5
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.116
12.12 **Latent Heat of Vaporization:** 103 Btu/lb = 57.2 cal/g = 2.4×10^5 J/kg
12.13 **Heat of Combustion:** Not pertinent
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 2.5 psia

NOTES

TCL	TRICHLOROETHYLENE

12.17 SATURATED LIQUID DENSITY	
Temperature (degrees F)	Pounds per cubic foot
0	94.669
5	94.410
10	94.150
15	93.889
20	93.629
25	93.370
30	93.110
35	92.849
40	92.589
45	92.330
50	92.070
55	91.809
60	91.549
65	91.290
70	91.030
75	90.770
80	90.509
85	90.250
90	89.990
95	89.730
100	89.469
105	89.209
110	88.950
115	88.690
120	88.429
125	88.169

12.18 LIQUID HEAT CAPACITY	
Temperature (degrees F)	British thermal unit per pound-F
0	.220
10	.221
20	.223
30	.225
40	.226
50	.228
60	.230
70	.231
80	.233
90	.235
100	.236
110	.238
120	.240
130	.241
140	.243
150	.245
160	.246
170	.248

12.19 LIQUID THERMAL CONDUCTIVITY	
Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
	N O T P E R T I N E N T

12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Centipoise
15	.800
20	.775
25	.750
30	.727
35	.705
40	.684
45	.664
50	.645
55	.627
60	.610
65	.593
70	.577
75	.562
80	.548
85	.534
90	.521
95	.508
100	.496
105	.485
110	.474
115	.463
120	.453

12.21 SOLUBILITY IN WATER	
Temperature (degrees F)	Pounds per 100 pounds of water
77.02	.110

12.22 SATURATED VAPOR PRESSURE	
Temperature (degrees F)	Pounds per square inch
40	.508
50	.678
60	.894
70	1.166
80	1.507
90	1.929
100	2.448
110	3.081
120	3.846
130	4.765
140	5.862
150	7.163
160	8.695
170	10.490
180	12.580
190	15.010
200	17.810
210	21.020

12.23 SATURATED VAPOR DENSITY	
Temperature (degrees F)	Pounds per cubic foot
40	.01245
50	.01628
60	.02105
70	.02695
80	.03418
90	.04296
100	.05354
110	.06619
120	.08120
130	.09891
140	.11960
150	.14380
160	.17180
170	.20390
180	.24080
190	.28280
200	.33040
210	.38420

12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	British thermal unit per pound-F
0	.136
25	.139
50	.143
75	.146
100	.149
125	.152
150	.155
175	.157
200	.160
225	.162
250	.165
275	.167
300	.169
325	.172
350	.174
375	.176
400	.177
425	.179
450	.181
475	.182
500	.184
525	.185
550	.186
575	.187
600	.188

ETHYLENE DICHLORIDE

EDC

Common Synonyms

1, 2-Dichloroethane
Ethylene chloride
EDC
Brocide
Dutch liquid
Glycol dichloride

Liquid — Colorless — Sweet odor

Sinks in water. Flammable, irritating vapor is produced.

Avoid contact with liquid and vapor. Keep people away.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Shut off ignition sources and call fire department.
Stop discharge if possible.
Stay upwind and use water spray to "knock down" vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
POISONOUS GASES ARE PRODUCED IN FIRE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Extinguish with dry chemical, foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause nausea, dizziness or difficult breathing.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Will burn skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

Dangerous to aquatic life in high concentrations.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Disperse and flush

2. LABEL

2.1 **Category:** Flammable liquid
2.2 **Class:** 3

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Halogenated hydrocarbon
3.2 **Formula:** $ClCH_2CH_2Cl$
3.3 **IMO/UN Designation:** 3.2/1184
3.4 **DOT ID No.:** 1184
3.5 **CAS Registry No.:** 107-06-2

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Ethereal; chloroform-like; ether-like

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Clean, body-covering clothing and safety glasses with side shields. Respiratory protection: up to 50 ppm, none; 50 ppm to 2%, 1/2 hr or less, full face mask and canister; greater than 2%, self-contained breathing apparatus.
5.2 **Symptoms Following Exposure:** Inhalation of vapors causes nausea, drunkenness, depression. Contact of liquid with eyes may produce corneal injury. Prolonged contact with skin may cause a burn.
5.3 **Treatment of Exposure:** INHALATION: if victim is overcome, remove him to fresh air, keep him quiet and warm, and get medical attention immediately; if breathing stops, give artificial respiration. INGESTION: induce vomiting; call a physician; treat the symptoms. EYES: flush immediately with copious amounts of flowing water for at least 15 min. SKIN: remove clothing and wash skin thoroughly with soap and water; wash contaminated clothing before reuse.
5.4 **Threshold Limit Value:** 10 ppm
5.5 **Short Term Inhalation Limits:** 200 ppm for 5 min. during any 3-hour period.
5.6 **Toxicity by Ingestion:** Grade 2; LD_{50} = 0.5 to 5 g/kg (rat)
5.7 **Late Toxicity:** Data not available
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Causes smarting of the skin and first-degree burns on short exposure; may cause secondary burns on long exposure.
5.10 **Odor Threshold:** 100 ppm
5.11 **IDLH Value:** 1,000 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** 60°F O.C.; 55°F C.C.
6.2 **Flammable Limits in Air:** 6.2%-15.6%
6.3 **Fire Extinguishing Agents:** Foam, carbon dioxide, dry chemical
6.4 **Fire Extinguishing Agents Not to be Used:** Water may be ineffective.
6.5 **Special Hazards of Combustion Products:** Toxic and irritating gases (hydrogen chloride, phosgene) are generated.
6.6 **Behavior in Fire:** Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back.
6.7 **Ignition Temperature:** 775°F
6.8 **Electrical Hazard:** Class I, group D
6.9 **Burning Rate:** 1.6 mm/min
6.10 **Adiabatic Flame Temperature:** Data Not Available

(Continued)

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data Not Available
7.8 **Reactivity Group:** 36

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 150 ppm/*/pin perch/TL_m/salt water
*Time period not specified.
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** 0.002 lb/lb, 5 days
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Commercial
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-X

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Flammable liquid
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	3
Health	
Vapor Irritant	2
Liquid or Solid Irritant	2
Poisons	3
Water Pollution	
Human Toxicity	3
Aquatic Toxicity	2
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	1

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 98.96
12.3 **Boiling Point at 1 atm:** 182.3°F = 83.5°C = 356.7°K
12.4 **Freezing Point:** −32.3°F = −35.7°C = 237.5°K
12.5 **Critical Temperature:** 550°F = 288°C = 561°K
12.6 **Critical Pressure:** 735 psia = 50 atm = 5.1 MN/m^2
12.7 **Specific Gravity:** 1.253 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 32.2 dynes/cm = 0.0322 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** (est.) 30 dynes/cm = 0.03 N/m at 25°C
12.10 **Vapor (Gas) Specific Gravity:** 3.4
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.118
12.12 **Latent Heat of Vaporization:** 138 Btu/lb = 76.4 cal/g = 3.2×10^5 J/kg
12.13 **Heat of Combustion:** (est.) 3400 Btu/lb
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** 21.12 cal/g
12.26 **Limiting Value:** Data Not Available
12.27 **Reid Vapor Pressure:** 2.7 psia

6. FIRE HAZARDS (Continued)

6.11 **Stoichiometric Air to Fuel Ratio:** Data Not Available
6.12 **Flame Temperature:** Data Not Available

EDC — ETHYLENE DICHLORIDE

12.17 SATURATED LIQUID DENSITY	
Temperature (degrees F)	Pounds per cubic foot
35	79.879
40	79.629
45	79.379
50	79.129
55	78.879
60	78.620
65	78.370
70	78.120
75	77.860
80	77.599
85	77.349
90	77.089
95	76.830
100	76.570
105	76.309
110	76.049
115	75.790
120	75.520
125	75.259
130	74.990
135	74.730
140	74.459
145	74.190
150	73.919
155	73.660
160	73.379

12.18 LIQUID HEAT CAPACITY	
Temperature (degrees F)	British thermal unit per pound-F
0	.283
10	.285
20	.288
30	.290
40	.293
50	.296
60	.298
70	.301
80	.303
90	.306
100	.309
110	.311
120	.314
130	.317
140	.319
150	.322
160	.324
170	.327

12.19 LIQUID THERMAL CONDUCTIVITY	
Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
0	.990
10	.982
20	.974
30	.965
40	.957
50	.949
60	.941
70	.933
80	.924
90	.916
100	.908
110	.900
120	.892
130	.883
140	.875
150	.867
160	.859
170	.850

12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Centipoise
35	1.098
40	1.054
45	1.013
50	.975
55	.938
60	.904
65	.871
70	.840
75	.811
80	.784
85	.758
90	.733
95	.709
100	.687
105	.665
110	.645
115	.625
120	.607
125	.589
130	.573
135	.556
140	.541
145	.526
150	.512
155	.499
160	.486

12.21 SOLUBILITY IN WATER	
Temperature (degrees F)	Pounds per 100 pounds of water
68.02	.800

12.22 SATURATED VAPOR PRESSURE	
Temperature (degrees F)	Pounds per square inch
15	.231
20	.274
25	.323
30	.380
35	.445
40	.520
45	.606
50	.704
55	.816
60	.942
65	1.085
70	1.246
75	1.428
80	1.632
85	1.860
90	2.116
95	2.401
100	2.718

12.23 SATURATED VAPOR DENSITY	
Temperature (degrees F)	Pounds per cubic foot
15	.00449
20	.00526
25	.00614
30	.00715
35	.00830
40	.00960
45	.01108
50	.01274
55	.01461
60	.01671
65	.01907
70	.02169
75	.02462
80	.02788
85	.03149
90	.03548
95	.03990
100	.04477

12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	British thermal unit per pound-F
0	.177
25	.182
50	.187
75	.191
100	.195
125	.200
150	.204
175	.208
200	.212
225	.217
250	.221
275	.225
300	.229
325	.232
350	.236
375	.240
400	.244
425	.247
450	.251
475	.254
500	.258
525	.261
550	.265
575	.268
600	.271

TETRACHLOROETHYLENE

TTE

Common Synonyms

Tetracap
Perclene
Perchloroethylene
Perk

Watery liquid — Colorless — Sweet odor

Sinks in water. Irritating vapor is produced.

Stop discharge if possible
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Not flammable.
Poisonous gases are produced when heated.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Not listed
3.2 **Formula:** $Cl_2C{=}CCl_2$
3.3 **IMO/UN Designation:** 9.0/1897
3.4 **DOT ID No.:** 1897
3.5 **CAS Registry No.:** 127-18-4

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Ethereal; like chloroform; mildly sweet

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** For high vapor concentrations use approved canister or air-supplied mask; chemical goggles or face shield, plastic gloves.
5.2 **Symptoms Following Exposure:** Vapor can affect central nervous system and cause anesthesia. Liquid may irritate skin after prolonged contact. May irritate eyes but causes no injury.
5.3 **Treatment of Exposure:** INHALATION: if illness occurs, remove patient to fresh air, keep him warm and quiet, and get medical attention. INGESTION: induce vomiting only on physician's recommendation. EYES AND SKIN: flush with plenty of water and get medical attention if irritation or injury occurs.
5.4 **Threshold Limit Value:** 50 ppm
5.5 **Short Term Inhalation Limits:** 100 ppm for 60 min.
5.6 **Toxicity by Ingestion:** Grade 2; LD_{50} = 0.5 to 5 g/kg
5.7 **Late Toxicity:** None
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause a slight smarting of the eyes or throat if present in high concentrations. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** 5 ppm
5.11 **IDLH Value:** 500 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** Not flammable
6.2 **Flammable Limits in Air:** Not flammable
6.3 **Fire Extinguishing Agents:** Not pertinent
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Toxic, irritating gases may be generated in fires.
6.6 **Behavior in Fire:** Not pertinent
6.7 **Ignition Temperature:** Not flammable
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** Not flammable
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** Data not available

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** Data not available
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** None
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Dry cleaning and industrial grades: 95+%
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-X

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** ORM-A
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	0
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	1

11.3 **NFPA Hazard Classification:** Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 165.83
12.3 **Boiling Point at 1 atm:** 250°F = 121°C = 394°K
12.4 **Freezing Point:** −6.3°F = −22.4°C = 250.8°K
12.5 **Critical Temperature:** 657°F = 347°C = 620°K
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** 1.63 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 31.3 dynes/cm = 0.0313 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** 44.4 dynes/cm = 0.0444 N/m at 25°C
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.116
12.12 **Latent Heat of Vaporization:** 90.2 Btu/lb = 50.1 cal/g = 2.10×10^5 J/kg
12.13 **Heat of Combustion:** Not pertinent
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

NOTES

TTE	TETRACHLOROETHYLENE

12.17 SATURATED LIQUID DENSITY	
Temperature (degrees F)	Pounds per cubic foot
35	103.400
40	103.099
45	102.900
50	102.599
55	102.299
60	102.000
65	101.700
70	101.400
75	101.099
80	100.799
85	100.500
90	100.200
95	99.910
100	99.610
105	99.320
110	99.020
115	98.730
120	98.429
125	98.139
130	97.839
135	97.549
140	97.250
145	96.959
150	96.669
155	96.370
160	96.080

12.18 LIQUID HEAT CAPACITY	
Temperature (degrees F)	British thermal unit per pound-F
0	.198
10	.200
20	.201
30	.202
40	.203
50	.204
60	.205
70	.206
80	.207
90	.208
100	.210
110	.211
120	.212
130	.213
140	.214
150	.215
160	.216
170	.217
180	.218
190	.220
200	.221
210	.222

12.19 LIQUID THERMAL CONDUCTIVITY	
Temperature (degrees F)	British thermal unit-inch per hour-square foot-F
	N O T P E R T I N E N T

12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Centipoise
55	.958
60	.929
65	.900
70	.873
75	.848
80	.823
85	.800
90	.777
95	.756
100	.736
105	.716
110	.698
115	.680
120	.663
125	.647
130	.631
135	.616
140	.601
145	.588
150	.574
155	.561
160	.549
165	.537
170	.526
175	.515

12.21 SOLUBILITY IN WATER	
Temperature (degrees F)	Pounds per 100 pounds of water
68.02	.016

12.22 SATURATED VAPOR PRESSURE	
Temperature (degrees F)	Pounds per square inch
60	.236
70	.318
80	.425
90	.561
100	.732
110	.948
120	1.217
130	1.548
140	1.953
150	2.446
160	3.042
170	3.756
180	4.607
190	5.616
200	6.805
210	8.199
220	9.824
230	11.710
240	13.890
250	16.390
260	19.260
270	22.520
280	26.230

12.23 SATURATED VAPOR DENSITY	
Temperature (degrees F)	Pounds per cubic foot
60	.00702
70	.00929
80	.01216
90	.01575
100	.02022
110	.02571
120	.03242
130	.04055
140	.05032
150	.06199
160	.07583
170	.09215
180	.11130
190	.13360
200	.15940
210	.18910
220	.22330
230	.26230
240	.30660
250	.35680
260	.41330
270	.47680
280	.54790

12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	British thermal unit per pound-F
0	.108
25	.110
50	.113
75	.116
100	.118
125	.120
150	.122
175	.125
200	.127
225	.129
250	.131
275	.132
300	.134
325	.136
350	.138
375	.139
400	.141
425	.142
450	.143
475	.144
500	.146
525	.147
550	.148
575	.148
600	.149

APPENDIX D

DIRECTORATE OF SAFETY, HEALTH & ENVIRONMENT
ABERDEEN PROVING GROUND, MARYLAND

STANDING OPERATING PROCEDURE

June 1990

Safety

WELL DRILLING PROCEDURE FOR SOIL SAMPLING IN POTENTIALLY CONTAMINATED AREAS OF THE EDGEWOOD AREA

1. PURPOSE. To establish safe procedures to be employed while conducting well drilling and soil sampling in the Aberdeen Proving Ground - Edgewood Area (AE) which may contain unexploded ordnance (UXO), which may be contaminated with toxic chemical agents or other toxic compounds, and radionuclides.

2. APPLICABILITY. This procedure applies to all personnel, military or civilian, working at or visiting the drill sites. No deviation from this SOP will be permitted. When the approved method can be improved upon, the SOP will be revised.

3. COMMAND AND CONTROL. During all on-site well drilling procedures outlined in the SOP, Technical Escort Unit (TEU) will have complete control over all field operations and all participating personnel.

4. RESPONSIBILITIES.

a. The Commander, TEU or his designated representative will be responsible for:

(1) The overall safety of personnel and equipment at the drill site. Any problems regarding the safety of operations will be resolved by the Commander or the designated representative.

(2) Providing training for geology and drill rig crews in the use and care of Toxicological Agent Protective (TAP) clothing.

(3) Scheduling 24 hours in advance with Chief, Resource Coordination Office, U.S. Army Combat Systems Testing Activity (USACSTA), the intent to conduct operations at the EA.

(4) Prior to the start of each day's operations, conduct a communication check between TEU (Tech Operations) and with Range Central Operator (USACSTA), to ensure communications between TEU operations and Range Central; also confirm the availability of

patrol boats if required.

(5) Determining on a daily basis the go. no-go. of the operation based on existing wind and weather conditions.

(6) Establishing safe locations for a Class B bomb-proof shelter(s) (200 feet based on 155 mm high explosive (HE) rounds. Note that if a 155 mm round must be detonated at the surface, the UXO must be surrounded with sandbags prior to detonation as an extra safety precaution.) Location of the shelter(s) will be based on wind direction and weather conditions for each well hole to be drilled.

(7) Establishing the fragmentation radius and maximum credible event (MCE) based on the type of munition suspected to be encountered. (Based on most recent knowledge of the area the fragmentation radius is 1000 meters based on 155 mm HE filled round.) In the case of toxic chemical agents, the distance will be calculated using the 155 mm GB filled projectile as the maximum.

(8) Assuring the fragmentation radius is cleared of unauthorized personnel and the area access road or gate is barricaded or secured.

(9) Providing Explosive Ordnance Disposal (EOD) support as required.

(10) Providing two (2) unit personnel to set-up and operate bubblers used for monitoring for agent. Bubblers will be provided by CRDEC. In addition, testing of soil samples and drill cuttings for agent contamination using a M18A2 detector kit.

(11) Monitoring soil samples and drill cuttings for agent contamination.

(12) Providing training for geology and drilling crews in the recognition of UXO and recognition of agent exposure symptoms and in initial first aid for such exposure.

(13) Determining an emergency upwind evacuation assembly area in the event of a chemical agent release.

(14) Setting up a "hotline" at predetermined distance from the drill site.

(15) Transporting and setup of a portable shower facility at the hotline.

(16) Decontaminating any equipment which becomes contaminated and marking with degree of decontamination.

(17) When required, request from CSTA use of the observation patrol boats to clear and control that portion of the zone estab-

APPENDIX B

QUALITY ASSURANCE PROJECT PLAN

MGBG DRAFP QAPjP

IN5 170 023 498
AUGUST 1991

Draft
Quality Assurance Project Plan
for the RCRA Facility Investigation
Phase II Soils and Phase II Groundwater
at the Mustard Gas Burial Ground NWSCC,
Martin County, Indiana

Prepared for Northern Division,
Naval Facilities Engineering Command
Environmental Division, Code 1421

Prepared by Robert Magee
Wilmington Engineering District
US Army Corps of Engineers
Wilmington, N.C.

Date:

Approvals: _____ Date _____
Carol Witt-Smith
Corrective Action Expert

_____ Date _____
Director, Central Region Laboratory

_____ Date _____
Regional QA Manager

MGBG DRAFP QAPjP

IN5 170 023 498
AUGUST 1991

ELEMENT 1

QUALITY ASSURANCE PROJECT PLANS FOR RCRA FACILITY INVESTIGATION (RFI) AT THE MUSTARD GAS BURIAL GROUND SOLID WASTE MANAGEMENT UNIT 01/12 NAVAL WEAPONS SUPPORT CENTER, CRANE, INDIANA

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ELEMENT 16 : QUALITY ASSURANCE REPORT 27

ELEMENT 3

PROJECT DESCRIPTION

Introduction. At the Mustard Gas Burial Grounds (MGBG) a wide variety of wastes were buried. Some of these materials present special (chemical weapons and radioactive materials) hazards. The MGBG was identified as a Solid Waste Management Unit (SWMU). Phase II release assessments must be performed at MGBG.

Background. To fulfill the Corrective Action Requirements of the Federal Portion of the Final RCRA/HSWA Part B Permit, Naval Weapons Support Center (NWSC), Crane, Indiana will be conducting a RCRA Facility Investigation (RFI) at the Mustard Gas Burial Grounds (MGBG). The US Army Corps of Engineers' (USACE), Waterways Experiment Station (USACEWES) will be conducting the study.

The Mustard Gas Burial Grounds was established in the late 1940's or early 1950's. Quantities of radioactive waste material (Thorium Nitrate) and chemical weapons were buried at the site in the mid 1950's. Evidence is inconclusive as to the total amount and types of material which were disposed at the site. Three hazards are considered to have existed at the site. These hazards include chemical weapons, radioactive material, and waste chemicals.

An effort was made to exhume the weapons in 1974. During the excavation effort, Mustard Gas bombs and Thorium Nitrate were uncovered. Three uncovered weapons contained chemical agents. The effort was halted at that point. The bombs and radioactive materials were secured and placed in a nearby bunker. Later the radioactive material, seven 55-gallon drums of soil, Thorium Nitrate, and debris, removed during the excavation effort, were taken to a disposal site in Barnwell, South Carolina. A second clean up effort was started in 1980. Additional possible burial sites were located. The original 10 bombs were disposed of. Additional anomalies were investigated. Six additional empty bombs and some quantity of Thorium Nitrate debris were found and processed. The other anomalies were determined to be benign. The drums of contaminated soil left at the site after the 1973 effort were removed from the site. The contaminated soil from the spoil piles and the excavation pit walls was removed and placed in drums. All waste was sent to approved facilities. A program was put in place to certify the site free of chemical agent and radioactive material.

A groundwater monitoring effort was started in 1981. Chemical contamination was detected (Figure 1). A north-northwest trending contaminated groundwater plume was detected. The detected groundwater pollutants are: 1,2-Dichloroethane, 1,2-Dichloroethene, 1,1,2-Trichlorethane, 1,1,1-Trichlorethane, 1,1,2,2-Tetrachloroethylene, Bromoform, Dibromochloromethane, Tetrachloroethene, Trichloroethene, Trichloroethylene. No groundwater monitoring has occurred at the site since 1986. The source of the chemical contamination is unknown.

Site Setting. NWSCC is a Navy facility located in Martin County Indiana. NWSCC covers approximately 62,463 acres (Figure 2). The Mustard Gas Burial Grounds occupies approximately 2 acres. The area is in a remote portion of the facility. MGBG is located in the section 24, T4N, R4W. This area is located on a ridge crest in a heavily forested portion of the facility. The countryside around this part of the facility is rural in nature with few private residences. The site is fenced and marked with signs which explain the site's hazards. The soil is thin (2' to 12') and is classed as mostly a clay or sandy clay. The underlying rocks are sedimentary sand- stones and shales of the Pennsylvanian Age. The superficial and upper bedrock aquifer form one groundwater system.

Target Compounds. The groundwater and soil samples will be analyzed for the presence of organic and inorganic compounds. Chemical analysis will be done using SW-846 analytical methods, or other accepted methods when no SW-846 method is available. The contamination detected in the groundwater is principally chlorinated solvent compounds. The other possible contaminants are metals and Thorium nitrate. EPA methods 8240 and 8270 analysis will be run to detect the organic contamination. Analytical routines for Appendix IX metals will be run to detect presence of any toxic metal contaminants. In an attempted to establish monitoring parameters tests for Total Organic Halgens, Total Chloride, and Conductance will be run on the groundwater samples.

Project Objective. This is a RFI Phase II soils and groundwater study. The intent of the project is to provide data of sufficient quality to support Corrective Action decisions. The QAPjP was prepared in accordnace with the USEPA Region V guidance on preparing the 16 element QAPjP. The chemical analyte data must meet NEESA Level C (EPA Level 4 equivalent) specifications. This will be accomplished by judiciously selecting sample locations, selecting the appropriate analytes, and using proper analytical methods.

Sample Network and Rationale. Refer to Section 3.0 Sample and Analysis Plan, of the Work Plan for further discussion and rationale.

Project Schedule. Refer to Diagram 2.3.2.

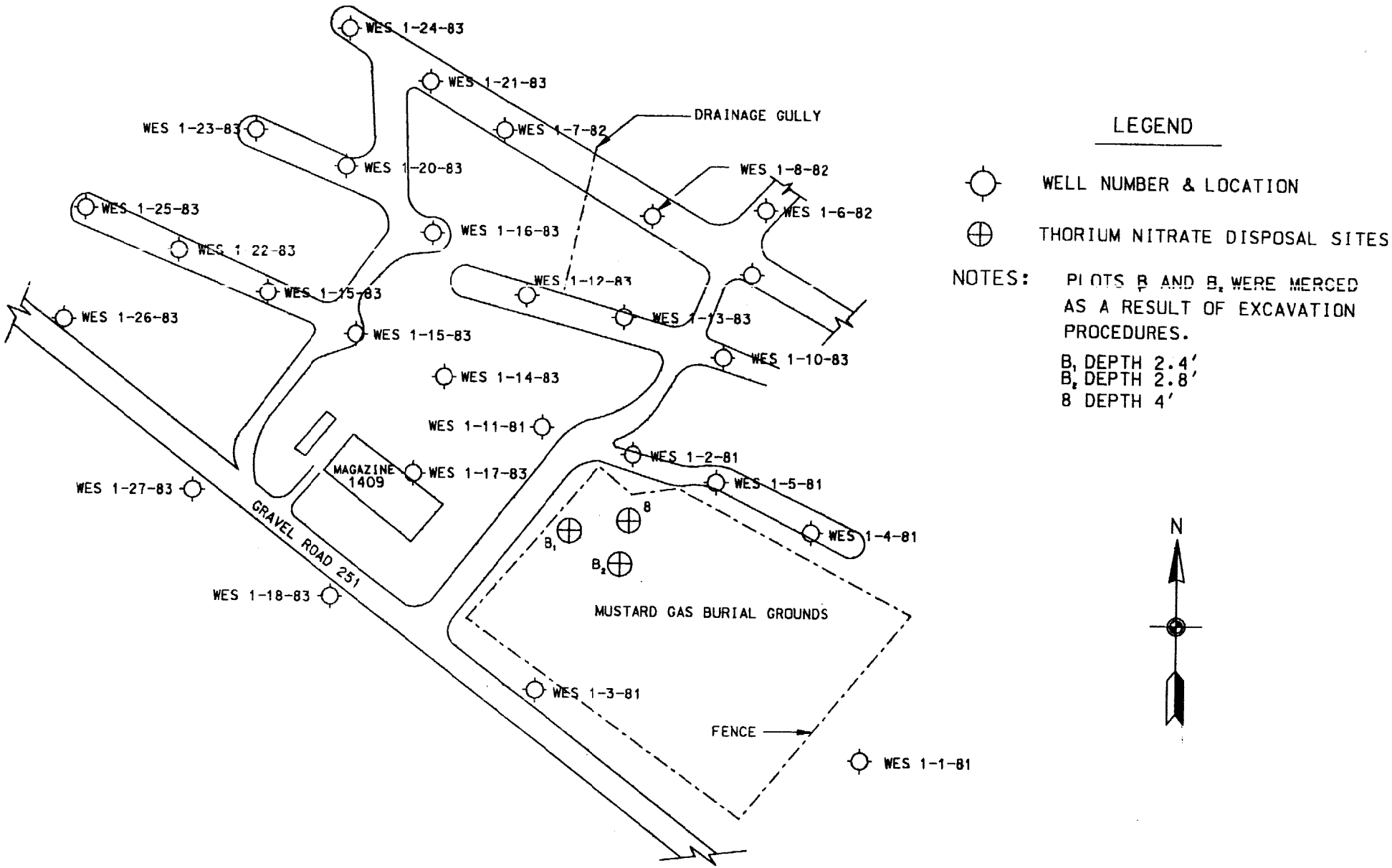


FIGURE 1 MUSTARD GAS BURIAL GROUND BORING LOCATIONS

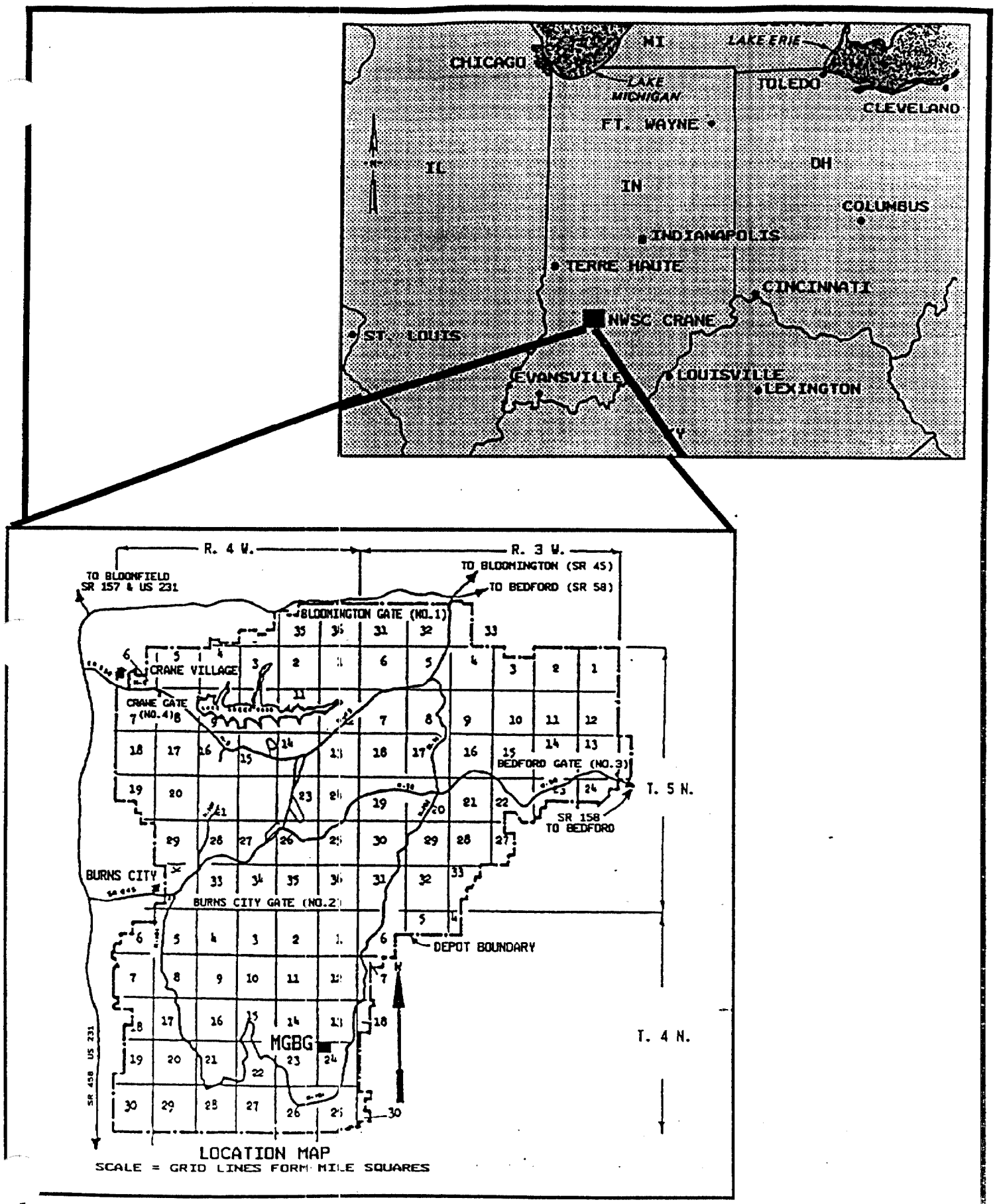


Figure 2 Location Map showing the location of NWSCC and the MGBG Site.

ELEMENT 4

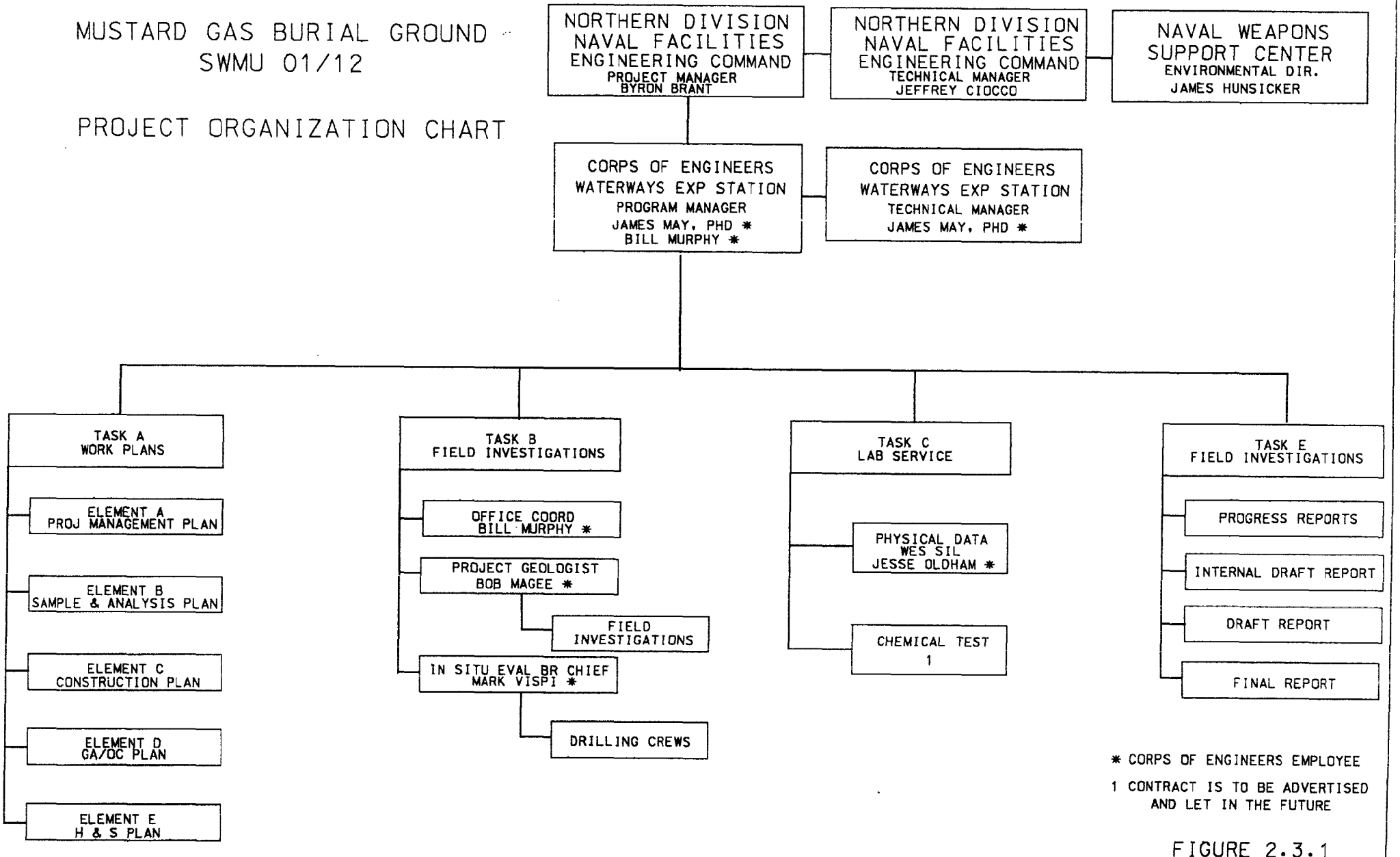
PROJECT ORGANIZATION

Management Responsibilities. U.S.Army Corps of Engineers Waterways Experiment Station (USCEWES) is the Navy's prime contractor for this RCRA investigation. The project team is made up of United States Army Corps of Engineers (USACE) personnel (Diagram 2.3.1). Oversight and management responsibility will be handled by Dr. James May and William Murphy of USACEWES' Geotechnical Section. The planning, scope writing, and report preparation is the responsibility of Robert Magee of USACE Engineering District, Wilmington, N.C. and Dr. James May of USACEWES' Geotechnical Section. Field work supervision will be the responsibility of Robert Magee of USACE Engineering District, Wilmington, N.C.. Drilling will be done by personnel from the In situ Section, Geotechnical Branch of USACEWES. Mr. Mark Vispi is the Section Chief. The chemical analysis is to be processed through the USACEWES' Analytical Laboratory Group (ALG) under the supervision of Ann Strong. All chemical data validation will be done by Blaze Willis of USACE Engineering District, Savannah, Ga.. Soils classification and physical testing will be done at USACEWES' Soils Investigation Laboratory under the supervision of Mr. Jesse Oldham.

RCRA FACILITY INVESTIGATION
PHASE II SOILS & GROUNDWATER

MUSTARD GAS BURIAL GROUND
SWMU 01/12

PROJECT ORGANIZATION CHART



* CORPS OF ENGINEERS EMPLOYEE

1 CONTRACT IS TO BE ADVERTISED AND LET IN THE FUTURE

FIGURE 2.3.1

ELEMENT 5

QUALITY ASSESSMENT OBJECTIVES

QC Level Selection. The field QC NEESA Level is a Level B. The QC level for the chemical detection is a NEESA Level C., EPA Level 4 equivalent. The objective of such a plan is to insure that the data collected is comparable with known conditions, the sources of extraneous contamination can be determined, and the decisions made are meaningful and supported.

A site requiring Level C QC would be a site near a populated area, not on the NPL, and not likely to be undergoing litigation. The Level C QC includes review and approval of laboratory QA and the site work plan. The laboratory must successfully analyze a performance sample, undergo an audit, correct deficiencies found during the audit, and provide monthly progress reports on QA. ALG has been approved by the Navy's laboratory audit system to do this work.

Level C allows the use of non-CLP methods. All methods used must be EPA methods or be equivalent to EPA methods. When EPA methods are not available other documented methods may be used.

Level C provides for the minimum detection limits, a wide range of calibrated analytes, matrix recovery information, laboratory process control information, and known precision and accuracy. Level C data may be used for risk assessment, site characterization, evaluation of alternatives, engineering design, and monitoring during implementation.

Chemical Data Quality Objectives The Navy's Level C requires that certain procedures be followed. They are:

1. EPA approved methods (SW-846 Third Edition), when available, be used.

2. Trip blanks must accompany every volatile organic analysis shipment.

3. Rinsate blanks be collected each day.

4. Field blanks be collected from each source of water.

5. A 10% duplication of samples be taken.

TABLE 1
CHEMICAL ANALYSIS
PRESERVATION AND HOLDING TIMES

MATRIX	PARAMETERS	PRESERVATION	MAX. HOLDING TIMES	
			EXTRACTION	ANALYSIS
Soil	Volatiles	Ice to 4 Deg.		14 d.
Soil	Semivolatiles	Ice to 4 Deg.	7 d.	40 d.
Soil	Metals except Hg	Ice to 4 Deg.	180 d.	
Soil	Mercury	Ice to 4 Deg.		28 d.
Water	Volatiles	Ice to 4 Deg.		14 d.
Water	Semivolatiles	Ice to 4 Deg.	7 d.	40 d.
Water	Metals except Hg	HNO_3 to pH<2.	180 d.	
Water	Mercury	HNO_3 to pH<2.		28 d.
Water	Chloride	None Required		28 d.
Water	Total Organic Halide	Ice to 4 Deg., H_2SO_4 to pH<2		14 d.
Water	Specific Conductance	Ice to 4 Deg.		28 d.

When only analysis holding time is given, this implies total holding time from sampling until analysis.

The validity of the data depend on the following of specific procedural constraints. Holding times are dictated by SW-846 procedures. Those holding times are parameter specific (Table 1). They are to be adhered to specifically to assure the quality of the analytical data.

ELEMENT 6

SAMPLE PROCEDURE

REFER TO WORK PLAN SECTION 3.0 ELEMENT B: SAMPLE & ANALYSIS PLAN

ELEMENT 7

SAMPLE CUSTODY PROCEDURES

Field Procedures. The field sampler is personally responsible for the care and custody of the samples until they are transferred or properly dispatched. All bottles must be labeled with management stickers and seals. Sample labels are to be completed using waterproof ink. The project manager will review all field activity to determine whether proper custody procedures are being followed. Sample information is to be recorded in the Field Logbook. This information should include measurements made, sample numbers, numbers of samples, sampled depths, boring and well numbers sampled, analysis requested, packing procedures, and date shipped.

Transfer of Custody. Samples are to be accompanied by a properly completed chain of custody form identifying the contents (Figure 4). One copy of the chain of custody is kept at the site, one copy of the chain of custody is sent to the project manager, and the original copy will travel with the samples. The sample numbers and locations will be listed on the chain of custody form. Each cooler of samples will be accompanied by a signed chain of custody. A commercial carrier is not required to sign off on the custody form as long as the custody forms are sealed inside the sample cooler and the custody seals remain intact. The sample custody is transferred from the sampler to the laboratory at the time when the ice chest containing the chain of custody is sealed. The laboratory assumes custody of the samples when the cooler is received in the laboratory and the seals are broken. Samples will not be accepted by the laboratory if the seals are not intact when received.

With the receipt of the chain-of-custody samples the samples are recorded in a permanent receipt book. Upon receipt at the laboratory, the sample management officer fills out a cooler receipt form (Figure 5). The sample collector or project manager is notified of any discrepancies noted on the cooler receipt form .

If samples are received from a commercial carrier, Form 2097 is filled out by the sample management officer. The ALG uses preprinted consecutively numbered duplicate gummed labels to identify samples. One label is placed on the sample bottle and the other label is placed on Form 2097 under the heading Lab I.D. No. next to the corresponding Project I.D. No. This information is also entered into a permanent log book, WES Form 2108. The estimated cost is calculated, entered onto the Sample Receipt Form 2118, and the original copy returned to the Project Manager.

All samples except volatiles are stored in the locked walk-in cooler which is maintained at 4 degrees Celsius and equipped with an alarm system that goes off when the temperature deviates by more than two degrees. A separate refrigerator is maintained for volatile analysis and temperatures are recorded in a refrigerator log. Two ALG employees have keys to the cooler and a permanent log is maintained to check chain-of-custody samples in and out of the cooler for analysis. The analyst is required to keep chain-of-custody samples behind locked doors if he is away from the area where analyses are in progress.

The sample management officer then enters the information into the ALG computer data management system. Job files are created for use by the analysts in recording their data.

FINAL EVIDENCE FILES: All data generated (raw and final) are kept at the laboratory on permanent file. This data is kept in digital format. It can be retrieved and duplicated upon request.

U.S. Army Corps of Engineers

Chain of Custody Record

(ER 1110-1-263)

Proj. No.	Project Name														
Sampler : (Signature)															
Date	Time	Pres.	Grab	Comp	Site Code/Sample Number	Number of Containers									Remarks:

Sampler Relinquished by:	Date/Time	Received by: (Sig.)	Date/Time	Hazards Associated with Samples
Relinquished by: (Sig.)	Date/Time	Received by: (Sig.)	Date/Time	
Relinquished by: (Sig)	Date/Time	Received for Laboratory by: (Sig.)	Date/Time	Remarks at time of receipt:
Custody Seal No.		Lab case No.:		

ENG Form 5021-R, Oct 90

Proponent: CEMP-RT

Figure 5

COOLER RECEIPT FORM
PROJECT:
Cooler received on and opened on by
Signature

1. Were custody seals on outside of cooler----------YES NO
   If yes, how many and where?
   Were signature and date correct?----------YES NO

2. Were custody papers taped to lid inside cooler--------YES NO

3. Were custody papers properly filled out(ink, signed)--YES NO

4. Did you sign custody papers in the appropriate place? YES NO

5. What kind of packing material was used?

6. Was sufficient ice used(if appropriate)----------YES NO

7. Were all bottles sealed in separate plastic bags?------YES NO

8. Did all bottles arrive in good condition(unbroken)?----YES NO

9. Were all bottle labels complete(date, signed, anal., preserv. etc.)? ----------YES NO
10. Did bottle labels and tags agree with custody papers? YES NO
11. Were correct bottles used for tests indicated?---------YES NO
12. Were VOA vials checked for absence of bubbles?---------YES NO
13. Did each bottle contain sufficient sample?----------YES NO
14. Were acid/base preserved samples checked with pH paper? YES NO

Explain any discrepancies------->

ELEMENT 8

CALIBRATION PROCEDURES

Field. Several field methods are to be used as scanning and detection tools. The scanning field instruments are the HNU, the OVA, and the geiger counter device. All of these instruments will be calibrated by a qualified repair representative prior to being used. The instruments calibration will be checked daily using instrument specific procedures prior to the start of the work effort for that day. These daily instrument checks will be recorded by the site manager in the site logbook.

For the geophysical devices there are no specific calibrations needed. These devices record relative data and are not calibration specific. Site specific adjustments may be necessary and they will be accomplished "on-site". Any adjustments will be recorded by the Site Manager in the site logbook.

Laboratory. All analytical methods require calibration. In keeping with method calibration requirements, the following requirements are presented. For all semivolatile and volatile analysis by GC/MS, the current CLP calibration method shall be used. The current CLP criteria shall be used for frequency of calibration, for the system performance check compounds (SPCCs), and for the calibration check compounds (CCCs).

For other methods, a minimum of three different concentration standards for each analyte shall be analyzed for initial calibration. Calibration shall be checked every 12h. of operation and prior to sample analysis. The laboratory shall use the calibration check acceptance criteria specified by the methods. The initial calibration curve shall be plotted and the correlation coefficient and response factors evaluated. The calibration shall include one standard at a concentration at the method detection limits. The calibration curve shall bracket all samples in the concentration range. If the samples are not within the 3 calibration ranges, appropriate dilution shall be performed to bring the samples into the calibration range.

ELEMENT 9

ANALYTICAL PROCEDURES

RCRA studies adhere to procedures and methods set out in "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods" SW-846, Third Edition when available. Organic and inorganic test methods are given in Tables 2.

TABLE 2
LIST OF PARAMETERS
AND SUMMARY OF METHODS
from SW-846

METAL ANALYSIS	TECHNIQUE*	EXTRACTION**	ANALYSIS
Aluminum	ICP	3050 S 3005 W	6010
Antimony	ICP	3050 S 3005 W	6010
Arsenic	GF	3050 S 3005 W	7060
Barium	ICP	3050 S 3005 W	6010
Beryllium	ICP	3050 S 3005 W	6010
Cadmium	ICP	3050 S 3005 W	6010
Calcium	ICP	3050 S 3005 W	6010
Chromium	ICP	3050 S 3005 W	6010
Copper	ICP	3050 S 3005 W	6010
Iron	ICP	3050 S 3005 W	6010
Lead	ICP	3050 S 3005 W	6010
Magnesium	ICP	3050 S 3005 W	6010
Manganese	ICP	3050 S 3005 W	6010
Mercury	CV		7471
Nickel	ICP	3050 S 3005 W	6010
Potassium	ICP	3050 S 3005 W	6010
Selenium	CF	3050 S 3005 W	7740
Silver	ICP	3050 S 3005 W	6010
Sodium	ICP	3050 S 3005 W	6010
Thallium	ICP	3050 S 3005 W	6010
Vanadium	ICP	3050 S 3005 W	6010
Zinc	ICP	3050 S 3005 W	6010
Thorium	SC	NO EPA METHODOLOGY	
Chloride	CO1		9250
Specific Conductance		N/A	9050
ORGANIC ANALYSIS			
Volatiles	GC/MS		8240
Semivolatiles	GC/MS	3540/3550/S	8270
Total Organic Halide	Mt		9220
Mustard Agent	GLC		CRDEC

* Abbreviations: GF = Graphite Furnace, CV = Cold Vapor, Mt = Microcoulometric-titration, SC = Scintillation Counter, Col = Colorimetric, ICP = Inductively Coupled Plasma, GCL = Gas-Liquid Chromatography.
**Extraction process, when not noted, is included in the analytical method.
S = Soil and sediment
W = Water

ELEMENT 10

INTERNAL QUALITY CONTROL CHECKS

Laboratory Analysis. For Level C a blank/spike control shall be analyzed with each batch and shall be plotted on control charts. For metals, and other wet chemical analysis, a method blank shall also be processed with each batch and shall contain less than the method detection limit for compounds of interest. In any method using surrogates spiked into the blank, the blank shall serve as both the method blank and blank/spike control. In methods not using surrogates such as metals, and wet chemical analysis, a blank and a blank/spike (laboratory control sample) shall be analyzed.

A matrix spike and matrix spike duplicate are required for volatiles, semivolatiles, and all GC analysis for every 20 samples of similar matrix. For metals analysis, a duplicate and a matrix spike are required for every 20 samples of similar matrix.

For all GC methods used in Level C QC, second column confirmation shall be used for all positive responses for the analytes of interest.

Field Activities.

Radiometer - Daily calibration checks will be done and their results will be recorded to assure any drift in instrument readings can be found.

HNU-Daily calibration checks will be done and their results will be recorded to assure any drift in instrument reading can be found.

OVA-Daily calibration checks will be done and their results will be recorded to assure any drift in instrument reading can be found.

M18S2 Test Kits-Test - Kits have an expiration date. Their results are only qualitative. The test only records the presence or absence to a determined detection level.

Slug tests - The instrumentation which records the hydraulic head declines record only relative data. Pressure is recorded over a time period. These instruments will be checked prior to mobilization. Pressure transducers are checked manually and electrically against induced water levels readings.

Ground penetration radar-The results from this device are relative results and can be check against "ground truth" drilling data. The instruments produce soil cross-sections which will be compared to known subsurface data points.

Electromagnetic Conductivity-This data is also relative. The generated interpretations will be refined using "ground truth" drilling data and GPR information.

Control Samples

QC Samples. The number of QC samples is determined by the level of QC implemented. The types of QC samples are:

1) Duplicates are identical splits of individual samples which are analyzed by the laboratory to test for method reproducibility. These samples are to be split in the laboratory.

2) Equipment Rinsates are the final analyte-free water rinse from equipment cleaning collected daily during a sampling event. Initially, samples from every other day should be analyzed. If analytes pertinent to the project are found in the rinsate, the remaining samples must be analyzed. The results from the blanks will be used to flag or assess the levels of analytes in the samples. This comparison is made during data validation. The rinsates are analyzed for the same parameters as the related samples.

3) Field Blanks consist of the source water used in decontamination and steam cleaning. These blanks are collected and analyzed to determine the level of contamination introduced into the sample due to sampling techniques. At a minimum, one field blank from each event and each source of water must be collected and analyzed for the same parameters as the related samples.

4) Field Duplicates for soil samples are collected, homogenized, and split. All samples except VOAs are homogenized and split. Volatiles are not mixed, but select segments of soil are taken from the length of the core and placed in 40-mL glass vials. Field duplicates of water are aloquots of water collected from the same sampler at the same time. Field duplicates should be collected at a frequency of 10% per matrix for Level C. All the duplicates should be sent to the laboratory responsible for analysis. The same samples used for field duplicates shall be split by the laboratory and be used as the laboratory duplicate or matrix spike. Spikes are known amounts of specific chemical constituents added by the laboratory to selected samples to test the appropriateness and recover efficiencies of specific analytical methods. This means that for the duplicate sample, there will be analysis of the normal sample, the field duplicate, and the laboratory matrix spike/duplicate.

5) Matrix Spike is an aliquot of matrix (water or soil) spiked with known quantities of compounds and subjected to the entire analytical procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery.

6) Matrix spike Duplicate is a second aliquot of the same matrix as the matrix spike that is spiked in order to determine the precision of the method.

7) Method Blank is a blank sample run to ensure reported analytical results are not the results of laboratory contamination.

8) Method Blank/Spike is the distilled and /or deionized water for soil or sand spiked with known compounds or elements. The method blank as defined by the CLP for organics and the laboratory control sample as defined by the CLP maybe used as the method blank/spike.

9) Preparation Blank is an analytical control that contains distilled, deionized water and reagents, which is carried through the entire analytical procedure (digested and analyzed).

10) Trip Blanks are defined as samples which originate from analyte-free water taken from the laboratory to the sampling site and returned to the laboratory with the volatile organic (VOA) samples. One trip blank should accompany each cooler containing VOAs, should be stored at the laboratory with the samples, and analyzed by the laboratory. Trip blanks are only analyzed for VOAs.

ELEMENT 11

DATA REDUCTION VALIDATION AND REPORTING

Data Reduction. Data generated by this project will be in two forms, direct read and calculated. The following is a description of data reduction and reporting.

1) The chemical detection data is reduced using EPA specified Contract Laboratory Program procedures.

2) The physical data is determined by direct measurement.

3) The OVA, HNU, GPR, EM, and geiger counter are direct reading instruments.

4) The slug test data is recorded by the instruments, dumped into a computer data base from which decline charts are produced. The parameters, transmissivity, storativity, and hydraulic conductivity, are derived. Those parameters are calculated from generated curves and from calculations involving generalized formulas as those presented below.

Transmissivity

$$T = \frac{1.0}{t_1} r_c^2$$

where T = Transmissivity
t_1 = time 1
r_c = radius of the casing

Storitivity

$$S = \frac{(r_c u)^2}{r_s^2}$$

where S = Storativity
r_c = radius of the casing
r_s = radius of the well screen
u = equilibrium constant

Hydraulic Conductivity

$$K = \frac{T}{b}$$

where T = Transmissivity
b = thickness of the formation

Deliverables. For these studies the method blanks, blank/spike, surrogates, matrix spikes, matrix spike duplicates, duplicates, and initial and continuing calibration data shall be reported. Table 3 is a list of the needed documentary forms. The forms referred to are the current CLP forms for organics and metals/cyanide.

Table 3

Data set deliverables for Level C QA

Method requirements	Deliverables
Organics - Method blank spikes with results and Control Chart	control charts. Run with each batch of samples processed.
Results to be reported on CLP Form 1 or spreadsheet. Sample results using CLP data flags.	Form 1 or Sect. 9 1/Sample chromatograms and mass spectra
Surrogate recovery from samples reported on CLP Form 2. Surrogates to be used in volatiles, semivolatiles, pesticides/PCB. For volatiles by GC, the names of surrogates should be changed to reflect the surrogate used.	Form 2
Matrix spike/spike duplicate 1 spike and spike duplicate per 20 samples of similar matrix reported on Form 3.	Form 3
Method blank reported on CLP Form 4.	Form 4.
For volatiles by GC, a similar format will be used as CLP Form 4 for blanks.	
GC/MS tuning for volatiles/semi-volatiles. Report results on Form 5.	Form 5
Initial calibration data reported on Form 6.	Form 6

Table 3--Continued

Data set deliverables for Level C QA

Method requirements	Deliverables
For volatiles by GC, the initial calibration data with response factors must be reported.	No Form
For pesticide/PCB data Form 9 must be used for calibration data.	Form 9
Continuing calibration GC/MS data reported on Form 7.	Form 7
For volatiles, GC data, the response factors and their percent differences from the initial must be reported.	No Form
Internal Standard Area for volatiles and Semivolatiles.	Form 8

Metals - Level C, requirements	Deliverables
Sample results with CLP flagging system	CLP Form 1 or Equiv.
Initial and continuing calibration	CLP Form 2, Part 1 only
Blanks 10% frequency	Form 3
Method blank taken through digestion (1/20 samples of same matrix)	Form 3
ICP interference check sample	Form 4
Matrix spike recovery (1 per 20 samples of similar matrix)	Form 5, Part 1
Postdigestion spike sample recovery for ICP metals. Only done if predigest spike recovery exceed CLP limits.	Form 5, Part 2,1 (never used for GFAA work)

Table 3--Continued

Data set deliverables for Level C QA

Method requirements	Deliverables
Postdigest spike for GFAA.	Recovery will be noted on raw data
Duplicates (1 per 20 samples will be samples split and digested as separate Method blank spike information will be plotted on control chart, one per batch of samples processed.	Form 6
Standard addition. The decision process outlined in CLP page E-3 will be used to determine when standard additions are required.	Form 8
Holding times	Form 10

Level C Data Validation. Listed below are the validation criteria which will be utilized in evaluating the analytical data for a Level C QC site:

a. Volatile Organic Analysis

Holding Times - Holding times begin when the amples are collected. Samples must be analyzed within the holding times specified in Sect. 3 or the data should be marked as estimated (J).

GC/MS Tuning - Check that bromofluorobenzene tune is completed each 12-h shift of operation. Check that it meets the CLP criteria. Assure that each sample is associated with a tune.

Initial Calibration - The maximum relative standard deviation [(RSD) percent RSD] shall not be .30% for indicted CLP CCC. The maximum mean relative response factor (RRF) for SPCC shall be .0.300 (0.250 for bromoform). The SPCCs are chloromethane, 1,1-dichloroethane, bromoform, 1,1,2,2-tetrachloroethane, and chlorobenzene. The CCC compounds are vinyl chloride, 1,1-dichloroethene, chloroform, 1,2dichloropropane, toluene, and ethylbenzene.

Continuing Calibration - The minimum response factor for the SPCC components for VOA analysis shall not be <0.300 (0.250 for bromoform). The maximum response factor percent deviation for indicated CLP CCC components from the mean initial calibration response factor shall not exceed 25%. If these criteria are exceeded, a new calibration for the compound shall be employed.

Blank/Spike Control Samples - Any control sample which exceeds the internal QC limits set by the laboratory for a given sample matrix shall require all data from the associated batch of samples to be closely inspected. If no analytical problems are found, the data analyzed with the out-of-control point shall be discussed in the QC section of the MPR and final report. The Navy shall receive a carbon copy of the MPR. If problems are found in the analytical data, the samples associated with the batch shall be reanalyzed and the data from reanalysis reported. If holding times are exceeded in the reanalysis, both sets of data shall be presented.

If the blank/spike results are outside the internal laboratory limits and if the matrix spike results are outside the CLP limits, the laboratory will either reanalyze the samples within the holding times or the data will be flagged with an "R," and the data are not usable.

Surrogates - If surrogates exceed the CLP limits, the data shall be flagged that the surrogates exceeded limits.

Method Blanks - A method blank should be run each day following the Continuing Calibration Standard. Common laboratory solvents should not be found in the blank at levels over five times the detection limits. Other compounds should not be found in the blank at levels exceeding the detection limits. If common contaminant compounds are detected in samples at a concentration of <10 times the concentration found in the blank, or other compounds at <5 times the concentration in the blank, report those compounds as not detected. Adjust the sample quantitation limit to the value reported in the samples and flag the limit as estimated (UJ).

Matrix Spike/Spike Duplicate - Ensure that 1 out of 20 samples has been spiked in duplicate. The recoveries shall meet the CLP criteria. If the recoveries do not meet the criteria, examine the blank spike data. If the blank spike data exceed the limits and the matrix spikes exceed limits, the data shall be flagged as unusable (R). If the blank spike data from the batch are satisfactory, the data is usable, and the low recovery is discussed in the final report QA/QC and in the QC report sent to the NCR.

Field Trip and Equipment Blanks - If contaminant analytes are detected in samples at concentrations of <5 times the concentration found in the highest associated blank, the results are considered suspect and are reported as estimated.

a. Semivolatile Organics Analysis

Holding Times - Samples must be extracted within 7 days of collection and analyzed within 40 days of extraction. Any samples which do not meet these requirements must be flagged as estimated.

GC/MS Tune - Make certain that a decafluorotriphenylphosphine tune is completed every 12 h of sample analysis, that each sample is associated with a tune, and that each tune meets CLP requirements. Data are not reported if the instrument does not meet tune.

Initial Calibration - Ensure that a 5-point curve has been completed. The RRF of the BNA compounds shall be a minimum of 0.050 for the SPCC listed in the current revision of the CLP. The maximum RSD for the CCC listed in the CLP procedure is 30.0%. The minimum RRF for the SPCC is 0.050, and the maximum percent difference for the CCC is 25%. If these limits are exceeded, a new calibration curve shall be generated.

Continuing Calibration - The continuing calibration check will be performed once every 12 h during operation. The minimum RRF for the SPCC is 0.05, and the maximum percent difference from the initial calibration shall not exceed 25% for the CCC. If these limits are exceeded, a new calibration curve shall be generated.

Blank/Spike Control Samples - Any control sample which exceeds the internal QC limits set by the laboratory for a given sample matrix shall require all data from the associated batch of samples to be closely inspected. If no analytical problems are found, the data and the out-of-control point shall be discussed in the QC section of the report. If problems are found in the analytical data, the samples associated with the batch shall be reanalyzed and the data from reanalysis reported. If holding times are exceeded in the reanalysis, both sets of data shall be presented.

If the blank/spike results are outside the internal laboratory limits and if the matrix spike results are outside the CLP limits, the laboratory will either reanalyze the samples or the data will be flagged with an "R," and the data is not usable.

Surrogates - If surrogates exceed the CLP limits, the data shall be flagged that the surrogates exceeded limits.

Blanks - A method blank should be run each day following the Continuing Calibration Standard. Phthalate should not be found in the blank at levels over five times the detection limits. Other compounds should not be found in the blank at levels exceeding the detection limits. If common contaminant compounds are detected in samples at a concentration of <10 times the concentration found in the blank, or other compounds at <5 times the concentration in the blank, report those compounds as not detected. Adjust the sample quantitation limit to the value reported in the samples and flag the limit as estimated (UJ).

Matrix Spike/Spike Duplicate - Ensure that 1 out of 20 samples has been spiked in duplicate. The recoveries should meet the CLP criteria. If the recoveries do not meet the criteria, examine the blank spike data. If the blank spike data exceed the limits and the matrix spikes exceed limits, the data shall be flagged as unusable (R).

c. Metals

Holding Times - Samples must be analyzed within six months, except mercury shall be analyzed in 28 days from sample collection.

ICP Initial Calibration - A calibration blank and at least one standard must be analyzed daily. An initial calibration verification standard must be within 90 to 110% recovery or the samples should be reanalyzed. If it is not possible to perform reanalysis, the data are rejected and flagged with an "R."

AA Calibration - Calibration blank and at least three standards shall be used in establishing the curve prior to sample analysis. A curve shall be analyzed each day prior to sample analysis.

Calibration Verification - Verification using a standard obtained from a source other than that of the initial calibration shall be used and the result shall be within 90 to 110% of the true value for both ICP and AA work. Calibration verification shall be done at a minimum frequency of 10% or every 2 h, whichever is more frequent, and shall be done at the end of the analytical run.

Method Blanks - At least one preparation blank shall be prepared with each batch of samples. The blanks shall contain less than the detection limit for all analytes. If the concentration of the associated blanks is above the detection limit and if the lowest analyte concentration is #10 times the blank, reanalysis of the sample must occur. If reanalysis is not done, the data shall be reported and flagged as estimated. The blank shall never be subtracted from the sample.

Field and Equipment Blanks - If contaminant analytes are detected in samples at concentrations of <5 times the concentration found in the highest associated blank, the results are considered suspect and are reported as estimated.

Blank/Spike Laboratory Control Samples - Any laboratory control sample which exceeds the internal QC limits set by the laboratory for a given sample matrix shall require all data from the associated batch of samples to be closely inspected. If no analytical problems are found, the data and out-of-control point shall be discussed in the QC section of the report. If problems are found in the analytical data, the samples associated with the batch shall be reanalyzed and the data from reanalysis reported. If holding times are exceeded in the reanalysis, both sets of data shall be presented. A discussion of data reported when the blank/spike laboratory control sample is out of control shall be presented in the QC section of both the final report and the MPR.

If the blank/spike results are outside the internal laboratory limits and if the matrix spike results are outside the CLP limits, the laboratory will either reanalyze the samples or the data will be flagged with an "R," and the data are not usable.

ELEMENT 12

PERFORMANCE AND SYSTEM AUDITS

Field Audits. The project manager is responsible for monitoring the quality of the field activities. This will be accomplished by monitoring daily, weekly, and monthly goals given to the field team. Site inspections will be performed. Chain of custody forms will be audited. Coordination with the laboratory will be maintained on a least a weekly basis.

Laboratory Approval. All chemical analytical laboratories working on Navy Installation Restoration Program (IRP) projects must pass the Navy's laboratory screening program. NEESA has been assigned the task of managing that program. The program is instituted by a Navy contractor.

Once a laboratory has received Navy approval to begin analysis of samples, maintaining that approval requires adherence to the QA plan and reporting of QA-related information. The performance and reporting requirements outlined below are essential to ensuring that data of known and defensible quality are being generated throughout the course of a site investigation. Topics covered include control samples, control charts, out-of-control events, corrective action reports, significant changes in the QA plan, and other reporting requirements.

Monthly Progress Report. The primary means of communication from the laboratories to the NCR will be the monthly progress report (MPR) to be submitted by the laboratories to the NCR on the 15th of each month in which work for the Navy is performed. The following information is to be included in the MPR:

1. Site name and contract number.

2. Numbers, types and locations of samples collected and analyzed for Navy project only.

3. Data for blanks, spikes, laboratory duplicates and controls related to Navy samples.

4. New methods used for analysis and changes in old methods.

5. Copies of all control charts pertinent to Navy samples and to which results have been added over the reporting period.

6. Summaries of out-of-control incidents during the reporting period, including references to documentation and corrective action reports.

7. Descriptions of and justifications for significant changes in the QA.

8. Changes in LQAC personnel and other key technical personnel; resumes of new personnel must be submitted.

9. Completed sample data.

Much of the information presented in an MPR is incremental in nature and relates to changes and findings since the previous MPR:

1. Control charts from the minimizing control charts program and any additional control charts from monitoring matrix spikes, duplicates, or other QC parameters.

2. Personnel changes relating to QA responsibilities.

3. Method changes (e.g., a minor modification with an attached EPA variance).

4. Procedural changes in establishing control limits and/or the preparation and use of control charts.

Since the first such report for each laboratory has no precedent, more explanation and detail may be necessary; subsequent MPRs will likely not require as much detail in some areas.

ELEMENT 13

PREVENTATIVE MAINTENANCE

All Perkin-Elmer instruments (atomic absorption units) at WES are maintained by service contract that provides for twice yearly preventive maintenance and emergency repair. Permanent records are maintained of service visits.

The Plasma Emission Spectrometer (Spectrametrix) is maintained by service contract that provides for twice yearly preventive maintenance and emergency service. Permanent records are maintained of service visits.

All Hewlett-Packard Instruments (GC and GC/MS systems) are maintained by service contract that provides for twice yearly preventive maintenance and emergency repair. In addition, the GC/MS systems are tied via modem to the Analytical Response Center Support which can duplicate software problems at HP,s service center. Records of all service calls are maintained in permanent files.

All analytical balances are serviced annually by a certified balance technician.

All other instrumentation is serviced on an as needed basis and records are maintained of any repair calls.

Daily or routine maintenance of instruments is performed by the individual analysts and recorded in the instrument logs.

ELEMENT 14

DATA ASSESSMENT

All data is checked by the analyst, the inorganic team leader or the organic team leader, and the Chief, ALG before it is submitted to the customer. The following items are checked:

1. Completeness
2. Duplicate values for precision
3. Recovery of Spikes for accuracy
4. Method blanks for contamination
5. Surrogate recoveries for organic analysis
6. Data for QA check samples
7. Reasonableness and trends

If data falls outside acceptable limits, the sample is rerun if sample is available. If data falls outside acceptable limits on the reruns and QA check sample data is good, then data may be reported with qualifying explanations. Acceptable data is usually defined by the specific procedural method (i.e. SW-846).

DATA REDUCTION
ANALYSIS FLOW CHART

↓

LABORATORY DATA MANAGEMENT SYSTEM
(Bench Sheets)

↓

ANALYSIS OF SAMPLES

↓

ANALYST'S NOTEBOOK

↓

RAW DATA TO BENCH SHEETS

↓

TEAM LEADER

↓

LABORATORY DATA MANAGEMENT SYSTEM ⇄ QC CHECK

↓

CHIEF, ANALYTICAL LABORATORY GROUP

↓

LABORATORY DATA MANAGEMENT SYSTEM

↓

FINAL REPORT
(Initialed by C/ALG)

ELEMENT 15

CORRECTIVE ACTION

The laboratory uses EPA Contract Laboratory Program procedures for determining Out of Control events, reporting those events, and corrective actions responses to those events.

ELEMENT 16

QUALITY ASSURANCE REPORT

The laboratory has a built in quality check procedure within its structure. The Laboratory chief will prepare a summary report to describe all discrepancies, out of control events, and corrective actions taken.

APPENDIX C

MGBG GROUNDWATER ANALYTICAL RESULTS

SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-01

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
MANGANESE	mg/L	01/28/86		2.40000
ORGANIC BROMINE	mg/L	01/28/86	ND	0.01000
ORGANIC BROMINE	mg/L	01/28/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	01/28/86	ND	1.00000
ORGANIC CHLORINE	mg/L	01/28/86		0.04000
ORGANIC CHLORINE	mg/L	01/28/86		0.04000
ORGANIC IODINE	mg/L	01/28/86	<	0.01000
ORGANIC IODINE	mg/L	01/28/86	<	0.01000
PHENOLS	mg/L	01/28/86		0.02000
PHENOLS	mg/L	01/28/86		0.02000
SODIUM	mg/L	01/28/86		45.00000
SODIUM	mg/L	01/28/86		45.00000
SPECIFIC CONDUCTANCE	umho/cm	01/28/86		1000.00000
SPECIFIC CONDUCTANCE	umho/cm	01/28/86		1000.00000
SULFATE	mg/L	01/28/86		330.00000
SULFATE	mg/L	01/28/86		330.00000
pH	S.U.	01/28/86		6.60000
pH	S.U.	01/28/86		6.60000
ORGANIC BROMINE	mg/L	06/03/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	06/03/86		3.00000
ORGANIC CHLORINE	mg/L	06/03/86	<	0.01000
ORGANIC IODINE	mg/L	06/03/86	<	0.01000
SPECIFIC CONDUCTANCE	umho/cm	06/03/86		960.00000
pH	S.U.	06/03/86		6.20000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-01

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED
ORGANIC CHLORINE	mg/L	01/31/84	0.02200
ORGANIC IODINE	mg/L	01/31/84	ND 0.00200
PHENOLS	mg/L	01/31/84	ND 0.00400
SODIUM	mg/L	01/31/84	43.00000
SPECIFIC CONDUCTANCE	umho/cm	01/31/84	1200.00000
SULFATE	mg/L	01/31/84	340.00000
pH, Field	S.U.	01/31/84	6.50000
ORGANIC BROMINE	mg/L	06/08/84	ND 0.00200
ORGANIC CARBON, TOTAL	mg/L	06/08/84	< 2.00000
ORGANIC CHLORINE	mg/L	06/08/84	0.07000
ORGANIC IODINE	mg/L	06/08/84	0.00300
SPECIFIC CONDUCTANCE	umho/cm	06/08/84	1200.00000
pH, Field	S.U.	06/08/84	6.40000
CONDUCTANCE, Field	umho/cm	06/10/85	620.00000
CONDUCTANCE, Field	umho/cm	06/10/85	620.00000
ORGANIC CARBON, TOTAL	mg/L	06/10/85	4.40000
ORGANIC CARBON, TOTAL	mg/L	06/10/85	4.40000
TOTAL ORGANIC HALOGENS	mg/L	06/10/85	0.01310
TOTAL ORGANIC HALOGENS	mg/L	06/10/85	0.01310
pH, Field	S.U.	06/10/85	6.20000
pH, Field	S.U.	06/10/85	6.20000
CHLORIDE	mg/L	01/28/86	45.00000
CHLORIDE	mg/L	01/28/86	45.00000
IRON, TOTAL	mg/L	01/28/86	0.68000
IRON, TOTAL	mg/L	01/28/86	0.68000
MANGANESE	mg/L	01/28/86	2.40000

SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-01

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED
SODIUM	mg/L	11/30/81	56.00000
SPECIFIC CONDUCTANCE	umho/cm	11/30/81	1300.00000
			1290.00000
			1290.00000
			1290.00000
SULFATE	mg/L	11/30/81	331.00000
TOTAL ORGANIC HALOGENS	mg/L	11/30/81	0.01400
			0.02300
			ND 0.01000
			ND 0.01000
TOTCOLBACT	PHM	11/30/81	ND 1.00000
TOXAPHENE	mg/L	11/30/81	ND 0.00160
pH, Field	S.U.	11/30/81	6.60000
			6.70000
			6.60000
			6.70000
MANGANESE	mg/L	03/05/82	2.15000
SULFATE	mg/L	03/05/82	331.00000
2,4-D	mg/L	03/23/82	ND 0.00380
ARSENIC	mg/L	03/23/82	ND 0.01000
BARIUM	mg/L	03/23/82	ND 0.10000
CADMIUM	mg/L	03/23/82	ND 0.00500
CHLORIDE	mg/L	03/23/82	40.40000
CHROMIUM	mg/L	03/23/82	ND 0.01000
ENDRIN	mg/L	03/23/82	ND 0.00004
FLUORIDE	mg/L	03/23/82	0.21000
GROSS ALPHA	pcu/L	03/23/82	< 5.72000
GROSS ALPHA	pcu/L	03/23/82	< 5.72000
GROSS BETA	pcu/L	03/23/82	2.13000
GROSS BETA	pcu/L	03/23/82	2.13000

FAST LIST REPORT F[illegible] [illegible]
SITE : 01 MUS[illegible]RIAL GROUNDS
WELLNUMBER : 01-01

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
2,4-D	mg/L	11/30/81	ND	0.00380
ARSENIC	mg/L	11/30/81	ND	0.01000
BARIUM	mg/L	11/30/81	ND	0.10000
CADMIUM	mg/L	11/30/81	ND	0.00500
CHLORIDE	mg/L	11/30/81		43.10000
CHROMIUM	mg/L	11/30/81	ND	0.01000
ENDRIN	mg/L	11/30/81	ND	0.00004
FLUORIDE	mg/L	11/30/81		0.20000
GROSS ALPHA	pcu/L	11/30/81	ND	4.08000
GROSS ALPHA	pCi/l	11/30/81	ND	4.08000
GROSS BETA	pcu/L	11/30/81		3.17000
GROSS BETA	pCi/l	11/30/81		3.17000
IRON	mg/L	11/30/81		0.12000
LEAD	mg/L	11/30/81	ND	0.01000
LINDANE	mg/L	11/30/81	ND	0.00008
MANGANESE	mg/L	11/30/81		2.15000
MERCURY	mg/L	11/30/81	ND	0.00020
METHOXYCHLOR	mg/L	11/30/81	ND	0.00160
NO2+NO3 AS N	mg/L	11/30/81		0.06000
ORGANIC CARBON, TOTAL	mg/L	11/30/81		10.90000
				9.70000
				10.40000
				10.00000
PHENOLS	mg/L	11/30/81	ND	0.01000
SELENIUM	mg/L	11/30/81	ND	0.00500
SILVER	mg/L	11/30/81	ND	0.01000
SILVEX	mg/L	11/30/81	ND	0.00050

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-01

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
IRON	mg/L	03/23/82		0.07000
LEAD	mg/L	03/23/82	ND	0.01000
LINDANE	mg/L	03/23/82	ND	0.00008
MANGANESE	mg/L	03/23/82		2.06000
MERCURY	mg/L	03/23/82	ND	0.00020
METHOXYCHLOR	mg/L	03/23/82	ND	0.00160
NO2+NO3 AS N	mg/L	03/23/82	ND	0.05000
ORGANIC CARBON, TOTAL	mg/L	03/23/82		5.00000
				7.00000
				7.00000
				5.00000
PHENOLS	mg/L	03/23/82	ND	0.01000
RADIUM-226	pcu/L	03/23/82		0.31000
RADIUM-226	pcu/L	03/23/82		0.31000
SELENIUM	mg/L	03/23/82	ND	0.00500
SILVER	mg/L	03/23/82	ND	0.01000
SILVEX	mg/L	03/23/82	ND	0.00050
SODIUM	mg/L	03/23/82		55.00000
SPECIFIC CONDUCTANCE	umho/cm	03/23/82		1220.00000
				1215.00000
				1210.00000
				1205.00000
SULFATE	mg/L	03/23/82		340.00000
TOTAL ORGANIC HALOGENS	mg/L	03/23/82		0.01600
				0.01000
				0.01200
				0.01100
TOXAPHENE	mg/L	03/23/82	ND	0.00160
pH, Field	S.U.	03/23/82		6.40000
				6.40000
				6.30000
				6.40000

FAST LIST REPORT FOR A GIVEN WELLNUMBER

SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-01

PARAMETER NAME	UNITS	DATESAMPLE		AMOUNT DETECTED
MANGANESE	mg/L	07/18/82		2.06000
SULFATE	mg/L	07/18/82		340.00000
pH, Field	S.J.	07/18/82		6.40000
				6.40000
				6.30000
				6.40000
2,4-D	mg/L	07/20/82	ND	0.00380
ARSENIC	mg/L	07/20/82	ND	0.01000
BARIUM	mg/L	07/20/82	ND	0.10000
CADMIUM	mg/L	07/20/82	ND	0.00500
CHLORIDE	mg/L	07/20/82		46.00000
CHROMIUM	mg/L	07/20/82	ND	0.01000
ENDRIN	mg/L	07/20/82	ND	0.00004
FLUORIDE	mg/L	07/20/82		0.20000
GROSS ALPHA	pcu/L	07/20/82	<	5.63000
GROSS ALPHA	pcu/L	07/20/82	<	5.63000
GROSS BETA	pcu/L	07/20/82		2.04000
GROSS BETA	pcu/L	07/20/82		2.04000
IRON	mg/L	07/20/82	ND	0.03000
LEAD	mg/L	07/20/82	ND	0.01000
LINDANE	mg/L	07/20/82	ND	0.00008
MANGANESE	mg/L	07/20/82		2.15000
MERCURY	mg/L	07/20/82	ND	0.00020
METHOXYCHLOR	mg/L	07/20/82	ND	0.00160
NO2+NO3 AS N	mg/L	07/20/82	ND	0.05000
ORGANIC CARBON, TOTAL	mg/L	07/20/82		62.00000
				61.00000
				61.00000
				61.00000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-01

PARAMETER NAME	UNITS	DATESAMPLE		AMOUNT DETECTED
PHENOLS	mg/L	07/20/82		0.03000
RADIUM-226	pcu/L	07/20/82		0.34000
SELENIUM	mg/L	07/20/82	ND	0.00500
SILVER	mg/L	07/20/82	ND	0.01000
SILVEX	mg/L	07/20/82	ND	0.00050
SODIUM	mg/L	07/20/82		53.00000
SPECIFIC CONDUCTANCE	umho/cm	07/20/82		1150.00000
				1160.00000
				1150.00000
				1160.00000
SULFATE	mg/L	07/20/82		310.00000
TOTAL ORGANIC HALOGENS	mg/L	07/20/82		0.04300
			ND	0.01000
				0.04000
				0.04700
TOXAPHENE	mg/L	07/20/82	ND	0.00160
pH, Field	S.U.	07/20/82		6.50000
				6.50000
				6.50000
				6.50000
RADIUM-226	pcu/L	08/21/82		0.34000
1,1,2,2-TETRACHLOROETHANE	mg/L	10/05/82	ND	0.00100
1,1-DICHLOROETHYLENE	mg/L	10/05/82	ND	0.00100
1,2-DICHLOROETHANE	mg/L	10/05/82	ND	0.00100
2,4-D	mg/L	10/05/82	ND	0.00380
ARSENIC	mg/L	10/05/82	ND	0.01000
BARIUM	mg/L	10/05/82	ND	0.10000
BROMOFORM	mg/L	10/05/82	ND	0.00200
CADMIUM	mg/L	10/05/82	ND	0.00500
CARBON TETRACHLORIDE	mg/L	10/05/82		0.00000

SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-01

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
CHLORIDE	mg/L	10/05/82		37.00000
CHLOROBENZENE	mg/L	10/05/82	ND	0.00100
CHLOROFORM	mg/L	10/05/82	ND	0.00100
CHROMIUM	mg/L	10/05/82	ND	0.01000
ENDRIN	mg/L	10/05/82	ND	0.00004
FLUORIDE	mg/L	10/05/82		0.20000
GROSS ALPHA	pcu/L	10/05/82	<	6.10000
GROSS ALPHA	pcu/L	10/05/82	<	6.10000
GROSS BETA	pcu/L	10/05/82		2.51000
GROSS BETA	pcu/L	10/05/82		2.51000
IRON	mg/L	10/05/82	ND	0.03000
LEAD	mg/L	10/05/82	ND	0.01000
LINDANE	mg/L	10/05/82	ND	0.00008
MANGANESE	mg/L	10/05/82		1.78000
MERCURY	mg/L	10/05/82		0.00020
METHOXYCHLOR	mg/L	10/05/82	ND	0.00160
METHYLENE CHLORIDE	mg/L	10/05/82		0.00800
NO2+NO3 AS N	mg/L	10/05/82		0.06000
ORGANIC CARBON, TOTAL	mg/L	10/05/82		6.00000 6.00000 6.00000 6.00000
PHENOLS	mg/L	10/05/82		0.01000
RADIUM-226	pCi	10/05/82		0.34000
RADIUM-226	pCi/l	10/05/82	<	0.21000
SELENIUM	mg/L	10/05/82	ND	0.00500
SILVER	mg/L	10/05/82	ND	0.01000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-01

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED
SILVEX	mg/L	10/05/82	ND 0.00050
SODIUM	mg/L	10/05/82	49.00000
SPECIFIC CONDUCTANCE	umho/cm	10/05/82	1300.00000
			1300.00000
			1300.00000
			1300.00000
SULFATE	mg/L	10/05/82	270.00000
TETRACHLOROETHYLENE	mg/L	10/05/82	ND 0.00010
TOTAL ORGANIC HALOGENS	mg/L	10/05/82	0.01400
			ND 0.01000
			ND 0.01000
			0.01500
TOXAPHENE	mg/L	10/05/82	ND 0.00160
TRANS-1,2-DICHLOROETHYLENE	mg/L	10/05/82	ND 0.00100
TRICHLOROETHYLENE	mg/L	10/05/82	ND 0.00100
pH, Field	S.U.	10/05/82	6.40000
			6.60000
			6.50000
			6.40000
MANGANESE	mg/L	11/08/82	2.15000
SULFATE	mg/L	11/08/82	310.00000
MANGANESE	mg/L	01/14/83	1.78000
SULFATE	mg/L	01/14/83	270.00000
pH, Field	S.U.	01/14/83	6.40000
			6.40000
CHLORIDE	mg/L	02/22/83	43.00000
IRON	mg/L	02/22/83	ND 0.03000
MANGANESE	mg/L	02/22/83	1.86000
ORGANIC CARBON, TOTAL	mg/L	02/22/83	44.00000
			42.00000
			43.00000
			43.00000

SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-01

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED
PHENOLS	mg/L	02/22/83	ND 0.01000
SODIUM	mg/L	02/22/83	45.00000
SPECIFIC CONDUCTANCE	umho/cm	02/22/83	1065.00000
			1060.00000
			1060.00000
			1065.00000
SULFATE	mg/L	02/22/83	280.00000
TOTAL ORGANIC HALOGENS	mg/L	02/22/83	0.02100
			0.01900
			0.01500
			0.01700
pH, Field	S.U.	02/22/83	6.30000
			6.30000
			6.30000
			6.30000
ORGANIC CARBON, TOTAL	mg/L	07/26/83	56.00000
			55.00000
			56.00000
			55.00000
SPECIFIC CONDUCTANCE	umho/cm	07/26/83	1400.00000
			1400.00000
			1350.00000
			1400.00000
TOTAL ORGANIC HALOGENS	mg/L	07/26/83	C 0.07400
			C 0.06900
			C 0.06800
			C 0.04500
pH, Field	S.U.	07/26/83	6.10000
			6.10000
			6.10000
			6.20000
CHLORIDE	mg/L	01/31/84	46.00000
IRON, TOTAL	mg/L	01/31/84	0.59000
MANGANESE	mg/L	01/31/84	2.70000
ORGANIC BROMINE	mg/L	01/31/84	ND 0.00200
ORGANIC CARBON, TOTAL	mg/L	01/31/84	ND 2.00000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-02

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
2,4-D	mg/L	11/30/81	ND	0.00380
ARSENIC	mg/L	11/30/81	ND	0.01000
BARIUM	mg/L	11/30/81	ND	0.10000
CADMIUM	mg/L	11/30/81	ND	0.00500
CHLORIDE	mg/L	11/30/81		13.70000
CHROMIUM	mg/L	11/30/81	ND	0.01000
ENDRIN	mg/L	11/30/81	ND	0.00004
FLUORIDE	mg/L	11/30/81		0.12000
GROSS ALPHA	pcu/L	11/30/81		4.59000
GROSS ALPHA	pCi/l	11/30/81		4.59000
GROSS BETA	pcu/L	11/30/81		3.03000
GROSS BETA	pCi/l	11/30/81		3.03000
IRON	mg/L	11/30/81		0.50000
LEAD	mg/L	11/30/81	ND	0.01000
LINDANE	mg/L	11/30/81	ND	0.00008
MANGANESE	mg/L	11/30/81		0.17000
MERCURY	mg/L	11/30/81	ND	0.00020
METHOXYCHLOR	mg/L	11/30/81	ND	0.00160
NO2+NO3 AS N	mg/L	11/30/81		0.08000
ORGANIC CARBON, TOTAL	mg/L	11/30/81		19.40000 17.80000 16.20000 18.40000
PHENOLS	mg/L	11/30/81		0.01000
SELENIUM	mg/L	11/30/81	ND	0.00500
SILVER	mg/L	11/30/81	ND	0.01000
SILVEX	mg/L	11/30/81	ND	0.00050

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-02

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
SODIUM	mg/L	11/30/81		180.00000
SPECIFIC CONDUCTANCE	umho/cm	11/30/81		1930.00000
				1910.00000
				1920.00000
				1920.00000
SULFATE	mg/L	11/30/81		544.00000
TOTAL ORGANIC HALOGENS	mg/L	11/30/81		0.11800
				0.10300
				0.12600
				0.13800
TOTCOLBACT	PHM	11/30/81	ND	1.00000
TOXAPHENE	mg/L	11/30/81	ND	0.00160
pH, Field	S.U.	11/30/81		7.40000
				7.40000
				7.40000
				7.40000
IRON	mg/L	03/05/82		0.50000
MANGANESE	mg/L	03/05/82		0.17000
SULFATE	mg/L	03/05/82		544.00000
2,4-D	mg/L	03/23/82	ND	0.00380
ARSENIC	mg/L	03/23/82	ND	0.01000
BARIUM	mg/L	03/23/82	ND	0.10000
CADMIUM	mg/L	03/23/82	ND	0.00500
CHLORIDE	mg/L	03/23/82		29.90000
CHROMIUM	mg/L	03/23/82	ND	0.01000
ENDRIN	mg/L	03/23/82	ND	0.00004
FLUORIDE	mg/L	03/23/82	ND	0.10000
GROSS ALPHA	pcu/L	03/23/82	<	2.89000
GROSS ALPHA	pcu/L	03/23/82	<	2.89000
GROSS BETA	pcu/L	03/23/82	ND	1.55000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-02

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
GROSS BETA	pcu/L	03/23/82	ND	1.55000
IRON	mg/L	03/23/82		0.03000
LEAD	mg/L	03/23/82	ND	0.01000
LINDANE	mg/L	03/23/82	ND	0.00008
MANGANESE	mg/L	03/23/82		0.03000
MERCURY	mg/L	03/23/82	ND	0.00020
METHOXYCHLOR	mg/L	03/23/82	ND	0.00160
NO2+NO3 AS N	mg/L	03/23/82		0.16000
ORGANIC CARBON, TOTAL	mg/L	03/23/82		3.00000
				3.00000
				3.00000
				3.00000
PHENOLS	mg/L	03/23/82	ND	0.01000
SELENIUM	mg/L	03/23/82	ND	0.00500
SILVER	mg/L	03/23/82	ND	0.01000
SILVEX	mg/L	03/23/82	ND	0.00050
SODIUM	mg/L	03/23/82		35.00000
SPECIFIC CONDUCTANCE	umho/cm	03/23/82		420.00000
				420.00000
				420.00000
				420.00000
SULFATE	mg/L	03/23/82		44.00000
TOTAL ORGANIC HALOGENS	mg/L	03/23/82		8.90000
				9.60000
				8.68000
				7.62000
TOXAPHENE	mg/L	03/23/82	ND	0.00160
pH, Field	S.U.	03/23/82		6.10000
				6.20000
				6.10000
				6.10000
pH, Field	S.U.	07/18/82		6.10000
				6.20000
				6.10000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-02

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
2,4-D	mg/L	07/20/82	ND	0.00380
ARSENIC	mg/L	07/20/82	ND	0.01000
BARIUM	mg/L	07/20/82	ND	0.10000
CADMIUM	mg/L	07/20/82	ND	0.00500
CHLORIDE	mg/L	07/20/82		95.00000
CHROMIUM	mg/L	07/20/82	ND	0.01000
ENDRIN	mg/L	07/20/82	ND	0.00004
FLUORIDE	mg/L	07/20/82		0.10000
GROSS ALPHA	pcu/L	07/20/82	<	6.41000
GROSS ALPHA	pcu/L	07/20/82	<	6.41000
GROSS BETA	pcu/L	07/20/82	ND	2.12000
GROSS BETA	pcu/L	07/20/82	ND	2.12000
IRON	mg/L	07/20/82		0.19000
LEAD	mg/L	07/20/82	ND	0.01000
LINDANE	mg/L	07/20/82	ND	0.00008
MANGANESE	mg/L	07/20/82		0.49000
MERCURY	mg/L	07/20/82	ND	0.00020
METHOXYCHLOR	mg/L	07/20/82	ND	0.00160
NO2+NO3 AS N	mg/L	07/20/82		0.05000
ORGANIC CARBON, TOTAL	mg/L	07/20/82		61.00000 62.00000 61.00000 62.00000
PHENOLS	mg/L	07/20/82		0.17000
RADIUM-226	pcu/L	07/20/82	ND	0.23000
SELENIUM	mg/L	07/20/82	ND	0.00500
SILVER	mg/L	07/20/82	ND	0.01000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-02

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
SILVEX	mg/L	07/20/82	ND	0.00050
SODIUM	mg/L	07/20/82		126.00000
SPECIFIC CONDUCTANCE	umho/cm	07/20/82		1420.00000
				1430.00000
				1430.00000
				1420.00000
SULFATE	mg/L	07/20/82		330.00000
TOTAL ORGANIC HALOGENS	mg/L	07/20/82		104.00000
				102.00000
				102.00000
				103.00000
TOXAPHENE	mg/L	07/20/82	ND	0.00160
pH, Field	S.U.	07/20/82		6.60000
				6.60000
				6.60000
				6.60000
RADIUM-226	pcu/L	08/21/82	ND	0.23000
1,1,2,2-TETRACHLOROETHANE	mg/L	10/05/82		36.00000
1,1-DICHLOROETHYLENE	mg/L	10/05/82		0.06500
1,2-DICHLOROETHANE	mg/L	10/05/82		2.10000
2,4-D	mg/L	10/05/82	ND	0.00380
ARSENIC	mg/L	10/05/82	ND	0.01000
BARIUM	mg/L	10/05/82	ND	0.10000
BROMOFORM	mg/L	10/05/82		8.60000
CADMIUM	mg/L	10/05/82	ND	0.00500
CARBON TETRACHLORIDE	mg/L	10/05/82		0.03400
CHLORIDE	mg/L	10/05/82		110.00000
CHLOROBENZENE	mg/L	10/05/82		0.00600
CHLOROFORM	mg/L	10/05/82		2.00000
CHROMIUM	mg/L	10/05/82	ND	0.01000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-02

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
ENDRIN	mg/L	10/05/82	ND	0.00004
FLUORIDE	mg/L	10/05/82	ND	0.10000
GROSS ALPHA	pcu/L	10/05/82	<	8.05000
GROSS ALPHA	pcu/L	10/05/82	<	8.05000
GROSS BETA	pcu/L	10/05/82		1.51000
GROSS BETA	pcu/L	10/05/82		1.51000
IRON	mg/L	10/05/82		0.12000
LEAD	mg/L	10/05/82	ND	0.00000
LINDANE	mg/L	10/05/82	ND	0.00008
MANGANESE	mg/L	10/05/82		0.96000
MERCURY	mg/L	10/05/82		0.00020
METHOXYCHLOR	mg/L	10/05/82	ND	0.00160
METHYLENE CHLORIDE	mg/L	10/05/82		0.04700
NO2+NO3 AS N	mg/L	10/05/82		0.07000
ORGANIC CARBON, TOTAL	mg/L	10/05/82		65.00000 64.00000 65.00000 62.00000
PHENOLS	mg/L	10/05/82		0.03000
RADIUM-226	pcl	10/05/82	ND	0.23000
SELENIUM	mg/L	10/05/82	ND	0.00500
SILVER	mg/L	10/05/82	ND	0.01000
SILVEX	mg/L	10/05/82	ND	0.00050
SODIUM	mg/L	10/05/82		128.00000
SPECIFIC CONDUCTANCE	umho/cm	10/05/82		1700.00000 1700.00000 1700.00000 1700.00000
SULPHATE	mg/L	10/05/82		440.00000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-02

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
TETRACHLOROETHYLENE	mg/L	10/05/82		2.70000
TOTAL ORGANIC HALOGENS	mg/L	10/05/82		15.68000 12.76000 14.32000 18.64000
TOXAPHENE	mg/L	10/05/82	ND	0.00160
TRANS-1,2-DICHLOROETHYLENE	mg/L	10/05/82		2.30000
TRICHLOROETHYLENE	mg/L	10/05/82		42.00000
pH, Field	S.U.	10/05/82		6.70000 6.80000 6.70000 6.70000
MANGANESE	mg/L	11/08/82		0.49000
SULFATE	mg/L	11/08/82		330.00000
1,1,1-TRICHLOROETHANE	mg/L	11/18/82	ND	0.00100
1,1,2,2-TETRACHLOROETHANE	mg/L	11/18/82		589.00000
1,1,2-TRICHLOROETHANE	mg/L	11/18/82	ND	0.00100
1,1-DICHLOROETHANE	mg/L	11/18/82	ND	0.00100
1,1-DICHLOROETHYLENE	mg/L	11/18/82	ND	0.00100
1,2-DICHLOROBENZENE	mg/L	11/18/82	ND	0.00100
1,2-DICHLOROETHANE	mg/L	11/18/82		4.07000
1,2-DICHLOROPROPANE	mg/L	11/18/82	ND	0.00100
1,3-DICHLOROBENZENE	mg/L	11/18/82	ND	0.00100
1,3-DICHLOROPROPENE	mg/L	11/18/82	ND	0.00100
1,4-DICHLOROBENZENE	mg/L	11/18/82	ND	0.00100
2-CHLOROETHYL VINYL ETHER	mg/L	11/18/82	ND	0.00200
BENZENE	mg/L	11/18/82	ND	0.00100
BROMODICHLOROMETHANE	mg/L	11/18/82	ND	0.00100
BROMOFORM	mg/L	11/18/82	ND	0.00200

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-02

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
BROMOMETHANE	mg/L	11/18/82	ND	0.00200
CARBON TETRACHLORIDE	mg/L	11/18/82	ND	0.00100
CHLOROBENZENE	mg/L	11/18/82	ND	0.00100
CHLOROETHANE	mg/L	11/18/82	ND	0.00200
CHLOROFORM	mg/L	11/18/82	ND	0.00100
CHLOROMETHANE	mg/L	11/18/82	ND	0.00200
DIBROMOCHLOROMETHANE	mg/L	11/18/82		3.04000
DICHLOROFLUOROMETHANE	mg/L	11/18/82	ND	0.00200
ETHYL BENZENE	mg/L	11/18/82	ND	0.00100
METHYL CHLORIDE	mg/L	11/18/82	ND	0.00100
METHYLENE CHLORIDE	mg/L	11/18/82	ND	0.00100
TETRACHLOROETHYLENE	mg/L	11/18/82		4.20000
TOLUENE	mg/L	11/18/82	ND	0.00100
TRANS-1,2-DICHLOROETHYLENE	mg/L	11/18/82		2.65000
TRICHLOROETHYLENE	mg/L	11/18/82		133.00000
TRICHLOROFLUOROMETHANE	mg/L	11/18/82	ND	0.00100
VINYL CHLORIDE	mg/L	11/18/82	ND	0.00100
MANGANESE	mg/L	01/14/83		0.96000
SULFATE	mg/L	01/14/83		440.00000
CHLORIDE	mg/L	02/22/83		82.00000
IRON	mg/L	02/22/83	ND	0.03000
MANGANESE	mg/L	02/22/83		0.71000
ORGANIC CARBON, TOTAL	mg/L	02/22/83		42.00000 42.00000 41.00000 41.00000
PHENOLS	mg/L	02/22/83	ND	0.01000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-02

PARAMETER NAME	UNITS	DATESAMPLE		AMOUNT DETECTED
SODIUM	mg/L	02/22/83		87.00000
SPECIFIC CONDUCTANCE	umho/cm	02/22/83		1220.00000
				1220.00000
				1225.00000
				1225.00000
SULFATE	mg/L	02/22/83		190.00000
TOTAL ORGANIC HALOGENS	mg/L	02/22/83		17.32000
				16.60000
				17.58000
				17.10000
pH, Field	S.U.	02/22/83		6.90000
				7.00000
				7.00000
				6.90000
ORGANIC CARBON, TOTAL	mg/L	07/26/83		42.00000
				43.00000
				43.00000
				44.00000
SPECIFIC CONDUCTANCE	umho/cm	07/26/83		1950.00000
				1950.00000
				1950.00000
				1950.00000
TOTAL ORGANIC HALOGENS	mg/L	07/26/83	C	15.26000
			C	14.49000
			C	12.80000
			C	13.72000
pH, Field	S.U.	07/26/83		6.60000
				6.60000
				6.60000
				6.60000
CHLORIDE	mg/L	01/31/84		96.00000
IRON, TOTAL	mg/L	01/31/84		0.01000
MANGANESE	mg/L	01/31/84		0.63000
ORGANIC BROMINE	mg/L	01/31/84	ND	0.00400
ORGANIC CARBON, TOTAL	mg/L	01/31/84		5.00000
ORGANIC CHLORINE	mg/L	01/31/84		30.00000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-02

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
ORGANIC IODINE	mg/L	01/31/84		0.03600
PHENOLS	mg/L	01/31/84	ND	0.00400
SODIUM	mg/L	01/31/84		110.00000
SPECIFIC CONDUCTANCE	umho/cm	01/31/84		1400.00000
SULFATE	mg/L	01/31/84		440.00000
pH, Field	S.U.	01/31/84		6.60000
ORGANIC BROMINE	mg/L	06/07/84	ND	0.00200
ORGANIC CARBON, TOTAL	mg/L	06/07/84		3.00000
ORGANIC CHLORINE	mg/L	06/07/84		34.00000
ORGANIC IODINE	mg/L	06/07/84		0.15000
SPECIFIC CONDUCTANCE	umho/cm	06/07/84		1000.00000
pH, Field	S.U.	06/07/84		6.90000
1,1,1-TRICHLOROETHANE	mg/L	01/08/85	<	0.00100
1,1,1-TRICHLOROETHANE	mg/L	01/08/85	<	0.00100
1,1,2,2-TETRACHLOROETHANE	mg/L	01/08/85		0.52500
1,1,2,2-TETRACHLOROETHANE	mg/L	01/08/85		0.52500
1,1,2-TRICHLOROETHANE	mg/L	01/08/85		0.00220
1,1,2-TRICHLOROETHANE	mg/L	01/08/85		0.00220
1,1-DICHLOROETHANE	mg/L	01/08/85	<	0.00100
1,1-DICHLOROETHANE	mg/L	01/08/85	<	0.00100
1,1-DICHLOROETHANE	mg/L	01/08/85	<	0.00100
1,2-DICHLOROETHANE	mg/L	01/08/85	<	0.00100
1,2-DICHLOROETHANE	mg/L	01/08/85	<	0.00100
1,2-DICHLOROETHANE	mg/L	01/08/85	<	0.00100
1,2-DICHLOROPROPANE	mg/L	01/08/85	<	0.00100
1,2-DICHLOROPROPANE	mg/L	01/08/85	<	0.00100

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-02

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
2-CHLOROETHYL VINYL ETHER	mg/L	01/08/85	<	0.00100
2-CHLOROETHYL VINYL ETHER	mg/L	01/08/85	<	0.00100
ACROLEIN	mg/L	01/08/85	<	0.10000
ACROLEIN	mg/L	01/08/85	<	0.10000
ACRYLONITRILE	mg/L	01/08/85	<	0.10000
ACRYLONITRILE	mg/L	01/08/85	<	0.10000
BENZENE	mg/L	01/08/85	<	0.00100
BENZENE	mg/L	01/08/85	<	0.00100
BROMOFORM	mg/L	01/08/85	<	0.00100
BROMOFORM	mg/L	01/08/85	<	0.00100
CARBON TETRACHLORIDE	mg/L	01/08/85	<	0.00100
CARBON TETRACHLORIDE	mg/L	01/08/85	<	0.00100
CHLOROBENZENE	mg/L	01/08/85	<	0.00100
CHLOROBENZENE	mg/L	01/08/85	<	0.00100
CHLORODIBROMOMETHANE	mg/L	01/08/85	<	0.00100
CHLORODIBROMOMETHANE	mg/L	01/08/85	<	0.00100
CHLOROETHANE	mg/L	01/08/85	<	0.01000
CHLOROETHANE	mg/L	01/08/85	<	0.01000
CHLOROFORM	mg/L	01/08/85	<	0.00100
CHLOROFORM	mg/L	01/08/85	<	0.00100
CIS-1,3-DICHLOROPROPENE	mg/L	01/08/85	<	0.00100
CIS-1,3-DICHLOROPROPENE	mg/L	01/08/85	<	0.00100
DICHLOROBROMOMETHANE	mg/L	01/08/85	<	0.00100
DICHLOROBROMOMETHANE	mg/L	01/08/85	<	0.00100
DICHLORODIFLUOROMETHANE	mg/L	01/08/85	<	0.01000
DICHLORODIFLUOROMETHANE	mg/L	01/08/85	<	0.01000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-02

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
ETHYL BENZENE	mg/L	01/08/85	<	0.00100
ETHYL BENZENE	mg/L	01/08/85	<	0.00100
METHYL BROMIDE	mg/L	01/08/85	<	0.01000
METHYL BROMIDE	mg/L	01/08/85	<	0.01000
METHYL CHLORIDE	mg/L	01/08/85	<	0.00100
METHYL CHLORIDE	mg/L	01/08/85	<	0.00100
METHYLENE CHLORIDE	mg/L	01/08/85	<	0.00100
METHYLENE CHLORIDE	mg/L	01/08/85	<	0.00100
TETRACHLOROETHENE	mg/L	01/08/85		0.18700
TETRACHLOROETHENE	mg/L	01/08/85		0.18700
TOLUENE	mg/L	01/08/85	<	0.00100
TOLUENE	mg/L	01/08/85	<	0.00100
TRANS-1,2-DICHLOROETHENE	mg/L	01/08/85		0.02430
TRANS-1,2-DICHLOROETHENE	mg/L	01/08/85		0.02430
TRANS-1,3-DICHLOROPROPENE	mg/L	01/08/85	<	0.00100
TRANS-1,3-DICHLOROPROPENE	mg/L	01/08/85	<	0.00100
TRICHLOROETHENE	mg/L	01/08/85		1.18000
TRICHLOROETHENE	mg/L	01/08/85		1.18000
TRICHLOROFLUOROMETHANE	mg/L	01/08/85	<	0.00100
TRICHLOROFLUOROMETHANE	mg/L	01/08/85	<	0.00100
VINYL CHLORIDE	mg/L	01/08/85	<	0.01000
VINYL CHLORIDE	mg/L	01/08/85	<	0.01000
CONDUCTANCE, Field	umho/cm	06/10/85		707.00000
ORGANIC CARBON, TOTAL	mg/L	06/10/85		6.10000
TOTAL ORGANIC HALOGENS	mg/L	06/10/85		7.76000
pH, Field	S.U.	06/10/85		7.00000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-02

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED
1,1,2,2-TETRACHLOROETHANE	mg/L	01/29/86	66.00000
TRICHLOROETHENE	mg/L	01/29/86	30.00000
ORGANIC BROMINE	mg/L	06/03/86	ND 0.01000
ORGANIC CARBON, TOTAL	mg/L	06/03/86	5.00000
ORGANIC CHLORINE	mg/L	06/03/86	48.00000
ORGANIC IODINE	mg/L	06/03/86	nd 0.50000
SPECIFIC CONDUCTANCE	umho/cm	06/03/86	960.00000
pH	S.U.	06/03/86	6.40000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-03

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
2,4-D	mg/L	11/30/81	ND	0.00380
ARSENIC	mg/L	11/30/81	ND	0.01000
BARIUM	mg/L	11/30/81	ND	0.10000
CADMIUM	mg/L	11/30/81	ND	0.00500
CHLORIDE	mg/L	11/30/81		4.50000
CHROMIUM	mg/L	11/30/81	ND	0.01000
ENDRIN	mg/L	11/30/81	ND	0.00004
FLUORIDE	mg/L	11/30/81		0.11000
GROSS ALPHA	pcu/L	11/30/81	ND	4.08000
GROSS ALPHA	pCi/l	11/30/81	ND	4.08000
GROSS BETA	pcu/L	11/30/81		2.07000
GROSS BETA	pCi/l	11/30/81		2.07000
IRON	mg/L	11/30/81		0.65000
LEAD	mg/L	11/30/81	ND	0.01000
LINDANE	mg/L	11/30/81	ND	0.00008
MANGANESE	mg/L	11/30/81		0.03000
MERCURY	mg/L	11/30/81	ND	0.00020
METHOXYCHLOR	mg/L	11/30/81	ND	0.00160
NO2+NO3 AS N	mg/L	11/30/81		0.17000
ORGANIC CARBON, TOTAL	mg/L	11/30/81		3.60000 3.50000 3.50000 3.40000
PHENOLS	mg/L	11/30/81	ND	0.01000
SELENIUM	mg/L	11/30/81	ND	0.00500
SILVER	mg/L	11/30/81	ND	0.01000
SILVEX	mg/L	11/30/81	ND	0.00050

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-03

PARAMETER NAME	UNITS	DATESAMPLE		AMOUNT DETECTED
SODIUM	mg/L	11/30/81		16.00000
SPECIFIC CONDUCTANCE	umho/cm	11/30/81		540.00000
				540.00000
				540.00000
				540.00000
SULFATE	mg/L	11/30/81		36.50000
TOTAL ORGANIC HALOGENS	mg/L	11/30/81		0.04700
				0.06500
				0.03800
				0.05100
TOTCOLBACT	PHM	11/30/81		5.00000
TOXAPHENE	mg/L	11/30/81	ND	0.00160
pH, Field	S.U.	11/30/81		7.30000
				7.30000
				7.20000
				7.30000
IRON	mg/L	03/05/82		0.65000
TOTCOLBACT	PHM	03/05/82		5.00000
2,4-D	mg/L	03/23/82	ND	0.00380
ARSENIC	mg/L	03/23/82	ND	0.01000
BARIUM	mg/L	03/23/82	ND	0.10000
CADMIUM	mg/L	03/23/82	ND	0.00500
CHLORIDE	mg/L	03/23/82		7.00000
CHROMIUM	mg/L	03/23/82	ND	0.01000
ENDRIN	mg/L	03/23/82	ND	0.00004
FLUORIDE	mg/L	03/23/82	ND	0.10000
GROSS ALPHA	pcu/L	03/23/82	<	3.22000
GROSS ALPHA	pcu/L	03/23/82	<	3.22000
GROSS BETA	pcu/L	03/23/82		4.49000
GROSS BETA	pcu/L	03/23/82		4.49000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-03

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
IRON	mg/L	03/23/82		0.10000
LEAD	mg/L	03/23/82	ND	0.01000
LINDANE	mg/L	03/23/82	ND	0.00008
MANGANESE	mg/L	03/23/82	ND	0.01000
MERCURY	mg/L	03/23/82	ND	0.00020
METHOXYCHLOR	mg/L	03/23/82	ND	0.00160
NO2+NO3 AS N	mg/L	03/23/82		0.13000
ORGANIC CARBON, TOTAL	mg/L	03/23/82		2.00000
				3.00000
				2.00000
				3.00000
PHENOLS	mg/L	03/23/82	ND	0.01000
SELENIUM	mg/L	03/23/82	ND	0.01000
SILVER	mg/L	03/23/82		0.01000
SILVEX	mg/L	03/23/82	ND	0.00050
SODIUM	mg/L	03/23/82		17.00000
SPECIFIC CONDUCTANCE	umho/cm	03/23/82		422.00000
				420.00000
				421.00000
				422.00000
SULFATE	mg/L	03/23/82		29.80000
TOTAL ORGANIC HALOGENS	mg/L	03/23/82		0.01400
				0.02900
				0.01500
				0.01700
TOXAPHENE	mg/L	03/23/82	ND	0.00160
pH, Field	S.U.	03/23/82		6.40000
				6.40000
				6.40000
				6.40000
pH, Field	S.U.	07/18/82		6.40000
				6.40000
				6.40000
				6.40000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-03

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
2,4-D	mg/L	07/20/82	ND	0.00380
ARSENIC	mg/L	07/20/82	ND	0.01000
BARIUM	mg/L	07/20/82	ND	0.10000
CADMIUM	mg/L	07/20/82	ND	0.00500
CHLORIDE	mg/L	07/20/82		7.00000
CHROMIUM	mg/L	07/20/82	ND	0.01000
ENDRIN	mg/L	07/20/82	ND	0.00004
FLUORIDE	mg/L	07/20/82		0.10000
GROSS ALPHA	pcu/L	07/20/82	<	3.11000
GROSS ALPHA	pcu/L	07/20/82	<3	0.11000
GROSS BETA	pcu/L	07/20/82	ND	2.12000
GROSS BETA	pcu/L	07/20/82	ND	2.12000
IRON	mg/L	07/20/82		0.71000
LEAD	mg/L	07/20/82	ND	0.01000
LINDANE	mg/L	07/20/82	ND	0.00008
MANGANESE	mg/L	07/20/82	ND	0.03000
MERCURY	mg/L	07/20/82	ND	0.00020
METHOXYCHLOR	mg/L	07/20/82	ND	0.00160
NO2+NO3 AS N	mg/L	07/20/82		0.06000
ORGANIC CARBON, TOTAL	mg/L	07/20/82		38.00000 38.00000 38.00000 38.00000
PHENOLS	mg/L	07/20/82		0.06000
SELENIUM	mg/L	07/20/82	ND	0.00500
SILVER	mg/L	07/20/82	ND	0.01000
SILVEX	mg/L	07/20/82	ND	0.00050

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-03

PARAMETER NAME	UNITS	DATESAMPLE		AMOUNT DETECTED
SODIUM	mg/L	07/20/82		13.00000
SPECIFIC CONDUCTANCE	umho/cm	07/20/82		465.00000
				465.00000
				465.00000
				465.00000
SULFATE	mg/L	07/20/82		31.00000
TOTAL ORGANIC HALOGENS	mg/L	07/20/82		0.04000
				0.06400
				0.08800
				0.04000
TOXAPHENE	mg/L	07/20/82	ND	0.00160
pH, Field	S.U.	07/20/82		6.70000
				6.70000
				6.70000
				6.70000
1,1,2,2-TETRACHLOROETHANE	mg/L	10/05/82		0.02000
1,1-DICHLOROETHYLENE	mg/L	10/05/82	ND	0.00100
1,2-DICHLOROETHANE	mg/L	10/05/82	ND	0.00100
2,4-D	mg/L	10/05/82	ND	0.00380
ARSENIC	mg/L	10/05/82	ND	0.01000
BARIUM	mg/L	10/05/82	ND	0.10000
BROMOFORM	mg/L	10/05/82	ND	0.00200
CADMIUM	mg/L	10/05/82	ND	0.00500
CARBON TETRACHLORIDE	mg/L	10/05/82	ND	0.00100
CHLORIDE	mg/L	10/05/82	ND	1.00000
CHLOROBENZENE	mg/L	10/05/82	ND	0.00100
CHLOROFORM	mg/L	10/05/82	ND	0.00100
CHROMIUM	mg/L	10/05/82	ND	0.01000
ENDRIN	mg/L	10/05/82	ND	0.00004
FLUORIDE	mg/L	10/05/82		0.20000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-03

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
FLUORIDE	mg/L	10/05/82	ND	0.10000
GROSS ALPHA	pcu/L	10/05/82	<	3.04000
GROSS ALPHA	pcu/L	10/05/82	<	3.04000
GROSS BETA	pcu/L	10/05/82	ND	1.66000
GROSS BETA	pcu/L	10/05/82	ND	1.66000
IRON	mg/L	10/05/82	ND	0.03000
LEAD	mg/L	10/05/82	ND	0.01000
LINDANE	mg/L	10/05/82	ND	0.00008
MANGANESE	mg/L	10/05/82		0.29000
MERCURY	mg/L	10/05/82		0.00090
METHOXYCHLOR	mg/L	10/05/82	ND	0.00160
METHYLENE CHLORIDE	mg/L	10/05/82	ND	0.00100
NO2+NO3 AS N	mg/L	10/05/82		0.11000
ORGANIC CARBON, TOTAL	mg/L	10/05/82		34.00000
				33.00000
				34.00000
				34.00000
PHENOLS	mg/L	10/05/82		0.03000
SELENIUM	mg/L	10/05/82	ND	0.00500
SILVER	mg/L	10/05/82	ND	0.01000
SILVEX	mg/L	10/05/82	ND	0.00050
SODIUM	mg/L	10/05/82		10.00000
SPECIFIC CONDUCTANCE	umho/cm	10/05/82		500.00000
				500.00000
				500.00000
				500.00000
SULFATE	mg/L	10/05/82		15.00000
TETRACHLOROETHYLENE	mg/L	10/05/82	ND	0.00100
TOTAL ORGANIC HALOGENS	mg/L	10/05/82	ND	0.01000
				0.01000
				0.01100
				0.01100

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-03

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
TOXAPHENE	mg/L	10/05/82	ND	0.00160
TRANS-1,2-DICHLOROETHYLENE	mg/L	10/05/82	ND	0.00100
TRICHLOROETHYLENE	mg/L	10/05/82		0.00300
pH, Field	S.U.	10/05/82		7.00000
				7.00000
				7.10000
				7.10000
IRON	mg/L	11/08/82		0.71000
MANGANESE	mg/L	01/14/83		0.29000
SULFATE	mg/L	01/14/83		15.00000
CHLORIDE	mg/L	02/22/83		6.00000
IRON	mg/L	02/22/83		0.11000
MANGANESE	mg/L	02/22/83		0.01000
ORGANIC CARBON, TOTAL	mg/L	02/22/83		25.00000
				26.00000
				24.00000
				24.00000
PHENOLS	mg/L	02/22/83	ND	0.01000
SODIUM	mg/L	02/22/83		17.00000
SPECIFIC CONDUCTANCE	umho/cm	02/22/83		590.00000
				590.00000
				595.00000
				590.00000
SULFATE	mg/L	02/22/83		33.00000
TOTAL ORGANIC HALOGENS	mg/L	02/22/83	ND	0.01000
				0.01000
			ND	0.01000
			ND	0.01000
pH, Field	S.U.	02/22/83		7.20000
				7.20000
				7.20000
				7.20000
ORGANIC CARBON, TOTAL	mg/L	07/27/83		32.00000
				31.00000
				31.00000
				32.00000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-03

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
SPECIFIC CONDUCTANCE	umho/cm	07/27/83		650.00000
				650.00000
				650.00000
				650.00000
TOTAL ORGANIC HALOGENS	mg/L	07/27/83	C	0.09100
			C	0.10000
			C	0.06100
			C	0.09700
pH, Field	S.U.	07/27/83	.	6.50000
				6.40000
				6.50000
				6.50000
CHLORIDE	mg/L	01/31/84		5.00000
IRON, TOTAL	mg/L	01/31/84	<	0.01000
MANGANESE	mg/L	01/31/84	<	0.00500
ORGANIC BROMINE	mg/L	01/31/84		0.01600
ORGANIC CARBON, TOTAL	mg/L	01/31/84	ND	2.00000
ORGANIC CHLORINE	mg/L	01/31/84		1.30000
ORGANIC IODINE	mg/L	01/31/84		0.00600
PHENOLS	mg/L	01/31/84	<	0.00400
SODIUM	mg/L	01/31/84		12.00000
SPECIFIC CONDUCTANCE	umho/cm	01/31/84		360.00000
SULFATE	mg/L	01/31/84		26.00000
pH, Field	S.U.	01/31/84		6.90000
ORGANIC BROMINE	mg/L	06/07/84	ND	0.00200
ORGANIC CARBON, TOTAL	mg/L	06/07/84	<	2.00000
ORGANIC CHLORINE	mg/L	06/07/84		0.06000
ORGANIC IODINE	mg/L	06/07/84		0.00700
SPECIFIC CONDUCTANCE	umho/cm	06/07/84		400.00000
pH, Field	S.U.	06/07/84		7.20000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-03

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
CONDUCTANCE, Field	umho/cm	06/10/85		350.00000
ORGANIC CARBON, TOTAL	mg/L	06/10/85		2.80000
TOTAL ORGANIC HALOGENS	mg/L	06/10/85		0.20000
pH, Field	S.U.	06/10/85		7.30000
CHLORIDE	mg/L	01/28/86		4.00000
IRON, TOTAL	mg/L	01/28/86	<	0.02000
MANGANESE	mg/L	01/28/86	ND	0.02000
ORGANIC BROMINE	mg/L	01/28/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	01/28/86	ND	1.00000
ORGANIC CHLORINE	mg/L	01/28/86	<	0.01000
ORGANIC IODINE	mg/L	01/28/86	<	0.01000
PHENOLS	mg/L	01/28/86	ND	0.01000
SODIUM	mg/L	01/28/86		12.00000
SPECIFIC CONDUCTANCE	umho/cm	01/28/86		320.00000
SULFATE	mg/L	01/28/86		27.00000
VOLATILES SCAN	mg/L	01/28/86	ND	5.00000
VOLATILES SCAN	mg/L	01/28/86	ND	5.00000
pH	S.U.	01/28/86		7.00000
ORGANIC BROMINE	mg/L	06/03/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	06/03/86		3.00000
ORGANIC CHLORINE	mg/L	06/03/86		0.10000
ORGANIC IODINE	mg/L	06/03/86		0.01000
SPECIFIC CONDUCTANCE	umho/cm	06/03/86		415.00000
pH	S.U.	06/03/86		6.70000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-04

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
2,4-D	mg/L	11/30/81	ND	0.00380
ARSENIC	mg/L	11/30/81	ND	0.01000
BARIUM	mg/L	11/30/81	ND	0.10000
CADMIUM	mg/L	11/30/81	ND	0.00500
CHLORIDE	mg/L	11/30/81		28.60000
CHROMIUM	mg/L	11/30/81	ND	0.01000
ENDRIN	mg/L	11/30/81	ND	0.00004
FLUORIDE	mg/L	11/30/81		0.24000
GROSS ALPHA	pcu/L	11/30/81	ND	4.08000
GROSS ALPHA	pCi/l	11/30/81	ND	4.08000
GROSS BETA	pcu/L	11/30/81		3.36000
GROSS BETA	pCi/l	11/30/81		3.36000
IRON	mg/L	11/30/81	ND	0.03000
LEAD	mg/L	11/30/81	ND	0.01000
LINDANE	mg/L	11/30/81	ND	0.00008
MANGANESE	mg/L	11/30/81		6.20000
MERCURY	mg/L	11/30/81	ND	0.00020
METHOXYCHLOR	mg/L	11/30/81	ND	0.00160
NO2+NO3 AS N	mg/L	11/30/81		0.06000
ORGANIC CARBON, TOTAL	mg/L	11/30/81		12.70000 12.90000 12.80000 12.80000
PHENOLS	mg/L	11/30/81	ND	0.01000
SELENIUM	mg/L	11/30/81	ND	0.00500
SILVER	mg/L	11/30/81	ND	0.01000
SILVEX	mg/L	11/30/81	ND	0.00050

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-04

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
SODIUM	mg/L	11/30/81		90.00000
SPECIFIC CONDUCTANCE	umho/cm	11/30/81		1300.00000
				1300.00000
				1310.00000
				1310.00000
SULFATE	mg/L	11/30/81		372.00000
TOTAL ORGANIC HALOGENS	mg/L	11/30/81		0.10200
				0.09300
				0.09000
				0.11900
TOTCOLBACT	PHM	11/30/81		9.00000
TOXAPHENE	mg/L	11/30/81	ND	0.00160
pH, Field	S.U.	11/30/81		6.80000
				6.90000
				6.80000
				6.90000
MANGANESE	mg/L	03/05/82		6.20000
SULFATE	mg/L	03/05/82		372.00000
TOTCOLBACT	PHM	03/05/82		9.00000
2,4-D	mg/L	03/23/82	ND	0.00380
ARSENIC	mg/L	03/23/82	ND	0.01000
BARIUM	mg/L	03/23/82	ND	0.10000
CADMIUM	mg/L	03/23/82	ND	0.00500
CHLORIDE	mg/L	03/23/82		62.40000
CHROMIUM	mg/L	03/23/82	ND	0.01000
ENDRIN	mg/L	03/23/82	ND	0.00004
FLUORIDE	mg/L	03/23/82		0.19000
GROSS ALPHA	pcu/L	03/23/82	<	6.73000
GROSS ALPHA	pcu/L	03/23/82	<	6.73000
GROSS BETA	pcu/L	03/23/82		2.88000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-04

PARAMETER NAME	UNITS	DATESAMPLE		AMOUNT DETECTED
GROSS BETA	pcu/L	03/23/82		2.88000
IRON	mg/L	03/23/82		0.08000
LEAD	mg/L	03/23/82	ND	0.01000
LINDANE	mg/L	03/23/82	ND	0.00008
MANGANESE	mg/L	03/23/82		7.00000
MERCURY	mg/L	03/23/82	ND	0.00020
METHOXYCHLOR	mg/L	03/23/82	ND	0.00160
NO2+NO3 AS N	mg/L	03/23/82	ND	0.05000
ORGANIC CARBON, TOTAL	mg/L	03/23/82		11.00000 12.00000 11.00000 11.00000
PHENOLS	mg/L	03/23/82	ND	0.01000
RADIUM-226	pcu/L	03/23/82		0.19000
RADIUM-226	pcu/L	03/23/82		0.19000
SELENIUM	mg/L	03/23/82	ND	0.00500
SILVER	mg/L	03/23/82	ND	0.01000
SILVEX	mg/L	03/23/82	ND	0.00050
SODIUM	mg/L	03/23/82		80.00000
SPECIFIC CONDUCTANCE	umho/cm	03/23/82		1500.00000 1500.00000 1500.00000 1500.00000
SULFATE	mg/L	03/23/82		460.00000
TOTAL ORGANIC HALOGENS	mg/L	03/23/82		0.01800 0.01200 0.01200 0.05100
TOXAPHENE	mg/L	03/23/82	ND	0.00160
pH, Field	S.U.	03/23/82		6.40000 6.30000 6.50000 6.40000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-04

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
MANGANESE	mg/L	07/18/82		7.00000
SULFATE	mg/L	07/18/82		460.00000
pH, Field	S.U.	07/18/82		6.40000 6.30000 6.40000
2,4-D	mg/L	07/20/82	ND	0.00380
ARSENIC	mg/L	07/20/82	ND	0.01000
BARIUM	mg/L	07/20/82	ND	0.10000
CADMIUM	mg/L	07/20/82	ND	0.00500
CHLORIDE	mg/L	07/20/82		30.00000
CHROMIUM	mg/L	07/20/82	ND	0.01000
ENDRIN	mg/L	07/20/82	ND	0.00004
FLUORIDE	mg/L	07/20/82		0.26000
GROSS ALPHA	pcu/L	07/20/82	<	6.54000
GROSS ALPHA	pcu/L	07/20/82	<	6.54000
GROSS BETA	pcu/L	07/20/82		1.55000
GROSS BETA	pcu/L	07/20/82		1.55000
IRON	mg/L	07/20/82		0.12000
LEAD	mg/L	07/20/82	ND	0.01000
LINDANE	mg/L	07/20/82	ND	0.00008
MANGANESE	mg/L	07/20/82		0.15000
MERCURY	mg/L	07/20/82	ND	0.00020
METHOXYCHLOR	mg/L	07/20/82	ND	0.00160
NO2+NO3 AS N	mg/L	07/20/82	ND	0.05000
ORGANIC CARBON, TOTAL	mg/L	07/20/82		48.00000 48.00000 47.00000 48.00000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-04

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
PHENOLS	mg/L	07/20/82		0.02000
RADIUM-226	pcu/L	07/20/82		0.17000
SELENIUM	mg/L	07/20/82	ND	0.00500
SILVER	mg/L	07/20/82	ND	0.01000
SILVEX	mg/L	07/20/82	ND	0.00050
SODIUM	mg/L	07/20/82		130.00000
SPECIFIC CONDUCTANCE	umho/cm	07/20/82		1350.00000
				1350.00000
				1340.00000
				1340.00000
SULFATE	mg/L	07/20/82		510.00000
TOTAL ORGANIC HALOGENS	mg/L	07/20/82		0.01700
			ND	0.01000
				0.01900
				0.03400
TOXAPHENE	mg/L	07/20/82	ND	0.00160
pH, Field	S.U.	07/20/82		6.80000
				6.80000
				6.70000
				6.80000
RADIUM-226	pcu/L	08/21/82		0.17000
1,1,2,2-TETRACHLOROETHANE	mg/L	10/05/82	ND	0.00100
1,1-DICHLOROETHYLENE	mg/L	10/05/82	ND	0.00100
1,2-DICHLOROETHANE	mg/L	10/05/82	ND	0.00100
2,4-D	mg/L	10/05/82	ND	0.00380
ARSENIC	mg/L	10/05/82	ND	0.01000
BARIUM	mg/L	10/05/82	ND	0.10000
BROMOFORM	mg/L	10/05/82	ND	0.00200
CADMIUM	mg/L	10/05/82	ND	0.00500
CARBON TETRACHLORIDE	mg/L	10/05/82	ND	0.00100

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-04

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
CHLORIDE	mg/L	10/05/82		22.00000
CHLOROBENZENE	mg/L	10/05/82	ND	0.00100
CHLOROFORM	mg/L	10/05/82	ND	0.00100
CHROMIUM	mg/L	10/05/82	ND	0.01000
ENDRIN	mg/L	10/05/82	ND	0.00004
FLUORIDE	mg/L	10/05/82		0.26000
GROSS ALPHA	pcu/L	10/05/82	<	6.33000
GROSS ALPHA	pcu/L	10/05/82	<	6.33000
GROSS BETA	pcu/L	10/05/82	ND	1.66000
GROSS BETA	pcu/L	10/05/82	ND	1.66000
IRON	mg/L	10/05/82	ND	1.00000
LEAD	mg/L	10/05/82	ND	0.01000
LINDANE	mg/L	10/05/82	ND	0.00008
MANGANESE	mg/L	10/05/82		0.50000
MERCURY	mg/L	10/05/82		0.00070
METHOXYCHLOR	mg/L	10/05/82	ND	0.00160
METHYLENE CHLORIDE	mg/L	10/05/82	ND	0.00100
NO2+NO3 AS N	mg/L	10/05/82		0.18000
ORGANIC CARBON, TOTAL	mg/L	10/05/82		58.00000 58.00000 59.00000 60.00000
PHENOLS	mg/L	10/05/82		0.01000
RADIUM-226	pcl	10/05/82		0.17000
RADIUM-226	pCi/l	10/05/82		0.25000
SELENIUM	mg/L	10/05/82	ND	0.00500
SILVER	mg/L	10/05/82	ND	0.01000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-04

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
SILVEX	mg/L	10/05/82	ND	0.00050
SODIUM	mg/L	10/05/82		109.00000
SPECIFIC CONDUCTANCE	umho/cm	10/05/82		1480.00000
				1490.00000
				1490.00000
				1480.00000
SULPHATE	mg/L	10/05/82		420.00000
TETRACHLOROETHYLENE	mg/L	10/05/82	ND	0.00100
TOTAL ORGANIC HALOGENS	mg/L	10/05/82		0.01000
				0.04100
				0.07000
				0.03200
TOXAPHENE	mg/L	10/05/82	ND	0.00160
TRANS-1,2-DICHLOROETHYLENE	mg/L	10/05/82	ND	0.00100
TRICHLOROETHYLENE	mg/L	10/05/82	ND	0.00100
pH, Field	S.U.	10/05/82		6.70000
				6.70000
				6.60000
				6.90000
MANGANESE	mg/L	11/08/82		0.15000
SULFATE	mg/L	11/08/82		510.00000
MANGANESE	mg/L	01/14/83		0.50000
SULFATE	mg/L	01/14/83		420.00000
CHLORIDE	mg/L	02/22/83		21.00000
IRON	mg/L	02/22/83	ND	0.03000
MANGANESE	mg/L	02/22/83		1.09000
ORGANIC CARBON, TOTAL	mg/L	02/22/83		22.00000
				23.00000
				22.00000
				22.00000
PHENOLS	mg/L	02/22/83	ND	0.01000
SODIUM	mg/L	02/22/83		132.00000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-04

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED
SPECIFIC CONDUCTANCE	umho/cm	02/22/83	1375.00000
			1375.00000
			1380.00000
			1380.00000
SULFATE	mg/L	02/23/83	430.00000
TOTAL ORGANIC HALOGENS	mg/L	02/22/83	0.01100
			0.01300
			0.01800
			0.01200
pH, Field	S.U.	02/22/83	7.10000
			7.10000
			7.00000
			7.00000
ORGANIC CARBON, TOTAL	mg/L	07/26/83	25.00000
			25.00000
			25.00000
			25.00000
SPECIFIC CONDUCTANCE	umho/cm	07/26/83	1850.00000
			1800.00000
			1800.00000
			1800.00000
TOTAL ORGANIC HALOGENS	mg/L	07/26/83	C 0.01100
			C 0.01300
			C 0.01400
			C 0.01300
pH, Field	S.U.	07/26/83	6.70000
			6.80000
			6.70000
			6.60000
CHLORIDE	mg/L	01/31/84	19.00000
IRON, TOTAL	mg/L	01/31/84	< 0.01000
MANGANESE	mg/L	01/31/84	0.13000
ORGANIC BROMINE	mg/L	01/31/84	ND 0.00200
ORGANIC CARBON, TOTAL	mg/L	01/31/84	ND 2.00000
ORGANIC CHLORINE	mg/L	01/31/84	0.39000
ORGANIC IODINE	mg/L	01/31/84	0.00300

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-04

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED
PHENOLS	mg/L	01/31/84	< 0.00400
SODIUM	mg/L	01/31/84	120.00000
SPECIFIC CONDUCTANCE	umho/cm	01/31/84	1400.00000
SULFATE	mg/L	01/31/84	470.00000
pH, Field	S.U.	01/31/84	6.70000
ORGANIC BROMINE	mg/L	06/07/84	0.00800
ORGANIC CARBON, TOTAL	mg/L	06/07/84	2.00000
ORGANIC CHLORINE	mg/L	06/07/84	0.02000
ORGANIC IODINE	mg/L	06/07/84	0.00800
SPECIFIC CONDUCTANCE	umho/cm	06/07/84	1800.00000
pH, Field	S.U.	06/07/84	6.90000
CONDUCTANCE, Field	umho/cm	06/10/85	1204.00000
ORGANIC CARBON, TOTAL	mg/L	06/10/85	2.40000
TOTAL ORGANIC HALOGENS	mg/L	06/10/85	0.02350
pH, Field	S.U.	06/10/85	7.00000
CHLORIDE	mg/L	01/29/86	20.00000
IRON, TOTAL	mg/L	01/29/86	0.04000
MANGANESE	mg/L	01/29/86	0.07000
ORGANIC BROMINE	mg/L	01/29/86	ND 0.01000
ORGANIC CARBON, TOTAL	mg/L	01/29/86	3.00000
ORGANIC CHLORINE	mg/L	01/29/86	0.31000
ORGANIC IODINE	mg/L	01/29/86	< 0.01000
PHENOLS	mg/L	01/29/86	0.01000
SODIUM	mg/L	01/29/86	100.00000
SPECIFIC CONDUCTANCE	umho/cm	01/29/86	1300.00000
SPECIFIC CONDUCTANCE	umho/cm	01/29/86	2000.00000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-04

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
SULFATE	mg/L	01/29/86		340.00000
pH	S.U.	01/29/86		6.60000
ORGANIC BROMINE	mg/L	06/03/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	06/03/86	ND	1.00000
ORGANIC CHLORINE	mg/L	06/03/86	<	0.01000
ORGANIC IODINE	mg/L	06/03/86		0.01000
SPECIFIC CONDUCTANCE	umho/cm	06/03/86		1680.00000
pH	S.U.	06/03/86		6.60000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-05

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
2,4-D	mg/L	11/30/81	ND	0.00380
ARSENIC	mg/L	11/30/81	ND	0.01000
BARIUM	mg/L	11/30/81	ND	0.10000
CADMIUM	mg/L	11/30/81	ND	0.00500
CHLORIDE	mg/L	11/30/81		98.90000
CHROMIUM	mg/L	11/30/81	ND	0.01000
ENDRIN	mg/L	11/30/81	ND	0.00004
FLUORIDE	mg/L	11/30/81		0.17000
GROSS ALPHA	pcu/L	11/30/81	ND	4.08000
GROSS ALPHA	pCi/l	11/30/81	ND	4.08000
GROSS BETA	pcu/L	11/30/81		6.27000
GROSS BETA	pCi/l	11/30/81		6.27000
IRON	mg/L	11/30/81		0.20000
LEAD	mg/L	11/30/81	ND	0.01000
LINDANE	mg/L	11/30/81	ND	0.00008
MANGANESE	mg/L	11/30/81		5.70000
MERCURY	mg/L	11/30/81	ND	0.00020
METHOXYCHLOR	mg/L	11/30/81	ND	0.00160
NO2+NO3 AS N	mg/L	11/30/81	ND	0.05000
ORGANIC CARBON, TOTAL	mg/L	11/30/81		12.70000 12.90000 12.80000 12.80000
PHENOLS	mg/L	11/30/81		0.01000
SELENIUM	mg/L	11/30/81	ND	0.00500
SILVER	mg/L	11/30/81	ND	0.01000
SILVEX	mg/L	11/30/81	ND	0.00050

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-05

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
SODIUM	mg/L	11/30/81		136.00000
SPECIFIC CONDUCTANCE	umho/cm	11/30/81		2100.00000
				2120.00000
				2100.00000
				2110.00000
SULFATE	mg/L	11/30/81		711.00000
TOTAL ORGANIC HALOGENS	mg/L	11/30/81		0.03200
				0.04900
				0.05200
				0.06100
TOTCOLBACT	PHM	11/30/81		2.00000
TOXAPHENE	mg/L	11/30/81	ND	0.00160
pH, Field	S.U.	11/30/81		7.10000
				7.20000
				7.10000
				7.00000
MANGANESE	mg/L	03/05/82		5.70000
SULFATE	mg/L	03/05/82		711.00000
TOTCOLBACT	PHM	03/05/82		2.00000
2,4-D	mg/L	03/23/82	ND	0.00380
ARSENIC	mg/L	03/23/82	ND	0.01000
BARIUM	mg/L	03/23/82	ND	0.10000
CADMIUM	mg/L	03/23/82	ND	0.00500
CHLORIDE	mg/L	03/23/82		82.90000
CHROMIUM	mg/L	03/23/82	ND	0.01000
ENDRIN	mg/L	03/23/82	ND	0.00004
FLUORIDE	mg/L	03/23/82		0.15000
GROSS ALPHA	pcu/L	03/23/82	<	10.10000
GROSS ALPHA	pcu/L	03/23/82	<	10.10000
GROSS BETA	pcu/L	03/23/82		4.16000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-05

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
GROSS BETA	pcu/L	03/23/82		4.16000
IRON	mg/L	03/23/82		0.09000
LEAD	mg/L	03/23/82	ND	0.01000
LINDANE	mg/L	03/23/82	ND	0.00008
MANGANESE	mg/L	03/23/82		6.40000
MERCURY	mg/L	03/23/82	ND	0.00020
METHOXYCHLOR	mg/L	03/23/82	ND	0.00160
NO2+NO3 AS N	mg/L	03/23/82		0.12000
ORGANIC CARBON, TOTAL	mg/L	03/23/82		6.00000
				6.00000
				7.00000
				6.00000
PHENOLS	mg/L	03/23/82	ND	0.01000
RADIUM-226	pcu/L	03/23/82		0.48000
RADIUM-226	pcu/L	03/23/82		0.48000
SELENIUM	mg/L	03/23/82	ND	0.00500
SILVER	mg/L	03/23/82	ND	0.01000
SILVEX	mg/L	03/23/82	ND	0.00050
SODIUM	mg/L	03/23/82		210.00000
SPECIFIC CONDUCTANCE	umho/cm	03/23/82		2250.00000
				2250.00000
				2250.00000
				2250.00000
SULFATE	mg/L	03/23/82		760.00000
TOTAL ORGANIC HALOGENS	mg/L	03/23/82		0.08800
				0.22000
				0.09400
				0.10000
TOXAPHENE	mg/L	03/23/82	ND	0.00160
pH, Field	S.U.	03/23/82		6.40000
				6.60000
				6.60000
				6.60000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-05

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
MANGANESE	mg/L	07/18/82		6.40000
SULFATE	mg/L	07/18/82		760.00000
pH, Field	S.U.	07/18/82		6.40000 6.60000
2,4-D	mg/L	07/20/82	ND	0.00380
ARSENIC	mg/L	07/20/82	ND	0.01000
BARIUM	mg/L	07/20/82	ND	0.10000
CADMIUM	mg/L	07/20/82	ND	0.00500
CHLORIDE	mg/L	07/20/82		90.00000
CHROMIUM	mg/L	07/20/82	ND	0.01000
ENDRIN	mg/L	07/20/82	ND	0.00004
FLUORIDE	mg/L	07/20/82		0.19000
GROSS ALPHA	pcu/L	07/20/82	<	10.80000
GROSS ALPHA	pcu/L	07/20/82	<	10.80000
GROSS BETA	pcu/L	07/20/82		3.91000
GROSS BETA	pcu/L	07/20/82		3.91000
IRON	mg/L	07/20/82		0.12000
LEAD	mg/L	07/20/82	ND	0.01000
LINDANE	mg/L	07/20/82	ND	0.00008
MANGANESE	mg/L	07/20/82		2.82000
MERCURY	mg/L	07/20/82	ND	0.00020
METHOXYCHLOR	mg/L	07/20/82	ND	0.00160
NO2+NO3 AS N	mg/L	07/20/82		0.16000
ORGANIC CARBON, TOTAL	mg/L	07/20/82		66.00000 66.00000 66.00000 65.00000
PHENOLS	mg/L	07/20/82		0.05000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-05

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
RADIUM-226	pcu/L	07/20/82		0.33000
SELENIUM	mg/L	07/20/82	ND	0.00500
SILVER	mg/L	07/20/82	ND	0.01000
SILVEX	mg/L	07/20/82	ND	0.00050
SODIUM	mg/L	07/20/82		206.00000
SPECIFIC CONDUCTANCE	umho/cm	07/20/82		2380.00000
				2370.00000
				2350.00000
				2380.00000
SULFATE	mg/L	07/20/82		680.00000
TOTAL ORGANIC HALOGENS	mg/L	07/20/82		1.60000
				1.60000
				1.60000
				1.60000
TOXAPHENE	mg/L	07/20/82	ND	0.00160
pH, Field	S.U.	07/20/82		6.70000
				6.70000
				6.60000
				6.70000
RADIUM-226	pcu/L	08/21/82		0.33000
1,1,2,2-TETRACHLOROETHANE	mg/L	10/05/82		0.05800
1,1-DICHLOROETHYLENE	mg/L	10/05/82	ND	0.00100
1,2-DICHLOROETHANE	mg/L	10/05/82	ND	0.00100
2,4-D	mg/L	10/05/82	ND	0.00380
ARSENIC	mg/L	10/05/82		0.01000
BARIUM	mg/L	10/05/82	ND	0.10000
BROMOFORM	mg/L	10/05/82	ND	0.00200
CADMIUM	mg/L	10/05/82	ND	0.00500
CARBON TETRACHLORIDE	mg/L	10/05/82	ND	0.00100
CHLORIDE	mg/L	10/05/82		95.00000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-05

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
CHLOROBENZENE	mg/L	10/05/82	ND	0.00100
CHLOROFORM	mg/L	10/05/82	ND	0.00100
CHROMIUM	mg/L	10/05/82	ND	0.01000
ENDRIN	mg/L	10/05/82	ND	0.00004
FLUORIDE	mg/L	10/05/82		0.19000
GROSS ALPHA	pcu/L	10/05/82	<	9.35000
GROSS ALPHA	pcu/L	10/05/82	<	9.35000
GROSS BETA	pcu/L	10/05/82		3.30000
GROSS BETA	pcu/L	10/05/82		3.30000
IRON	mg/L	10/05/82	ND	0.03000
LEAD	mg/L	10/05/82	ND	0.01000
LINDANE	mg/L	10/05/82	ND	0.00008
MANGANESE	mg/L	10/05/82		4.80000
MERCURY	mg/L	10/05/82		0.00110
METHOXYCHLOR	mg/L	10/05/82	ND	0.00160
METHYLENE CHLORIDE	mg/L	10/05/82	ND	0.00100
NO2+NO3 AS N	mg/L	10/05/82		0.14000
ORGANIC CARBON, TOTAL	mg/L	10/05/82		72.00000 75.00000 76.00000 75.00000
PHENOLS	mg/L	10/05/82		0.01000
RADIUM-226	pcl	10/05/82		0.32000
RADIUM-226	pcl	10/05/82		0.33000
SELENIUM	mg/L	10/05/82	ND	0.00500
SILVER	mg/L	10/05/82	ND	0.01000
SILVEX	mg/L	10/05/82	ND	0.00050

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-05

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED
SODIUM	mg/L	10/05/82	144.00000
SPECIFIC CONDUCTANCE	umho/cm	10/05/82	2200.00000
SULFATE	mg/L	10/05/82	800.00000
TETRACHLOROETHYLENE	mg/L	10/05/82	ND 0.00100
TOTAL ORGANIC HALOGENS	mg/L	10/05/82	0.29000
			0.43000
			0.28000
			0.58000
TOXAPHENE	mg/L	10/05/82	ND 0.00160
TRANS-1,2-DICHLOROETHYLENE	mg/L	10/05/82	ND 0.00100
TRICHLOROETHYLENE	mg/L	10/05/82	2.90000
pH, Field	S.U.	10/05/82	6.80000
			6.70000
			6.70000
			6.70000
MANGANESE	mg/L	11/08/82	2.82000
SULFATE	mg/L	11/08/82	880.00000
MANGANESE	mg/L	01/14/83	4.80000
SULFATE	mg/L	01/14/83	800.00000
CHLORIDE	mg/L	02/22/83	88.00000
IRON	mg/L	02/22/83	ND 0.03000
MANGANESE	mg/L	02/22/83	4.50000
ORGANIC CARBON, TOTAL	mg/L	02/22/83	44.00000
			43.00000
			45.00000
			44.00000
PHENOLS	mg/L	02/22/83	ND 0.01000
SODIUM	mg/L	02/22/83	182.00000
SPECIFIC CONDUCTANCE	umho/cm	02/22/83	2520.00000
			2500.00000
			2500.00000
			2520.00000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-05

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED
SULFATE	mg/L	02/22/83	940.00000
TOTAL ORGANIC HALOGENS	mg/L	02/22/83	0.75000
			0.73000
			0.75000
			0.75000
pH, Field	S.U.	02/22/83	6.80000
			6.80000
			6.80000
			6.80000
ORGANIC CARBON, TOTAL	mg/L	07/27/83	72.00000
			70.00000
			71.00000
			71.00000
SPECIFIC CONDUCTANCE	umho/cm	07/27/83	2460.00000
			2460.00000
			2460.00000
			2460.00000
TOTAL ORGANIC HALOGENS	mg/L	07/27/83	C 0.39000
			C 0.40000
			C 0.40000
			C 0.41000
pH, Field	S.U.	07/27/83	6.80000
			6.70000
			6.60000
			6.80000
CHLORIDE	mg/L	01/31/84	94.00000
IRON, TOTAL	mg/L	01/31/84	0.55000
MANGANESE	mg/L	01/31/84	6.60000
ORGANIC BROMINE	mg/L	01/31/84	0.00500
ORGANIC CARBON, TOTAL	mg/L	01/31/84	7.00000
ORGANIC CHLORINE	mg/L	01/31/84	0.14000
ORGANIC IODINE	mg/L	01/31/84	0.00600
PHENOLS	mg/L	01/31/84	ND 0.00400
SODIUM	mg/L	01/31/84	140.00000
SPECIFIC CONDUCTANCE	umho/cm	01/31/84	2100.00000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-05

PARAMETER NAME	UNITS	DATESAMPLE		AMOUNT DETECTED
SULFATE	mg/L	01/31/84		900.00000
pH, Field	S.U.	01/31/84		6.70000
ORGANIC BROMINE	mg/L	06/07/84		0.01000
ORGANIC CARBON, TOTAL	mg/L	06/07/84		2.00000
ORGANIC CHLORINE	mg/L	06/07/84		0.45000
ORGANIC IODINE	mg/L	06/07/84		0.01000
SPECIFIC CONDUCTANCE	umho/cm	06/07/84		2300.00000
pH, Field	S.U.	06/07/84		7.30000
1,1,1-TRICHLOROETHANE	mg/L	01/07/85	<	0.00100
1,1,2,2-TETRACHLOROETHANE	mg/L	01/07/85		0.08590
1,1,2-TRICHLOROETHANE	mg/L	01/07/85		0.00460
1,1-DICHLOROETHANE	mg/L	01/07/85	<	0.00100
1,1-DICHLOROETHENE	mg/L	01/07/85	<	0.00100
1,1-DICHLOROETHENE	mg/L	01/07/85	<	0.00100
1,2-DICHLOROETHANE	mg/L	01/07/85	<	0.00100
1,2-DICHLOROPROPANE	mg/L	01/07/85	<	0.00100
2-CHLOROETHYL VINYL ETHER	mg/L	01/07/85	<	0.00100
ACROLEIN	mg/L	01/07/85	<	0.10000
ACRYLONITRILE	mg/L	01/07/85	<	0.10000
BENZENE	mg/L	01/07/85	<	0.00100
BROMOFORM	mg/L	01/07/85	<	0.00100
CARBON TETRACHLORIDE	mg/L	01/07/85	<	0.00100
CHLOROBENZENE	mg/L	01/07/85	<	0.00100
CHLORODIBROMOMETHANE	mg/L	01/07/85	<	0.00100
CHLOROETHANE	mg/L	01/07/85	<	0.01000
CHLOROFORM	mg/L	01/07/85	<	0.00100

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-05

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
CIS-1,3-DICHLOROPROPENE	mg/L	01/07/85	<	0.00100
DICHLOROBROMOMETHANE	mg/L	01/07/85	<	0.00100
DICHLORODIFLUOROMETHANE	mg/L	01/07/85	<	0.01000
ETHYL BENZENE	mg/L	01/07/85	<	0.00100
METHYL BROMIDE	mg/L	01/07/85	<	0.01000
METHYL CHLORIDE	mg/L	01/07/85	<	0.01000
METHYLENE CHLORIDE	mg/L	01/07/85	<	0.00100
TETRACHLOROETHENE	mg/L	01/07/85	<	0.00380
TOLUENE	mg/L	01/07/85	<	0.00100
TRANS-1,2-DICHLOROETHENE	mg/L	01/07/85	<	0.00100
TRANS-1,3-DICHLOROPROPENE	mg/L	01/07/85	<	0.00100
TRICHLOROETHENE	mg/L	01/07/85		1.01000
TRICHLOROFLUOROMETHANE	mg/L	01/07/85	<	0.00100
VINYL CHLORIDE	mg/L	01/07/85	<	0.01000
CONDUCTANCE, Field	umho/cm	06/10/85		1564.00000
ORGANIC CARBON, TOTAL	mg/L	06/10/85		3.60000
TOTAL ORGANIC HALOGENS	mg/L	06/10/85		2.19000
pH, Field	S.U.	06/10/85		7.00000
1,1,2,2-TETRACHLOROETHANE	mg/L	01/29/86		0.00700
1,1,2-TRICHLOROETHANE	mg/L	01/29/86		0.00500
CHLORIDE	mg/L	01/29/86		83.00000
IRON, TOTAL	mg/L	01/29/86		5.90000
MANGANESE	mg/L	01/29/86		5.70000
ORGANIC BROMINE	mg/L	01/29/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	01/29/86		5.00000
ORGANIC CHLORINE	mg/L	01/29/86		0.25000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-05

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
ORGANIC IODINE	mg/L	01/29/86	<	0.01000
PHENOLS	mg/L	01/29/86	ND	0.01000
SODIUM	mg/L	01/29/86		14.00000
SULFATE	mg/L	01/29/86		710.00000
TETRAHYDROFURAN	mg/L	01/29/86		0.01100
TETRAHYDROFURAN	mg/L	01/29/86		0.01100
TRICHLOROETHENE	mg/L	01/29/86		0.38000
VOLATILES SCAN	mg/L	01/29/86	SR	0.00000
pH	S.U.	01/29/86		6.60000
ORGANIC BROMINE	mg/L	06/03/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	06/03/86		3.00000
ORGANIC CHLORINE	mg/L	06/03/86		0.39000
ORGANIC IODINE	mg/L	06/03/86		0.01000
SPECIFIC CONDUCTANCE	umho/cm	06/03/86		2430.00000
pH	S.U.	06/03/86		6.60000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-06

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
1,1,2,2-TETRACHLOROETHANE	mg/L	10/05/82	ND	0.00100
1,1-DICHLOROETHYLENE	mg/L	10/05/82	ND	0.00100
1,2-DICHLOROETHANE	mg/L	10/05/82	ND	0.00100
BROMOFORM	mg/L	10/05/82	ND	0.00200
CARBON TETRACHLORIDE	mg/L	10/05/82	ND	0.00100
CHLOROBENZENE	mg/L	10/05/82	ND	0.00100
CHLOROFORM	mg/L	10/05/82	ND	0.00100
METHYLENE CHLORIDE	mg/L	10/05/82		0.00300
TETRACHLOROETHYLENE	mg/L	10/05/82	ND	0.00100
TRANS-1,2-DICHLOROETHYLENE	mg/L	10/05/82	ND	0.00100
TRICHLOROETHYLENE	mg/L	10/05/82	ND	0.00100
CHLORIDE	mg/L	01/30/86		4.00000
IRON, TOTAL	mg/L	01/30/86	<	0.02000
MANGANESE	mg/L	01/30/86		0.02000
ORGANIC BROMINE	mg/L	01/30/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	01/30/86	ND	1.00000
ORGANIC CHLORINE	mg/L	01/30/86	<	0.01000
ORGANIC IODINE	mg/L	01/30/86	ND	0.01000
PHENOLS	mg/L	01/30/86	ND	0.01000
SODIUM	mg/L	01/30/86		14.00000
SPECIFIC CONDUCTANCE	umho/cm	01/30/86		1400.00000
SULFATE	mg/L	01/30/86		420.00000
pH	S.U.	01/30/86		6.70000
ORGANIC BROMINE	mg/L	06/15/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	06/15/86		2.00000
ORGANIC CHLORINE	mg/L	06/15/86		0.01000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-06

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED
ORGANIC IODINE	mg/L	06/15/86	< 0.01000
SPECIFIC CONDUCTANCE	umho/cm	06/15/86	1670.00000
pH	S.U.	06/15/86	6.60000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-07

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
METHYLENE CHLORIDE	mg/L	11/18/82		0.04000
TRICHLOROETHYLENE	mg/L	11/18/82		0.00300
1,1,2,2-TETRACHLOROETHANE	mg/L	04/20/83	ND	0.00000
1,1,2,2-TETRACHLOROETHYLENE	mg/L	04/20/83	ND	0.00000
BENZENE	mg/L	04/20/83	ND	0.00000
BROMODICHLOROMETHANE	mg/L	04/20/83	ND	0.00000
BROMOFORM	mg/L	04/20/83	ND	0.00000
CHLOROFORM	mg/L	04/20/83	ND	0.00000
TRANS-1,2-DICHLOROETHYLENE	mg/L	04/20/83	ND	0.00000
TRICHLOROETHYLENE	mg/L	04/20/83	ND	0.00000
ORGANIC BROMINE	mg/L	06/07/84	ND	0.00200
ORGANIC CHLORINE	mg/L	06/07/84		0.02000
ORGANIC IODINE	mg/L	06/07/84	ND	0.00200
CHLORIDE	mg/L	01/07/85		2.00000
CONDUCTANCE, Field	umho/cm	01/07/85		1200.00000
IRON	mg/L	01/07/85		0.27000
IRON	mg/L	01/07/85		0.27000
MANGANESE	mg/L	01/07/85		1.40000
ORGANIC CARBON, TOTAL	mg/L	01/07/85		3.90000
PHENOLS	mg/L	01/07/85	<	0.05000
SODIUM	mg/L	01/07/85		26.00000
SULFATE	mg/L	01/07/85		290.00000
TOTAL ORGANIC HALOGENS	mg/L	01/07/85		0.00670
pH, Field	S.U.	01/07/85		6.40000
CONDUCTANCE, Field	umho/cm	06/10/85		940.00000
ORGANIC CARBON, TOTAL	mg/L	06/10/85		3.30000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-07

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
TOTAL ORGANIC HALOGENS	mg/L	06/10/85	<	0.00500
pH, Field	S.U.	06/10/85		6.20000
CHLORIDE	mg/L	01/29/86		16.00000
IRON, TOTAL	mg/L	01/29/86		1.30000
MANGANESE	mg/L	01/29/86		1.50000
ORGANIC BROMINE	mg/L	01/29/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	01/29/86	ND	1.00000
ORGANIC CHLORINE	mg/L	01/29/86		0.03000
ORGANIC IODINE	mg/L	01/29/86	ND	0.01000
PHENOLS	mg/L	01/29/86	ND	0.01000
SODIUM	mg/L	01/29/86		22.00000
SPECIFIC CONDUCTANCE	umho/cm	01/29/86		1100.00000
SULFATE	mg/L	01/29/86		380.00000
pH	S.U.	01/29/86		6.50000
ORGANIC BROMINE	mg/L	06/15/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	06/15/86	<	1.00000
ORGANIC CHLORINE	mg/L	06/15/86	<	0.01000
ORGANIC IODINE	mg/L	06/15/86	<	0.01000
SPECIFIC CONDUCTANCE	umho/cm	06/15/86		1240.00000
pH	S.U.	06/15/86		6.30000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-08

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
METHYLENE CHLORIDE	mg/L	11/18/82		0.00200
TRICHLOROETHYLENE	mg/L	11/18/82		0.00100
CHLORIDE	mg/L	01/07/85	<	1.00000
CONDUCTANCE, Field	umho/cm	01/07/85		500.00000
IRON	mg/L	01/07/85		2.99000
MANGANESE	mg/L	01/07/85		0.67000
ORGANIC CARBON, TOTAL	mg/L	01/07/85		3.90000
PHENOLS	mg/L	01/07/85	<	0.05000
SODIUM	mg/L	01/07/85		9.10000
SULFATE	mg/L	01/07/85		120.00000
TOTAL ORGANIC HALOGENS	mg/L	01/07/85		0.01800
pH, Field	S.U.	01/07/85		6.40000
CONDUCTANCE, Field	umho/cm	06/10/85		410.00000
ORGANIC CARBON, TOTAL	mg/L	06/10/85		9.70000
TOTAL ORGANIC HALOGENS	mg/L	06/10/85		0.00000
pH, Field	S.U.	06/10/85		6.10000
CHLORIDE	mg/L	01/29/86		7.00000
IRON, TOTAL	mg/L	01/29/86		3.70000
MANGANESE	mg/L	01/29/86		0.67000
ORGANIC BROMINE	mg/L	01/29/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	01/29/86	ND	1.00000
ORGANIC CHLORINE	mg/L	01/29/86		0.10000
ORGANIC IODINE	mg/L	01/29/86	ND	0.01000
PHENOLS	mg/L	01/29/86	ND	0.01000
SODIUM	mg/L	01/29/86		7.10000
SPECIFIC CONDUCTANCE	umho/cm	01/29/86		400.00000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-08

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED
SULFATE	mg/L	01/29/86	62.00000
pH	S.U.	01/29/86	6.40000
ORGANIC BROMINE	mg/L	06/15/86	ND 0.01000
ORGANIC CARBON, TOTAL	mg/L	06/15/86	3.00000
ORGANIC CHLORINE	mg/L	06/15/86	< 0.01000
ORGANIC IODINE	mg/L	06/15/86	< 0.01000
SPECIFIC CONDUCTANCE	umho/cm	06/15/86	470.00000
pH	S.U.	06/15/86	6.10000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-09

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
METHYLENE CHLORIDE	mg/L	11/18/82		0.00500
TRICHLOROETHYLENE	mg/L	11/18/82		0.00500
CHLORIDE	mg/L	01/07/85	<	1.00000
CONDUCTANCE, Field	umho/cm	01/07/85		290.00000
IRON	mg/L	01/07/85		0.03000
MANGANESE	mg/L	01/07/85		0.01000
ORGANIC CARBON, TOTAL	mg/L	01/07/85		5.40000
PHENOLS	mg/L	01/07/85	<	0.05000
SODIUM	mg/L	01/07/85		4.90000
SULFATE	mg/L	01/07/85		63.00000
TOTAL ORGANIC HALOGENS	mg/L	01/07/85		0.09100
pH, Field	S.U.	01/07/85		5.70000
CONDUCTANCE, Field	umho/cm	06/10/85		265.00000
ORGANIC CARBON, TOTAL	mg/L	06/10/85		2.20000
TOTAL ORGANIC HALOGENS	mg/L	06/10/85		0.18000
pH, Field	S.U.	06/10/85		7.10000
CHLORIDE	mg/L	01/29/86		1.00000
IRON, TOTAL	mg/L	01/29/86		0.02000
MANGANESE	mg/L	01/29/86	<	0.02000
ORGANIC BROMINE	mg/L	01/29/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	01/29/86		3.00000
ORGANIC CHLORINE	mg/L	01/29/86	<	0.01000
ORGANIC IODINE	mg/L	01/29/86	ND	0.01000
PHENOLS	mg/L	01/29/86	ND	0.01000
SODIUM	mg/L	01/29/86		3.80000
SPECIFIC CONDUCTANCE	umho/cm	01/29/86		390.00000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-09

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
SULFATE	mg/L	01/29/86		38.00000
pH	S.U.	01/29/86		7.00000
ORGANIC BROMINE	mg/L	06/15/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	06/15/86		7.00000
ORGANIC CHLORINE	mg/L	06/15/86	<	0.01000
ORGANIC IODINE	mg/L	06/15/86	<	0.01000
SPECIFIC CONDUCTANCE	umho/cm	06/15/86		330.00000
pH	S.U.	06/15/86		6.70000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-10

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
1,1,1-TRICHLOROETHANE	mg/L	01/25/83		0.00500
1,1,2,2-TETRACHLOROETHANE	mg/L	01/25/83	ND	0.00100
1,1,2-TRICHLOROETHANE	mg/L	01/25/83	ND	0.00100
1,1-DICHLOROETHANE	mg/L	01/25/83	ND	0.00100
1,1-DICHLOROETHYLENE	mg/L	01/25/83	ND	0.00100
1,2-DICHLOROBENZENE	mg/L	01/25/83	ND	0.00100
1,2-DICHLOROETHANE	mg/L	01/25/83	ND	0.00100
1,2-DICHLOROPROPANE	mg/L	01/25/83	ND	0.00100
1,3-DICHLOROBENZENE	mg/L	01/25/83	ND	0.00100
1,3-DICHLOROPROPENE	mg/L	01/25/83	ND	0.00100
1,4-DICHLOROBENZENE	mg/L	01/25/83	ND	0.00100
2-CHLOROETHYL VINYL ETHER	mg/L	01/25/83	ND	0.00200
BENZENE	mg/L	01/25/83		0.00100
BROMODICHLOROMETHANE	mg/L	01/25/83	ND	0.00100
BROMOFORM	mg/L	01/25/83	ND	0.00200
BROMOMETHANE	mg/L	01/25/83	ND	0.00200
CARBON TETRACHLORIDE	mg/L	01/25/83	ND	0.00100
CHLOROBENZENE	mg/L	01/25/83	ND	0.00100
CHLOROETHANE	mg/L	01/25/83	ND	0.00200
CHLOROFORM	mg/L	01/25/83	ND	0.00100
CHLOROMETHANE	mg/L	01/25/83	ND	0.00200
DIBROMOCHLOROMETHANE	mg/L	01/25/83	ND	0.00100
DICHLOROFLUOROMETHANE	mg/L	01/25/83	ND	0.00100
ETHYL BENZENE	mg/L	01/25/83	ND	0.00100
METHYLENE CHLORIDE	mg/L	01/25/83		0.00600
TETRACHLOROETHYLENE	mg/L	01/25/83		0.00100

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-10

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
TOLUENE	mg/L	01/25/83	ND	0.00100
TRANS-1,2-DICHLOROETHYLENE	mg/L	01/25/83	ND	0.00100
TRICHLOROETHYLENE	mg/L	01/25/83		0.00800
TRICHLOROFLUOROMETHANE	mg/L	01/25/83	ND	0.00100
VINYL CHLORIDE	mg/L	01/25/83	ND	0.00100
ORGANIC BROMINE	mg/L	06/07/84	ND	0.00200
ORGANIC CHLORINE	mg/L	06/07/84		0.03000
ORGANIC IODINE	mg/L	06/07/84		0.00200
CHLORIDE	mg/L	01/07/85	<	1.00000
CONDUCTANCE, Field	umho/cm	01/07/85		850.00000
IRON	mg/L	01/07/85		0.34000
MANGANESE	mg/L	01/07/85		0.87000
ORGANIC CARBON, TOTAL	mg/L	01/07/85	<	0.50000
PHENOLS	mg/L	01/07/85	<	0.05000
SODIUM	mg/L	01/07/85		21.00000
SULFATE	mg/L	01/07/85		140.00000
TOTAL ORGANIC HALOGENS	mg/L	01/07/85		0.00650
pH, Field	S.U.	01/07/85		7.00000
CONDUCTANCE, Field	umho/cm	06/10/85		572.00000
ORGANIC CARBON, TOTAL	mg/L	06/10/85		0.80000
TOTAL ORGANIC HALOGENS	mg/L	06/10/85	<	0.00500
pH, Field	S.U.	06/10/85		6.80000
CHLORIDE	mg/L	01/30/86		6.00000
IRON, TOTAL	mg/L	01/30/86		0.13000
MANGANESE	mg/L	01/30/86		0.53000
ORGANIC BROMINE	mg/L	01/30/86	ND	0.01000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-10

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
ORGANIC CARBON, TOTAL	mg/L	01/30/86	ND	1.00000
ORGANIC CHLORINE	mg/L	01/30/86	<	0.01000
ORGANIC IODINE	mg/L	01/30/86	ND	0.01000
PHENOLS	mg/L	01/30/86	ND	0.01000
SODIUM	mg/L	01/30/86		12.00000
SPECIFIC CONDUCTANCE	umho/cm	01/30/86		620.00000
SULFATE	mg/L	01/30/86		54.00000
pH	S.U.	01/30/86		7.00000
ORGANIC BROMINE	mg/L	06/04/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	06/04/86	ND	1.00000
ORGANIC CHLORINE	mg/L	06/04/86		0.06000
ORGANIC IODINE	mg/L	06/04/86	<	0.01000
SPECIFIC CONDUCTANCE	umho/cm	06/04/86		760.00000
pH	S.U.	06/04/86		7.00000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-16

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED
TRANS-1,3-DICHLOROPROPENE	mg/L	01/07/85	< 0.00100
TRICHLOROETHENE	mg/L	01/07/85	0.51300
TRICHLOROFLUOROMETHANE	mg/L	01/07/85	< 0.00100
VINYL CHLORIDE	mg/L	01/07/85	< 0.01000
pH, Field	S.U.	01/07/85	7.10000
CONDUCTANCE, Field	umho/cm	06/10/85	639.00000
ORGANIC CARBON, TOTAL	mg/L	06/10/85	3.40000
TOTAL ORGANIC HALOGENS	mg/L	06/10/85	1.33000
pH, Field	S.U.	06/10/85	6.40000

SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-17

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
1,1,1-TRICHLOROETHANE	mg/L	02/15/83		0.02300
1,1,2,2-TETRACHLOROETHANE	mg/L	02/15/83	ND	0.00100
1,1,2-TRICHLOROETHANE	mg/L	02/15/83	ND	0.00100
1,1-DICHLOROETHANE	mg/L	02/15/83	ND	0.00100
1,1-DICHLOROETHYLENE	mg/L	02/15/83	ND	0.00100
1,2-DICHLOROBENZENE	mg/L	02/15/83	ND	0.00100
1,2-DICHLOROETHANE	mg/L	02/15/83		0.00500
1,2-DICHLOROPROPANE	mg/L	02/15/83	ND	0.00100
1,3-DICHLOROBENZENE	mg/L	02/15/83	ND	0.00100
1,3-DICHLOROPROPENE	mg/L	02/15/83	ND	0.00100
1,4-DICHLOROBENZENE	mg/L	02/15/83	ND	0.00010
2-CHLOROETHYL VINYL ETHER	mg/L	02/15/83	ND	0.00200
BENZENE	mg/L	02/15/83	ND	0.00100
BROMODICHLOROMETHANE	mg/L	02/15/83	ND	0.00100
BROMOFORM	mg/L	02/15/83	ND	0.00200
BROMOMETHANE	mg/L	02/15/83	ND	0.00200
CARBON TETRACHLORIDE	mg/L	02/15/83	ND	0.00100
CHLOROBENZENE	mg/L	02/15/83	ND	0.00100
CHLOROETHANE	mg/L	02/15/83	ND	0.00200
CHLOROFORM	mg/L	02/15/83		0.00800
CHLOROMETHANE	mg/L	02/15/83	ND	0.00200
DIBROMOCHLOROMETHANE	mg/L	02/15/83	ND	0.00100
DICHLOROFLUOROMETHANE	mg/L	02/15/83	ND	0.00100
ETHYL BENZENE	mg/L	02/15/83	ND	0.00100
METHYLENE CHLORIDE	mg/L	02/15/83		0.00700
TETRACHLOROETHYLENE	mg/L	02/15/83		0.06800

SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-17

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
TOLUENE	mg/L	02/15/83	ND	0.00100
TRANS-1,2-DICHLOROETHYLENE	mg/L	02/15/83	ND	0.00100
TRICHLOROETHYLENE	mg/L	02/15/83		0.06700
TRICHLOROFLUOROMETHANE	mg/L	02/15/83		0.00400
VINYL CHLORIDE	mg/L	02/15/83	ND	0.00100
1,1,2,2-TETRACHLOROETHANE	mg/L	04/20/83	ND	0.00000
1,1,2,2-TETRACHLOROETHYLENE	mg/L	04/20/83		0.00600
BENZENE	mg/L	04/20/83	ND	0.00000
BROMODICHLOROMETHANE	mg/L	04/20/83	ND	0.00000
BROMOFORM	mg/L	04/20/83	ND	0.00000
CHLOROFORM	mg/L	04/20/83		0.00200
TRANS-1,2-DICHLOROETHYLENE	mg/L	04/20/83	ND	0.00000
TRICHLOROETHYLENE	mg/L	04/20/83		0.05800
ORGANIC BROMINE	mg/L	06/07/84	ND	0.00200
ORGANIC CHLORINE	mg/L	06/07/84		0.02000
ORGANIC IODINE	mg/L	06/07/84		0.01700
1,1,1-TRICHLOROETHANE	mg/L	01/07/85	<	0.00100
1,1,2,2-TETRACHLOROETHANE	mg/L	01/07/85	<	0.00100
1,1,2-TRICHLOROETHANE	mg/L	01/07/85	<	0.00100
1,1-DICHLOROETHANE	mg/L	01/07/85	<	0.00100
1,1-DICHLOROETHENE	mg/L	01/07/85	<	0.00100
1,2-DICHLOROETHANE	mg/L	01/07/85	<	0.00100
1,2-DICHLOROPROPANE	mg/L	01/07/85	<	0.00100
2-CHLOROETHYL VINYL ETHER	mg/L	01/07/85	<	0.00100
ACROLEIN	mg/L	01/07/85	<	0.10000
ACRYLONITRILE	mg/L	01/07/85	<	0.10000

SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-17

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
BENZENE	mg/L	01/07/85	<	0.00100
BROMOFORM	mg/L	01/07/85	<	0.00100
CARBON TETRACHLORIDE	mg/L	01/07/85	<	0.00100
CHLORIDE	mg/L	01/07/85		3.00000
CHLOROBENZENE	mg/L	01/07/85	<	0.00100
CHLOROETHANE	mg/L	01/07/85	<	0.01000
CHLOROFORM	mg/L	01/07/85	<	0.00100
CIS-1,3-DICHLOROPROPENE	mg/L	01/07/85	<	0.00100
CONDUCTANCE, Field	umho/cm	01/07/85		1200.00000
DICHLOROBROMOMETHANE	mg/L	01/07/85	<	0.00100
DICHLORODIBROMOMETHANE	mg/L	01/07/85	<	0.00100
DICHLORODIBROMOMETHANE	mg/L	01/07/85	<	0.00100
DICHLORODIFLUOROMETHANE	mg/L	01/07/85	<	0.00100
DICHLORODIFLUOROMETHANE	mg/L	01/07/85	<	0.01000
ETHYL BENZENE	mg/L	01/07/85	<	0.00100
IRON ?	mg/L	01/07/85	<	0.02000
MANGANESE	mg/L	01/07/85		0.16000
METHYL BROMIDE	mg/L	01/07/85	<	0.01000
METHYL CHLORIDE	mg/L	01/07/85	<	0.01000
METHYLENE CHLORIDE	mg/L	01/07/85	<	0.00100
ORGANIC CARBON, TOTAL	mg/L	01/07/85	<	0.50000
PHENOLS	mg/L	01/07/85	<	0.05000
SODIUM	mg/L	01/07/85		64.00000
SULFATE	mg/L	01/07/85		280.00000
TETRACHLOROETHENE	mg/L	01/07/85	<	0.00100
TOLUENE	mg/L	01/07/85	<	0.00100

SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-17

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
TOTAL ORGANIC HALOGENS	mg/L	01/07/85		0.18100
TRANS-1,2-DICHLOROETHENE	mg/L	01/07/85	<	0.00100
TRANS-1,3-DICHLOROPROPENE	mg/L	01/07/85	<	0.00100
TRICHLOROETHENE	mg/L	01/07/85	<	0.00100
TRICHLOROFLUOROMETHANE	mg/L	01/07/85	<	0.00100
VINYL CHLORIDE	mg/L	01/07/85	<	0.01000
pH, Field	S.U.	01/07/85		6.30000
CONDUCTANCE, Field	umho/cm	06/10/85		600.00000
ORGANIC CARBON, TOTAL	mg/L	06/10/85		5.40000
TOTAL ORGANIC HALOGENS	mg/L	06/10/85		0.17700
pH, Field	S.U.	06/10/85		6.80000
1,1,2,2-TETRACHLOROETHANE	mg/L	01/29/86		0.03200
CHLORIDE	mg/L	01/29/86		20.00000
CHLOROFORM	mg/L	01/29/86	<	0.00500
IRON, TOTAL	mg/L	01/29/86		0.05000
MANGANESE	mg/L	01/29/86		0.03000
ORGANIC BROMINE	mg/L	01/29/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	01/29/86	ND	1.00000
ORGANIC CHLORINE	mg/L	01/29/86		0.05000
ORGANIC IODINE	mg/L	01/29/86	<	0.01000
PHENOLS	mg/L	01/29/86		0.07000
SODIUM	mg/L	01/29/86		53.00000
SPECIFIC CONDUCTANCE	umho/cm	01/29/86		910.00000
SULFATE	mg/L	01/29/86		200.00000
TRICHLOROETHENE	mg/L	01/29/86		0.05200
VOLATILES SCAN	mg/L	01/29/86	SR	0.00000

SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-17

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED
pH	S.U.	01/29/86	6.70000
ORGANIC BROMINE	mg/L	06/04/86	ND 0.01000
ORGANIC CARBON, TOTAL	mg/L	06/04/86	ND 1.00000
ORGANIC CHLORINE	mg/L	06/04/86	0.03000
ORGANIC IODINE	mg/L	06/04/86	0.01000
SPECIFIC CONDUCTANCE	umho/cm	06/04/86	940.00000
pH	S.U.	06/04/86	6.60000

SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-19

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
1,1,1-TRICHLOROETHANE	mg/L	06/27/83	ND	0.00100
1,1-DICHLOROETHENE	mg/L	06/27/83	ND	0.00100
1,2-DICHLOROETHANE	mg/L	06/27/83		0.01900
BENZENE	mg/L	06/27/83	ND	0.00100
CHLOROFORM	mg/L	06/27/83		0.01500
METHYLENE CHLORIDE	mg/L	06/27/83	ND	0.00100
TOLUENE	mg/L	06/27/83	ND	0.00100
TRICHLOROETHYLENE	mg/L	06/27/83	ND	0.00100
TRICHLOROETHYLENE	mg/L	06/27/83		0.35000
TRICHLOROFLUOROMETHANE	mg/L	06/27/83		0.00200
ORGANIC BROMINE	mg/L	06/06/84	ND	0.00200
ORGANIC CHLORINE	mg/L	06/06/84		0.26000
ORGANIC IODINE	mg/L	06/06/84		0.01400
1,1,1-TRICHLOROETHANE	mg/L	01/08/85	<	0.00100
1,1,2,2-TETRACHLOROETHANE	mg/L	01/08/85		0.14600
1,1,2-TRICHLOROETHANE	mg/L	01/08/85		0.00570
1,1-DICHLOROETHANE	mg/L	01/08/85	<	0.00100
1,1-DICHLOROETHENE	mg/L	01/08/85	<	0.00100
1,2-DICHLOROETHANE	mg/L	01/08/85	<	0.00100
1,2-DICHLOROPROPANE	mg/L	01/08/85	<	0.00100
2-CHLOROETHYL VINYL ETHER	mg/L	01/08/85	<	0.00100
ACROLEIN	mg/L	01/08/85	<	0.10000
ACRYLONITRILE	mg/L	01/08/85	<	0.10000
ACRYLONITRILE	mg/L	01/08/85	<	0.10000
BENZENE	mg/L	01/08/85	<	0.00100
BENZENE	mg/L	01/08/85	<	0.00100

SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-19

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
BROMOFORM	mg/L	01/08/85	<	0.00100
BROMOFORM	mg/L	01/08/85	<	0.00100
CARBON TETRACHLORIDE	mg/L	01/08/85	<	0.00100
CARBON TETRACHLORIDE	mg/L	01/08/85	<	0.00100
CHLORIDE	mg/L	01/08/85		2.00000
CHLOROBENZENE	mg/L	01/08/85	<	0.00100
CHLORODIBROMOMETHANE	mg/L	01/08/85	<	0.00100
CHLOROETHANE	mg/L	01/08/85	<	0.01000
CHLOROFORM	mg/L	01/08/85		0.01000
CIS-1,3-DICHLOROPROPENE	mg/L	01/08/85	<	0.00100
CONDUCTANCE, Field	umho/cm	01/08/85		1800.00000
DICHLOROBROMOMETHANE	mg/L	01/08/85	<	0.00100
DICHLORODIFLUOROMETHANE	mg/L	01/08/85	<	0.01000
ETHYL BENZENE	mg/L	01/08/85	<	0.00100
IRON	mg/L	01/08/85		0.05000
MANGANESE	mg/L	01/08/85		0.07000
METHYL BROMIDE	mg/L	01/08/85	<	0.01000
METHYL CHLORIDE	mg/L	01/08/85	<	0.01000
METHYLENE CHLORIDE	mg/L	01/08/85	<	0.00100
ORGANIC CARBON, TOTAL	mg/L	01/08/85		5.10000
PHENOLS	mg/L	01/08/85	<	0.05000
SODIUM	mg/L	01/08/85		83.00000
SULFATE	mg/L	01/08/85		340.00000
TETRACHLOROETHANE	mg/L	01/08/85		0.00710
TETRACHLOROETHANE	mg/L	01/08/85		0.00710
TOLUENE	mg/L	01/08/85		0.00500

SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-19

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED
TOTAL ORGANIC HALOGENS	mg/L	01/08/85	0.99000
TRANS-1,2-DICHLOROETHENE	mg/L	01/08/85	0.01200
TRANS-1,3-DICHLOROPROPENE	mg/L	01/08/85	< 0.00100
TRICHLOROETHENE	mg/L	01/08/85	0.22100
TRICHLOROFLUOROMETHANE	mg/L	01/08/85	< 0.00100
VINYL CHLORIDE	mg/L	01/08/85	< 0.01000
pH, Field	S.U.	01/08/85	6.80000
CONDUCTANCE, Field	umho/cm	06/10/85	720.00000
ORGANIC CARBON, TOTAL	mg/L	06/10/85	8.90000
TOTAL ORGANIC HALOGENS	mg/L	06/10/85	0.50400
pH, Field	S.U.	06/10/85	6.70000
1,1,2,2-TETRACHLOROETHANE	mg/L	01/28/86	0.30000
1,1,2-TRICHLOROETHANE	mg/L	01/28/86	0.00900
1,2-DICHLOROETHANE	mg/L	01/28/86	0.01000
CHLOROFORM	mg/L	01/28/86	0.01400
TRANS-1,2-DICHLOROETHENE	mg/L	01/28/86	0.00800
TRICHLOROETHENE	mg/L	01/28/86	0.24000
UNKNOWN	mg/L	01/28/86	0.00700
ORGANIC BROMINE	mg/L	06/04/86	ND 0.01000
ORGANIC CARBON, TOTAL	mg/L	06/04/86	4.00000
ORGANIC CHLORINE	mg/L	06/04/86	0.32000
ORGANIC IODINE	mg/L	06/04/86	0.02000
SPECIFIC CONDUCTANCE	umho/cm	06/04/86	1140.00000
pH	S.U.	06/04/86	6.80000

SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-20

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
1,1,1-TRICHLOROETHANE	mg/L	06/27/83		0.00100
1,1-DICHLOROETHENE	mg/L	06/27/83		0.00600
1,2-DICHLOROETHANE	mg/L	06/27/83	ND	0.00100
BENZENE	mg/L	06/27/83	ND	0.00100
CHLOROFORM	mg/L	06/27/83	ND	0.00100
METHYLENE CHLORIDE	mg/L	06/27/83	ND	0.00100
TOLUENE	mg/L	06/27/83	ND	0.00100
TRICHLOROETHYLENE	mg/L	06/27/83		0.43000
TRICHLOROFLUOROMETHANE	mg/L	06/27/83	ND	0.00100
ORGANIC BROMINE	mg/L	06/06/84	ND	0.00200
ORGANIC CHLORINE	mg/L	06/06/84		0.04000
ORGANIC IODINE	mg/L	06/06/84	ND	0.00200
CHLORIDE	mg/L	01/08/85	<	1.00000
CONDUCTANCE, Field	umho/cm	01/08/85		1500.00000
IRON	mg/L	01/08/85		1.60000
MANGANESE	mg/L	01/08/85		0.64000
ORGANIC CARBON, TOTAL	mg/L	01/08/85		1.80000
PHENOLS	mg/L	01/08/85	<	0.05000
SODIUM	mg/L	01/08/85		29.00000
SULFATE	mg/L	01/08/85		670.00000
TOTAL ORGANIC HALOGENS	mg/L	01/08/85		0.01500
pH, Field	S.U.	01/08/85		7.40000
CONDUCTANCE, Field	umho/cm	06/10/85		1060.00000
ORGANIC CARBON, TOTAL	mg/L	06/10/85		2.40000
TOTAL ORGANIC HALOGENS	mg/L	06/10/85		0.13600
pH, Field	S.U.	06/10/85		5.80000

SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-20

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED
1,1,2,2-TETRACHLOROETHANE	mg/L	01/29/86	0.16000
CHLORIDE	mg/L	01/29/86	9.00000
CHLOROFORM	mg/L	01/29/86	< 0.00500
IRON, TOTAL	mg/L	01/29/86	< 0.02000
MANGANESE	mg/L	01/29/86	0.20000
ORGANIC BROMINE	mg/L	01/29/86	ND 0.01000
ORGANIC CARBON, TOTAL	mg/L	01/29/86	ND 1.00000
ORGANIC CHLORINE	mg/L	01/29/86	0.07000
ORGANIC IODINE	mg/L	01/29/86	ND 0.01000
PHENOLS	mg/L	01/29/86	0.01000
SODIUM	mg/L	01/29/86	30.00000
SPECIFIC CONDUCTANCE	umho/cm	01/29/86	1400.00000
SULFATE	mg/L	01/29/86	760.00000
TRICHLOROETHENE	mg/L	01/29/86	0.07500
VOLATILES SCAN	mg/L	01/29/86	SR 0.00000
pH	S.U.	01/29/86	6.30000
ORGANIC BROMINE	mg/L	06/04/86	ND 0.01000
ORGANIC CARBON, TOTAL	mg/L	06/04/86	4.00000
ORGANIC CHLORINE	mg/L	06/04/86	0.10000
ORGANIC IODINE	mg/L	06/04/86	< 0.01000
SPECIFIC CONDUCTANCE	umho/cm	06/04/86	1860.00000
pH	S.U.	06/04/86	6.20000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-21

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
1,1,1-TRICHLOROETHANE	mg/L	06/27/83		0.00100
1,1-DICHLOROETHENE	mg/L	06/27/83	ND	0.00100
1,2-DICHLOROETHANE	mg/L	06/27/83	ND	0.00100
BENZENE	mg/L	06/27/83		0.00200
CHLOROFORM	mg/L	06/27/83	ND	0.00100
METHYLENE CHLORIDE	mg/L	06/27/83		0.00300
TOLUENE	mg/L	06/27/83	ND	0.00100
TRICHLOROETHYLENE	mg/L	06/27/83	ND	0.00100
TRICHLOROFLUOROMETHANE	mg/L	06/27/83	ND	0.00100
ORGANIC BROMINE	mg/L	06/06/84	ND	0.00200
ORGANIC CHLORINE	mg/L	06/06/84		0.29000
ORGANIC IODINE	mg/L	06/06/84		0.00400
CHLORIDE	mg/L	01/08/85	<	1.00000
CONDUCTANCE, Field	umho/cm	01/08/85		1500.00000
IRON	mg/L	01/08/85		7.28000
MANGANESE	mg/L	01/08/85		0.69000
ORGANIC CARBON, TOTAL	mg/L	01/08/85		5.40000
PHENOLS	mg/L	01/08/85	<	0.05000
SODIUM	mg/L	01/08/85		16.00000
SULFATE	mg/L	01/08/85		210.00000
TOTAL ORGANIC HALOGENS	mg/L	01/08/85		0.13800
pH, Field	S.U.	01/08/85		6.20000
CONDUCTANCE, Field	umho/cm	06/10/85		565.00000
ORGANIC CARBON, TOTAL	mg/L	06/10/85		2.00000
TOTAL ORGANIC HALOGENS	mg/L	06/10/85		0.18000
pH, Field	S.U.	06/10/85		5.80000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-21

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
CHLORIDE	mg/L	01/30/86		8.00000
IRON, TOTAL	mg/L	01/30/86		11.00000
MANGANESE	mg/L	01/30/86		1.10000
ORGANIC BROMINE	mg/L	01/30/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	01/30/86	ND	1.00000
ORGANIC CHLORINE	mg/L	01/30/86		0.02000
ORGANIC IODINE	mg/L	01/30/86	ND	0.01000
PHENOLS	mg/L	01/30/86		0.01000
SODIUM	mg/L	01/30/86		14.00000
SPECIFIC CONDUCTANCE	umho/cm	01/30/86		770.00000
SULFATE	mg/L	01/30/86		220.00000
VOLATILES SCAN	mg/L	01/30/86	ND	5.00000
ORGANIC BROMINE	mg/L	06/15/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	06/15/86		3.00000
ORGANIC CHLORINE	mg/L	06/15/86	<	0.01000
ORGANIC IODINE	mg/L	06/15/86	<	0.01000
SPECIFIC CONDUCTANCE	umho/cm	06/15/86		700.00000
pH	S.U.	06/15/86		6.20000

SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-22

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
1,1,1-TRICHLORDETHANE	mg/L	07/14/83		0.00200
1,1,2,2-TETRACHLORDETHANE	mg/L	07/14/83		0.05000
1,2-DICHLOROETHANE	mg/L	07/14/83		0.00300
BENZENE	mg/L	07/14/83		0.00300
CHLOROFORM	mg/L	07/14/83		0.00400
METHYLENE CHLORIDE	mg/L	07/14/83	ND	0.00100
TRICHLOROETHYLENE	mg/L	07/14/83		0.08000
ORGANIC BROMINE	mg/L	06/06/84	ND	0.00200
ORGANIC CHLORINE	mg/L	06/06/84		0.26000
ORGANIC IODINE	mg/L	06/06/84		0.00500
1,1,1-TRICHLOROETHANE	mg/L	01/08/85	<	0.00100
1,1,2,2-TETRACHLORDETHANE	mg/L	01/08/85		0.06530
1,1,2-TRICHLOROETHANE	mg/L	01/08/85	<	0.00100
1,1-DICHLOROETHANE	mg/L	01/08/85	<	0.00100
1,1-DICHLOROETHENE	mg/L	01/08/85	<	0.00100
1,2-DICHLOROETHANE	mg/L	01/08/85	<	0.00100
2-CHLOROETHYL VINYL ETHER	mg/L	01/08/85	<	0.00100
ACROLEIN	mg/L	01/08/85	<	0.10000
ACRYLONITRILE	mg/L	01/08/85	<	0.10000
BENZENE	mg/L	01/08/85	<	0.00100
BROMOFORM	mg/L	01/08/85	<	0.00100
CARBON TETRACHLORIDE	mg/L	01/08/85	<	0.00100
CHLORIDE	mg/L	01/08/85		1.00000
CHLOROBENZENE	mg/L	01/08/85	<	0.00100
CHLORODIBROMOMETHANE	mg/L	01/08/85	<	0.00100
CHLOROETHANE	mg/L	01/08/85	<	0.01000

SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-22

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED
CHLOROFORM	mg/L	01/08/85	0.00440
CIS-1,3-DICHLOROPROPENE	mg/L	01/08/85	< 0.00100
CONDUCTANCE, Field	umho/cm	01/08/85	1900.00000
DICHLOROBROMOMETHANE	mg/L	01/08/85	< 0.00100
DICHLORODIFLUOROMETHANE	mg/L	01/08/85	< 0.01000
DICHLOROPROPANE	mg/L	01/08/85	< 0.00100
DICHLOROPROPANE	mg/L	01/08/85	< 0.00100
ETHYL BENZENE	mg/L	01/08/85	0.01050
IRON	mg/L	01/08/85	0.16000
MANGANESE	mg/L	01/08/85	0.24000
METHYL BROMIDE	mg/L	01/08/85	< 0.01000
METHYL CHLORIDE	mg/L	01/08/85	< 0.00100
METHYLENE CHLORIDE	mg/L	01/08/85	< 0.00100
ORGANIC CARBON, TOTAL	mg/L	01/08/85	4.40000
PHENOLS	mg/L	01/08/85	< 0.05000
SODIUM	mg/L	01/08/85	113.00000
SULFATE	mg/L	01/08/85	370.00000
TETRACHLOROETHENE	mg/L	01/08/85	< 0.00100
TOLUENE	mg/L	01/08/85	0.00510
TOTAL ORGANIC HALOGENS	mg/L	01/08/85	0.25700
TRANS-1,2-DICHLOROETHENE	mg/L	01/08/85	0.00710
TRANS-1,3-DICHLOROPROPENE	mg/L	01/08/85	< 0.00100
TRICHLOROETHENE	mg/L	01/08/85	0.11700
TRICHLOROFLUOROMETHANE	mg/L	01/08/85	< 0.00100
VINYL CHLORIDE	mg/L	01/08/85	< 0.01000
pH, Field	S.U.	01/08/85	6.50000

SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-22

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED
CONDUCTANCE, Field	umho/cm	06/10/85	880.00000
ORGANIC CARBON, TOTAL	mg/L	06/10/85	6.40000
TOTAL ORGANIC HALOGENS	mg/L	06/10/85	0.33600
pH, Field	S.U.	06/10/85	6.50000
1,1,2,2-TETRACHLOROETHANE	mg/L	01/28/86	0.12000
CHLOROFORM	mg/L	01/28/86	0.00800
TRICHLOROETHENE	mg/L	01/28/86	0.14000
ORGANIC BROMINE	mg/L	06/04/86	ND 0.01000
ORGANIC CARBON, TOTAL	mg/L	06/04/86	2.00000
ORGANIC CHLORINE	mg/L	06/04/86	0.18000
ORGANIC IODINE	mg/L	06/04/86	0.02000
SPECIFIC CONDUCTANCE	umho/cm	06/04/86	1420.00000
pH	S.U.	06/04/86	6.60000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-23

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED
1,1,1-TRICHLOROETHANE	mg/L	07/14/83	0.00200
1,1,2,2-TETRACHLOROETHANE	mg/L	07/14/83	ND 0.00100
1,2-DICHLOROETHANE	mg/L	07/14/83	ND 0.00100
CHLOROFORM	mg/L	07/14/83	0.00200
METHYLENE CHLORIDE	mg/L	07/14/83	0.00600
TRICHLOROETHYLENE	mg/L	07/14/83	0.00200
ORGANIC BROMINE	mg/L	06/07/84	0.00800
ORGANIC CHLORINE	mg/L	06/07/84	0.42000
ORGANIC IODINE	mg/L	06/07/84	0.01400
CHLORIDE	mg/L	01/07/85	< 1.00000
CONDUCTANCE, Field	umho/cm	01/07/85	2340.00000
IRON	mg/L	01/07/85	0.50000
MANGANESE	mg/L	01/07/85	0.45000
ORGANIC CARBON, TOTAL	mg/L	01/07/85	4.50000
PHENOLS	mg/L	01/07/85	< 0.05000
SODIUM	mg/L	01/07/85	50.00000
SULFATE	mg/L	01/07/85	990.00000
TOTAL ORGANIC HALOGENS	mg/L	01/07/85	0.00630
pH, Field	S.U.	01/07/85	6.70000
CONDUCTANCE, Field	umho/cm	06/10/85	1823.00000
ORGANIC CARBON, TOTAL	mg/L	06/10/85	1.50000
TOTAL ORGANIC HALOGENS	mg/L	06/10/85	0.00990
pH, Field	S.U.	06/10/85	6.40000
CHLORIDE	mg/L	01/30/86	20.00000
IRON, TOTAL	mg/L	01/30/86	< 0.02000
MANGANESE	mg/L	01/30/86	0.41000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-23

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
ORGANIC BROMINE	mg/L	01/30/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	01/30/86	ND	1.00000
ORGANIC CHLORINE	mg/L	01/30/86	<	0.01000
ORGANIC IODINE	mg/L	01/30/86	ND	0.01000
PHENOLS	mg/L	01/30/86		0.02000
SODIUM	mg/L	01/30/86		35.00000
SPECIFIC CONDUCTANCE	umho/cm	01/30/86		2000.00000
SULFATE	mg/L	01/30/86		800.00000
VOLATILES SCAN	mg/L	01/30/86	ND	5.00000
pH	S.U.	01/30/86		6.70000
ORGANIC BROMINE	mg/L	06/15/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	06/15/86		3.00000
ORGANIC CHLORINE	mg/L	06/15/86	<	0.01000
ORGANIC IODINE	mg/L	06/15/86	<	0.01000
SPECIFIC CONDUCTANCE	umho/cm	06/15/86		1860.00000
pH	S.U.	06/15/86		6.40000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-24

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
1,1,1-TRICHLOROETHANE	mg/L	07/14/83		0.00100
1,1,2,2-TETRACHLOROETHANE	mg/L	07/14/83	ND	0.00100
1,2-DICHLOROETHANE	mg/L	07/14/83	ND	0.00100
BENZENE	mg/L	07/14/83	ND	0.00100
CHLOROFORM	mg/L	07/14/83	ND	0.00100
METHYLENE CHLORIDE	mg/L	07/14/83		0.00200
TRICHLOROETHYLENE	mg/L	07/14/83	ND	0.00100
ORGANIC BROMINE	mg/L	06/06/84	ND	0.00200
ORGANIC CHLORINE	mg/L	06/06/84		0.23000
ORGANIC IODINE	mg/L	06/06/84		0.00200
CHLORIDE	mg/L	01/07/85	<	1.00000
CONDUCTANCE, Field	umho/cm	01/07/85		445.00000
IRON	mg/L	01/07/85		0.07000
MANGANESE	mg/L	01/07/85		0.69000
ORGANIC CARBON, TOTAL	mg/L	01/07/85		2.70000
PHENOLS	mg/L	01/07/85	<	0.05000
SODIUM	mg/L	01/07/85		21.00000
SULFATE	mg/L	01/07/85		42.00000
TOTAL ORGANIC HALOGENS	mg/L	01/07/85	<	0.00500
pH, Field	S.U.	01/07/85		6.60000
CONDUCTANCE, Field	umho/cm	06/10/85		285.00000
ORGANIC CARBON, TOTAL	mg/L	06/10/85		1.10000
TOTAL ORGANIC HALOGENS	mg/L	06/10/85	<	0.00500
pH, Field	S.U.	06/10/85		6.60000
CHLORIDE	mg/L	01/30/86		3.00000
IRON, TOTAL	mg/L	01/30/86		0.89000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-24

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
MANGANESE	mg/L	01/30/86		0.78000
ORGANIC BROMINE	mg/L	01/30/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	01/30/86	<	1.00000
ORGANIC CHLORINE	mg/L	01/30/86	<	0.01000
ORGANIC IODINE	mg/L	01/30/86	ND	0.01000
PHENOLS	mg/L	01/30/86	ND	0.01000
SODIUM	mg/L	01/30/86		14.00000
SPECIFIC CONDUCTANCE	umho/cm	01/30/86		430.00000
SULFATE	mg/L	01/30/86		26.00000
VOLATILES SCAN	mg/L	01/30/86	ND	5.00000
pH	S.U.	01/30/86		6.90000
ORGANIC BROMINE	mg/L	06/04/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	06/04/86		2.00000
ORGANIC CHLORINE	mg/L	06/04/86	<	0.01000
ORGANIC IODINE	mg/L	06/04/86	<	0.01000
SPECIFIC CONDUCTANCE	umho/cm	06/04/86		370.00000
pH	S.U.	06/04/86		6.50000

SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-25

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
ORGANIC BROMINE	mg/L	06/06/84	ND	0.00200
ORGANIC CHLORINE	mg/L	06/06/84		0.08000
ORGANIC IODINE	mg/L	06/06/84		0.00700
CHLORIDE	mg/L	01/08/85	<	1.00000
CONDUCTANCE, Field	umho/cm	01/08/85		2000.00000
IRON	mg/L	01/08/85	<	0.02000
MANGANESE	mg/L	01/08/85		0.32000
ORGANIC CARBON, TOTAL	mg/L	01/08/85		10.00000
PHENOLS	mg/L	01/08/85	<	0.05000
SODIUM	mg/L	01/08/85		127.00000
SULFATE	mg/L	01/08/85		400.00000
TOTAL ORGANIC HALOGENS	mg/L	01/08/85		0.10200
pH, Field	S.U.	01/08/85		6.00000
CONDUCTANCE, Field	umho/cm	06/10/85		910.00000
ORGANIC CARBON, TOTAL	mg/L	06/10/85		9.40000
TOTAL ORGANIC HALOGENS	mg/L	06/10/85		0.24600
pH, Field	S.U.	06/10/85		6.40000
1,1,2,2-TETRACHLOROETHANE	mg/L	01/28/86		0.04200
CHLOROFORM	mg/L	01/28/86	<	0.00500
TRICHLOROETHENE	mg/L	01/28/86		0.05900
ORGANIC BROMINE	mg/L	06/04/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	06/04/86		3.00000
ORGANIC CHLORINE	mg/L	06/04/86		0.05000
ORGANIC IODINE	mg/L	06/04/86		0.01000
SPECIFIC CONDUCTANCE	umho/cm	06/04/86		1500.00000
pH	S.U.	06/04/86		6.80000

SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-26

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
ORGANIC BROMINE	mg/L	06/08/84	ND	0.00200
ORGANIC CHLORINE	mg/L	06/08/84		0.02000
ORGANIC IODINE	mg/L	06/08/84		0.01100
CHLORIDE	mg/L	01/08/85	<	1.00000
CONDUCTANCE, Field	umho/cm	01/08/85		1900.00000
IRON	mg/L	01/08/85		2.06000
MANGANESE	mg/L	01/08/85		2.44000
ORGANIC CARBON, TOTAL	mg/L	01/08/85		9.50000
PHENOLS	mg/L	01/08/85	<	0.05000
SODIUM	mg/L	01/08/85		67.00000
SULFATE	mg/L	01/08/85		360.00000
TOTAL ORGANIC HALOGENS	mg/L	01/08/85		0.01700
pH, Field	S.U.	01/08/85		5.90000
CONDUCTANCE, Field	umho/cm	06/10/85		1080.00000
ORGANIC CARBON, TOTAL	mg/L	06/10/85		3.30000
TOTAL ORGANIC HALOGENS	mg/L	06/10/85		0.05500
pH, Field	S.U.	06/10/85		6.30000
BENZENE	mg/L	01/28/86		0.00500
ORGANIC BROMINE	mg/L	06/04/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	06/04/86		9.00000
ORGANIC CHLORINE	mg/L	06/04/86	<	0.01000
ORGANIC IODINE	mg/L	06/04/86	<	0.01000
SPECIFIC CONDUCTANCE	umho/cm	06/04/86		1310.00000
pH	S.U.	06/04/86		6.20000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-26

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
ORGANIC BROMINE	mg/L	06/08/84	ND	0.00200
ORGANIC CHLORINE	mg/L	06/08/84		0.02000
ORGANIC IODINE	mg/L	06/08/84		0.01100
CHLORIDE	mg/L	01/08/85	<	1.00000
CONDUCTANCE, Field	umho/cm	01/08/85		1900.00000
IRON	mg/L	01/08/85		2.06000
MANGANESE	mg/L	01/08/85		2.44000
ORGANIC CARBON, TOTAL	mg/L	01/08/85		9.50000
PHENOLS	mg/L	01/08/85	<	0.05000
SODIUM	mg/L	01/08/85		67.00000
SULFATE	mg/L	01/08/85		360.00000
TOTAL ORGANIC HALOGENS	mg/L	01/08/85		0.01700
pH, Field	S.U.	01/08/85		5.90000
CONDUCTANCE, Field	umho/cm	06/10/85		1080.00000
ORGANIC CARBON, TOTAL	mg/L	06/10/85		3.30000
TOTAL ORGANIC HALOGENS	mg/L	06/10/85		0.05500
pH, Field	S.U.	06/10/85		6.30000
BENZENE	mg/L	01/28/86		0.00500
ORGANIC BROMINE	mg/L	06/04/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	06/04/86		9.00000
ORGANIC CHLORINE	mg/L	06/04/86	<	0.01000
ORGANIC IODINE	mg/L	06/04/86	<	0.01000
SPECIFIC CONDUCTANCE	umho/cm	06/04/86		1310.00000
pH	S.U.	06/04/86		6.20000

FAST LIST REPORT FOR A GIVEN WELLNUMBER
SITE : 01 MUSTARD GAS BURIAL GROUNDS
WELLNUMBER : 01-27

PARAMETER NAME	UNITS	DATESAMPLE	AMOUNT DETECTED	
ORGANIC BROMINE	mg/L	06/07/84	ND	0.00200
ORGANIC CHLORINE	mg/L	06/07/84		0.02000
ORGANIC IODINE	mg/L	06/07/84		0.00500
CHLORIDE	mg/L	01/08/85		4.00000
CONDUCTANCE, Field	umho/cm	01/08/85		1530.00000
IRON	mg/L	01/08/85		0.03000
MANGANESE	mg/L	01/08/85		1.09000
ORGANIC CARBON, TOTAL	mg/L	01/08/85		2.90000
PHENOLS	mg/L	01/08/85	<	0.05000
SODIUM	mg/L	01/08/85		79.00000
SULFATE	mg/L	01/08/85		170.00000
TOTAL ORGANIC HALOGENS	mg/L	01/08/85		0.11200
pH, Field	S.U.	01/08/85		6.60000
CONDUCTANCE, Field	umho/cm	06/10/85		6400.00000
ORGANIC CARBON, TOTAL	mg/L	06/10/85		10.40000
TOTAL ORGANIC HALOGENS	mg/L	06/10/85		0.02370
pH, Field	S.U.	06/10/85		7.00000
TETRAHYDROFURAN	mg/L	01/28/86		0.04900
ORGANIC BROMINE	mg/L	06/03/86	ND	0.01000
ORGANIC CARBON, TOTAL	mg/L	06/03/86		4.00000
ORGANIC CHLORINE	mg/L	06/03/86	<	0.01000
ORGANIC IODINE	mg/L	06/03/86	<	0.01000
SPECIFIC CONDUCTANCE	umho/cm	06/03/86		1315.00000
pH	S.U.	06/03/86		6.60000

APPENDIX D

REPORT OF INSPECTION AND EXCAVATION OF CHEMICAL HARDWARE BURIAL GROUNDS

Report of Inspection and Excavation of Chemical Hardware Burial Grounds at Naval Ammunition Depot, Crane, Indiana

13-24 May 1974

Prepared by: John J. Fitch Code 122
Title: Industrial Hygienist
NAD Crane, Indiana

BACKGROUND

1. NAVORD speedletter 132[illegible] March 1972 requested that NAD Crane report the identity and quantity of buried explosive compounds and identify burial sites on station contour maps. This review brought to light that a quantity of mustard gas had been disposed of by burial, supposedly in the 1950's. Also at the same site, a quantity of Thorium Nitrate and "Illuminant Composition Compound", thought to contain Thorium, had been disposed of by burial on or about 29 October 1956. Additionally, the Industrial Hygienist at NAD Crane had buried some ninety small (few ounces each) quantities of aged laboratory chemicals on 18 March 1967.

2. A review of the records disclosed that records were available concerning the buried aged laboratory chemicals but that no records were available concerning the buried Mustard Gas or the buried "Illuminant Compound" and Thorium Nitrate. NAD Crane then proposed to excavate and remove the buried "Illuminant Compound" and Thorium Nitrate which were assumed to be radioactive. The radioactive material would then be disposed of through normal channels at an Atomic Energy approved disposal point. The Mustard Gas plots would be excavated and examined. It was assumed that the chemical agent had been demilitarized (detoxified) at the time of burial and that the hardware could be certified free of agent after proper chemical treatment,and disposed of in a sanitary landfill. This proposal was forwarded through NAVORD channels and approved. The proposal was implemented commencing on 13 May 1974. The following is a complete report of the proceedings:

a. An NAD Crane Safety Department employee and a retired NAD Crane Ordnance Department employee were located who remembered the burial of the Mustard Gas. The Mustard Gas was apparently being transferred from storage at NAD Crane at the time of the burial and the burial plots contained leaking munitions. Although it was assumed that the leaking munitions were demilitarized at the time of the burial of the items, neither employee could positively confirm this as a fact.

b. Personnel involved in the chemical hardware burial grounds excavation project were:

Mr. F. B. Sanchez, NWL Dahlgren, Technical Advisor
Mr. John J. Fitch, NAD Crane, Industrial Hygienist
Mr. Marston Mischler, NAD Crane, Safety Department representative
Mr. Ora Floyd, NAD Crane, Heavy Equipment Operator
Mr. Bernard Butcher, NAD Crane, Heavy Equipment Operator
Mr. Edward Walker, NAD Crane, Heavy Equipment Operator
CWO John Cribbs, NAD Crane, EOD Team Officer
GMGC Sterling Nally, NAD Crane, EOD Team member
BMCM Glen Douglas, NAD Crane, EOD Team member
1st Lt. Jonathan M. Coleman, Edgewood Arsenal, Tech-Escort Team Officer
SP4 William E. Baker, Edgewood Arsenal, Tech-Escort Team member
SP4 Gene S. Holland, Edgewood Arsenal, Tech-Escort Team member
SP5 Dennis K. Heinssen, Edgewood Arsenal, Tech-Escort Team member

c. 13 May 1974: Mr. F. B. Sanchez arrives on board from Naval Weapons

Laboratory (NWL), Dahlgren, Virginia; site is inspected. Public Works personnel (Bernard Butcher, Ora Floyd, and Edward Walker), who are to assist in the operation, are given physical examination, security clearances are checked, and all personnel are given briefing of the operation. Backhoe and bulldozer are moved to site; access path and fenced burial site surface are cleared of vegetation by bulldozer.

d. 14 May 1974: EOD team surveys site for buried metal with metal detector. Buried metal indicated near plots marked as 500 lbs. illuminating composition, 15 lbs. thorium, 570 lbs. mustard gas, 50 lbs. mustard gas, and at points outside of the fenced area, approximately 25 feet south of the southeast corner of the fenced area and a row of evenly spaced buried metal objects extending from approximately 75 feet south of the middle of the fenced area into the southwest quadrant of the fenced area. All of the plots inside of the fenced area were not surveyed for buried metal at this time. The locations of buried metal near the signs marking the burial plots for 500 lbs. of illuminating composition and 15 lbs. of thorium nitrate were marked with a small hand-dug hole for excavation with the backhoe. EOD team departs site and backhoe is brought into position, upwind (east) of the 500 lb. illuminating composition plot. Excavation is begun with Mr. Floyd operating the backhoe; Mr. Butcher assisting, Mr. Mischler observing, Mr. Sanchez directing the backhoe shovel, and Mr. Fitch checking each bucket of earth removed for visible findings and for radioactive material with a radiation survey meter. Metal objects which Mr. Fitch identifies as being functioned pyrotechnic devices are encountered at approximately 2-1/2 feet depth. A total of 37 of these items were removed. The items which show evidence of radioactive contamination (.05-.6 mr/hr), are segregated as are quantities of a wet, gray, metallic powder which also evidences radioactivity, and earth which evidenced radioactive contamination. The excavation is continued to a depth of approximately six feet where the earth walls seem undisturbed. A survey of the excavation is made by Mr. Fitch with a radiation survey meter to verify that all of the radioactive materials have been removed. The radioactive material is placed into four 55-gallon steel drums having plastic bag liners and covered, and the excavation is filled in.

e. 15 May 1974: Backhoe is positioned upwind from 15 lb. thorium nitrate burial plot and excavation begins as on the previous day. Metal objects, the same as in the previous excavation, are encountered at a depth of approximately 2-1/2 feet. A total of 56 of these are removed by hand by Mr. Butcher and Mr. Fitch from this excavation. Very little of the radioactive gray, wet metallic powder is encountered, however. All material removed from the excavation is segregated. The last of the pyrotechnic items are removed at a depth of approximately 5-1/2 feet. (The excavation filled with water when the pyrotechnic items were encountered and a side trench was constructed to drain the water from the excavation. The bottom of the excavation, which is now aporoximately 2 feet wide and 5-1/2 feet deep, is of a thick soupy consistency and indicates that radioactive material is still present in the bottom of the hole (.05-.0 mr/hr). The segregated materials are placed into three 55-gallon steel drums with plastic bag liners and covered. The excavation is left open overnight to dry as much as possible.

f. 16 May 1974: Backhoe bucket has been left in side trench overnight to prevent cave-in of excavation. A plastic bag is placed into the backhoe

bucket next to the bottom of the excavation and Mr. Fitch enters excavation and proceeds to transfer mud from bottom of excavation to plastic bag. When approximately 12 inches increase has been made in the depth of the excavation, Mr. Fitch surveys the walls and bottom of the excavation with a radiation survey meter, and finds several small areas which still indicate the presence of radioactive material (.05-.10 mr/hr). These are removed by hand shovel until the excavation shows no remaining trace of radioactive material with the survey meter. The plastic bag of radioactive contaminated earth is placed into a 55-gallon steel drum with plastic bag liner. The deck is surveyed for any remaining traces of radioactive material and these are collected and placed into the three drums. The drums are closed with lids and the excavation covered over with dirt from the excavation. Mr. Edward Walker joins the party at this point and will assist as equipment operator through 24 May 1974. The barrels are rolled to the edge of the site and transferred to a pick-up truck bed, using a chain and the backhoe boom to lift the barrels onto the truck. The barrels are removed to Highway 251 adjacent to the site. The bulldozer and backhoe are moved to Highway 251 and Mr. Sanchez hooks up Scout pumper and generator to steam jenny and proceeds to steam-clean backhoe, bulldozer, and barrel exteriors.

g. 17 May 1974: Mr. Floyd is absent this morning and will not be assisting further with this project. At site, party uses backhoe boom and cahin to lift barrels (7) of radioactive material onto flatbed truck for transfer to storage igloo #1403. Loaded barrels are moved to storage igloo #1403, and unloaded using backhoe boom and chain. Barrels are positioned in the storage igloo and the igloo is secured. Party returns to site and has gas mask drill. Mr. Fitch monitors area and collects radioactive material from decon operation and this material is placed into plastic bags for later transfer to steel drum. Access path to site is widened with bulldozer and site is secured for weekend.

h. 20 May 1974: At site, backhoe is brought from Highway 251 to position east (upwind) from loaction where metal detector indicated metal buried near sign reading 570 lbs. mustard gas. Steam jenny, portable electric generator, and pick-up truck are moved into site. Backhoe will not restart, trouble determined to be deac battery. Excavation began 1155 hours. Mr. Fitch and Mr. Sanchez are in Class B uniforms, Mr. Walker is operating backhoe and has gas mask in slung position. First few buckets of earth contain a toxic chemical apron, wooden pieces which appear to be pallet parts, part of a large glass carboy which has the distinct odor of hypochlorite. The excavation has a strong odor of decomposed organic matter and hypochlorite. The air sampler mounted on the backhoe cab is activated and allowed to operate until the excavation is completed. At a depth of approximately 2-1/2 feet, the first bomb is encountered. The bomb is removed by hand by Mr. Sanchez and Mr. Fitch and examined carefully. The bomb exterior shows no sign of agent contamination, is approximately 40" long by 8" in diameter. Bomb has holes (approximately 3/8" in diameter) near end of bomb. Holes appear to have been drilled. Mr. Sanchez determines that the bomb does not have fuze in tail end; nose burster charge well is closed with threaded plug. Next three bombs are also removed by hand and all are placed carefully onto plastic sheet positioned at south edge of hole to receive materials removed from the excavation. All four bombs appear to have been drilled and emptied at the time of initial burial. The next six bombs are removed carefully with the backhoe bucket and carefully placed on the plastic sheet at the south edge of the excavation.

The second bomb removed from the excavation was leaking a clear yellow fluid from a rusted hole in the side of the bomb. A sample of this fluid was collected and packaged for transfer to the Industrial Hygiene laboratory in Building 12 for analysis. The eighth bomb removed from the excavation had a rusted hole in the side of the bomb near the larger end and was leaking a dark brown muddy-appearing fluid. (Burster charge well visible through rusted hole.) Samples of this fluid were collected and packaged for transfer to Building 12. Excavation completed by approximately 1330 hours. (Three bombs noted to be much heavier than others.) Air sampler turned off and packaged for transfer to Building 12, bombs covered with plastic sheet for securing overnight. Steam jenny, portable generator, and pick-up truck pulled from the site with bulldozer; area secured for night and party decons and departs for Building 12. Gas chromatograph analysis of the three samples taken in field are negative for HD (mustard gas). Commanding Officer notified of progress to date, approximately 1540 hours, and his preference is requested in the manner of disposal of cleaned hardware later. It was suggested that Mr. Sanchez's recommendation to rebury the hardware on-site when we are finished is safe and would save time and money. Commanding Officer concurred, instructing Industrial Hygienist to report situation to Executive Officer next morning.

i. 21 May 1974: Executive Officer notified of situation to date. At the site, portable generator and steam jenny brought into site, Scout pumper positioned outside of fence, and pumper is brought to fill four barrels which have been placed at sides of excavation (three on the west side, one on the south side). EOD arrives and removes plugs from burster charge walls. One bomb exhibits slight internal pressure and smoking at plug threads. Party and EOD pull back to allow plug to vent. Executive Officer and Acting Public Works Officer arrive at site for inspection, tuck trouser cuffs in stocking, are issued and check gas masks, and are led through safe area to site. Bombs are still covered with plastic sheet. Mr. Sanchez explains to Executive Officer and Acting Public Works Officer (Code 09) that burster well plugs are being removed by EOD. Executive Officer and Code 09 depart. Approximately one-half hour later, Mr. Sanchez and Mr. Fitch enter site and observe that plug has not completed venting. (Mr. Sanchez and Mr. Fitch are in Class B uniforms.) Mr. Fitch directs stream of water on plug while Mr. Sanchez loosens plug 2-1/2 turns. Smoking still evident and pressure still venting. EOD recalled to site at 1200 hours to try to remove plug remotely. This fails due to poor condition of plug. EOD safely removed plug by hand tools with water deluge. Small amount of dark fluid leaking slowly from burster charge well, sample taken and packaged for transport to laboratory. EOD departs. Mr. Fitch and Mr. Butcher assist Mr. Sanchez in moving bombs to sheets of plastic on west edge of excavation for steam cleaning of exteriors prior to taking samples from the bomb interiors. This progresses smoothly until the seventh bomb which begins leaking dark fluid from the burster charge well opening when heated with steam. A sample is collected of the fluid and packaged for transfer to the laboratory for analysis. As it is getting late and it now appears that there might be some significant contamination of some of the hardware with chemical agent, the excavation is prepared by adding approximately 250 gallons of water and approximately 70 lbs. of HTH bleach. The bombs (10) are rolled into the excavation for holding overnight. Gas chromatograph analysis of both samples and MB paper shows positive for HD. EOD is notified that we will need their assistance with a hook and line in removing bombs from the excavation the next morning at 0830 hours, for further examination. Mr. Mischler instructed to inform Safety De-

partment that mustard gas had been found.

j. 22 May 1974: Party and EOD at site at 0830 hours. Team #1, CWO Cribbs and Mr. Sanchez, put on Class A uniforms (M3 suits), GMGC Nally and Mr. Fitch put on Class B uniforms and are to be Team #2. GMGC Nally to back up Team #1 at excavation; Mr. Fitch to be just inside of hot line to assist in decon of personnel, if necessary; BMCM Douglas to be in coveralls, rubber boots, with mask and rubber gloves just at hot line to assist Mr. Fitch with decon of personnel, if needed; Mr. Mischler to be at Scout pumper outside of site to pass instructions to support personnel--large pumper operators, Mr. Butcher and Mr. Walker, who are to be at pumper at Highway 251 adjacent to the site. Water and HTH are added to barrels inside of site. Due to mud conditions, GMGC Nally is needed to assist Team #1 in removing the bombs from the excavation. The bombs are retrieved and placed at the edge of the excavation. The mud covering the bomb exteriors has been cleared from the bombs in the pit overnight and inspection of the bombs shows that one bomb has significant interior agent contamination; three bombs do not have open drilled holes but do have metal plugs in two holes (one located near each end of each bomb). These bombs are heavier than the rest. CWO Cribbs and Mr. Sanchez elect to investigate the bombs having metal plugs by driving one of the plugs on one of the bombs completely into the bomb. This is accomplished with a non-sparking hammer and it becomes evident from the dark oily liquid gushing from the bomb that the bombs are filled with chemical agent. Some of the liquid is poured into a barrel of decon solution nearby (approximately 1-2 quarts) to minimize soil contamination. The bomb is then lowered to the ground with the open hole pointed up. The area is treated with HTH and water. CWO Cribbs puts temporary wood plug in open hole of bomb and all parties pull back and decon and leave the area to evaluate the situation and decide on the proper course of action to take.

After some discussion, it is agreed in the afternoon that the open bomb should be sealed, all three filled bombs should be wrapped in plastic and containerized and buried in a shallow grave for holding. The area should be decontaminated and secured until higher authority can evaluate the entire situation and provide instructions for final resolution of the situation. (Mr. Willis and Mr. McDonald of the Safety Department, NAD Crane, informed by Mr. Sanchez later this evening in private discussion.)

k. 23 May 1974: CWO Cribbs has reviewed his EOD Manual and decided that he must take charge of the situation at this point. He has notified his next higher EOD echelon (Fort Storey, Virginia) the previous evening and apprises Executive Officer of this the next morning in a meeting between Executive Officer, Mr. Sanchez, CWO Cribbs, and Mr. Fitch. CDR Friddle (XO) calls Code 20 (CDR Cadow) to the meeting and Mr. Willis (Safety Director) joins meeting. Mr. Willis has contacted ORD 048 this morning and says that he (ORD 048) advises to turn the situation over to Army Tech-Escort personnel. Executive Officer contacts ORD 046 for advice and is told to contact ORD 048. ORD 048 (Mr. Jones) checks and gives permission for Navy personnel to detoxify material in open bomb and secure the rest of the area if we are sure it can be handled safely, but recommends that the situation then be turned over to technical escort personnel as soon as possible. (Later EOD Facility #2 at Indianhead contacts CWO Cribbs and advises that area should be left as is and turned over to Army Tech-Escort personnel for decon and securing the area.) In a later

telephone conversat[illegible] from Mr. Anderson of the Army [illegible]ety Office to Mr. Sanchez, Mr. Sanchez explains situation to Mr. Anderson -- that we have technical ability to handle securing of the area but are short-handed and need more trained personnel to assist. Mr. Anderson called back in approximately one-half hour and stated that Army interpretation of the regulations concerning these situations permit the Army to provide only technical advisory assistance (which we do not need). The Navy must authorize the Army to assume control of the situation if Army personnel are to actively participate in capacities other than advisory. Mr. Sanchez informs Mr. Anderson that as an advisor to Command, he (Mr. Sanchez) does not have that authority; that Mr. Anderson would have to contact ORD 048 to get that kind of authority. Mr. Anderson contacts ORD 048 and agrees that Army Tech-Escort will detoxify the open bomb and render it safe, package and containerize the other two agent-filled bombs, and decontaminate and secure the area. Mr. Sanchez confirms with Command that he is no longer needed, confirms with EOD that they do not need him longer, informs EOD of need for breather on containerized bombs for storage, and departs for home as ORD 048 has advised that they prefer that he (Mr. Sanchez) be available in Washington the following Tuesday. Executive Officer instructs Mr. Fitch to stay with operation as observer and advisor and complies with Mr. Fitch's request to be relieved of the over all safety responsibility as this is now a military operation. NAD Crane received word that Army Tech-Escort crew will arrive on morning of 24 May 1974.

1. 24 May 1974: Army Tech-Escort crew (LT Coleman and three enlisted personnel) arrive on board approximately 1100 hours. CWO Cribbs and LT Coleman attend briefing in Commanding Officer's office and return to EOD office. CWO Cribbs, LT Coleman, and Mr. Fitch review gear that will be needed, inspect the MK-11 containers at EOD which have been provided by Code 20 to containerize the filled bombs for storage, and review the procedure to be used in handling the rest of the job. Tech-Escort crew will work in the site; EOD, Mr. Fitch, and support personnel (Mr. Butcher and Mr. Walker, large pumper truck operators; safety observer; and medical corpsman) to be at Highway 251 to provide support items and assistance, if needed. No problems anticipated. LT Coleman plans to seal filled bombs with plaster of paris, place in double plastic bags, and containerize bombs in MK-11 containers for storage. A 10% void in container will take care of any pressure build-up. Parties depart for site. At site, Lt Coleman's crew moves backhoe, dozer, generator, and steam jenny to Highway 251 for wash-down of equipment. Tech-Escort crew moves into site, spreads plastic sheet over work area, and two men don Class B uniforms with hoods. Additional MK-11 containers are brought to site by Code 20 personnel to contain the empty bombs for holding in decon soltuion and are moved onto site. The MK-11 containers to be used for containg the filled bombs in storage have two green stripes applied to the exterior to the containers. The open bomb is sealed with plaster of paris and it, with the other two filled bombs, are double-bagged in plastic, sealed, and containerized. The empty bombs are placed in open MK-11 containers, stood vertically, and filled with water and HTH on site. One empty bomb is found to have significant contamination and is placed into open vertical MK-11 container with two green stripes and left open in the site in HTH and water solution. EOD, Mr. Fitch, and Mr. Mischler move additional hypochlorite to site and Tech-Escort applies approximately 425 lbs. of the hypochlorite to the soil in the area which has been thoroughly wetted down. Containers to be left in area are secured to fence with cotton line, trash is placed into excavation. Containers for storage (3) are put into

EOD truck and transferred to storage. Containers with filled bombs (3) are put into metal crib on metal pallet in igloo #1403 and secured. Area is secured and all parties leave area. Commanding Officer notified that area is secured. Transportation arranged for Tech-Escort party and gear to Bloomington, Indiana.

m. The unexpected finding of weapons filled with chemical agent indicates that any further excavation of the chemical hardware burial grounds at NAD Crane might violate regulations contained in Public Law 91-121 (November 19, 1969) as amended by Public Law 91-441 (October 7, 1970). Unless otherwise directed, NAD Crane will leach the burial with HTH every month for the next six months and will not excavate the rest of the site. This decision was concurred in by LTCOL Templeton during a telephone conversation on 3 June 1974 between CDR Friddle, (XO), NAD Crane and LTCOL Templeton of Edgewood Arsenal.

n. The stored chemical agent will be kept in storage in the MK-11 containers unless otherwise directed.

o. The security fence enclosing the chemical hardware burial grounds at NAD Crane will be expanded to enclose all buried metal objects whose locations have been identified and warning signs will be placed at the fence on all four sides.

APPENDIX E

SITE CHRONOLOGY

INSTALLATION RESTORATION PROGRAM MEETING
MUSTARD GAS BURIAL GROUNDS
NAVAL WEAPONS SUPPORT CENTER, CRANE , INDIANA
24 JANUARY 1991

CHRONOLOGY OF SIGNIFICANT EVENTS, MUSTARD GAS BURIAL GROUNDS (MGBG), NAVAL WEAPONS SUPPORT CENTER CRANE (NWSCC), INDIANA

(1)	22 OCT 1956	NWSCC RADIATION SAFETY OFFICER - MEMORANDUM RADIATION MEASUREMENTS OF THORIUM OXIDE PROCESSING; 1ST STATEMENT OF PROBLEM, DISCUSS THORIUM BURIAL
(2)	UNDATED	NWSCC INDUSTRIAL HYGIENIST - PROPOSAL FOR DECONTAMINATION AND CERTIFICATION OF CHEMICAL BURIAL SITE AT NAD/CRANE, INDIANA - NWSCC
(3)	13 MAY 1974	NWSCC INDUSTRIAL HYGIENIST - REPORT OF INSPECTION AND EXCAVATION OF CHEMICAL HARDWARE BURIAL GROUNDS AT NAVAL AMMUNITION DEPOT, CRANE, INDIANA
(4)	17 JUN 1974	US ARMY TECHNICAL ESCORT CENTER, EDGEWOOD ARSENAL, ABERDEEN - AFTER ACTION REPORT FOR CRANE NAVAL AMMUNITION DEPOT INCIDENT
(5)	21 JUN 1977	NWL DAHLGREN - SANCHEZ; POST OPERATION DISCUSSION
(6)	12 NOV 1976	NAVAL SEA SYSTEMS COMMAND - 1ST NOTE OF INSTALLATION RESTORATION PROGRAM (IRP) FUNDING FOR SECOND EXHUMATION PROJECT
(7)	02 FEB 1977	NOS INDIAN HEAD - RECOMMENDS NCEL ASSIST EFD WITH CHEMICAL BURIAL SITE
(8)	01 MAR 1977	DETAILED DISCUSSION OF MAGNETIC SURVEY
(9)	10 MAY 1977	NWSCC TRIP REPORTS - TRIP REPORT AND ENVIRONMENTAL ASSESSMENT OF NWSCC, GOOD DESCRIPTION OF HD AGENT
(10)	08 SEP 1977	NWSCC - REPORT OF POSSIBLE SOURCES OF CONTAMINATION FOR CHEMICAL DEMILITARIZATION AND FACILITIES RESTORATION STUDY, EARLY INITIAL ASSESSMENT STUDY (IAS) DISCUSSION
(11)	07 JAN 1979	NAVAL SEA SYSTEMS COMMAND - SPEEDLETTER PUTTING 2ND EXHUMATION EFFORT IN PLACE
(12)	25 JUL 1979	U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA) LETTER REQUESTING INFORMATION OF NWSCC HAZARDOUS MATERIALS STORAGE AND DISPOSAL

(13) 24 SEP 1979 NWSCC - LETTER RESPONDING TO 25 JUL 79 EPA REQUEST

(14) 10 DEC 1979 NOS INDIAN HEAD - MEETING FOR DEVELOPMENT OF FIELD OPERATIONS PLAN

(15) 07 JAN 1980 OESO - INFORMAL DISCUSSION WITH USEPA RCRA INDIVIDUAL TO 'CLOSE' MGBG SITE

(16) 28 FEB 1980 NWSCC - MEETING MINUTES TO DISCUSS OPERATION PLANS AND SCHEDULE 1980 EXHUMATION EFFORT

(17) **01 OCT 1980 NWSCC - AFTER ACTION REPORT, CHEMICAL BURIAL GROUND EXHUMATION PROJECT**

(18) 12 NOV 1982 NOS INDIAN HEAD - DISCUSSION OF MGBG GROUND WATER CONTAMINATION

(19) 01 APR 1982 US ARMY ENGINEER WATERWAYS EXPERIMENTAL STATION (USAEWES) REPORT - HYDROGEOLOGIC STUDY OF MGBG

(20) 01 MAY 1983 NAVAL ENERGY AND ENVIRONMENTAL SUPPORT OFFICE (NEESA) IAS - LIST MGBG AS HAZARDOUS WASTE SITE FOR INVESTIGATION UNDER IRP BY NORTHERN DIVISION, NAVAL FACILITIES ENGINEERING COMMAND

(21) 01 FEB 1984 USAEWES - 2ND REPORT OF HYDROGEOLOGICAL STUDY AT MGBG

(22) 01 NOV 1984 HAZARDOUS MATERIAL TECHNICAL CENTER (HMTC) - CONFIRMATION STUDY OF MGBG UNDER IRP

(23) 23 DEC 1989 USEPA FEDERAL PERMIT - LIST MGBG AS SOLID WASTE MANAGEMENT UNIT (SWMU) REQUIRING INVESTIGATION

APPENDIX F

AFTER ACTION REPORT, DEPT OF THE ARMY, TECHNICAL ESCORT CENTER, dtd 17 JUNE 1974

from Andrade of Edgewood.

File Crane

3

Tech Escort

Tech. Escort Report

TECH ESCORT ACTION REPORT

FOR

CRANE NAVAL AMMUNITION DEPOT INCIDENT

DEPARTMENT OF THE ARMY
US ARMY CHEMICAL ESCORT CENTER, EDGEWOOD ARSENAL
ABERDEEN PROVING GROUND, MARYLAND 21010

17 June 1974

Incl 1

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ANNEX A. PHOTOGRAPHS - MUSTARD DISPOSAL AREA

1. Background.

At 1135 hrs, 23 May 1974, SGM Bush of the US Army Technical Escort Center (TEC) was telephoned by CPT Covington, the Army Chemical Liaison Officer at the EOD facility, Indian Head, MD. CPT Covington requested TEC assistance for the Naval Ammunition Depot, Crane, Indiana, in the clearance of chemical filled ordnance which had been excavated from a World War II burial site. Information he had been given from personnel at the site indicated that the site had been used to bury decontaminated German and/or Italian chemical filled ordnance. During initial excavation, seven empty bomb casings were reported to have been uncovered. Later three other bombs which contained liquid were removed. In an attempt to determine what the bombs contained, one was opened at a filling plug near the base of the bomb. The liquid poured out onto the ground and onto one individual wearing the M3 toxicological agent protective suit. At this time the agent was determined to be mustard (a blister agent). SGM Bush informed CPT Covington that Mr. Al Ervin at AMC must give approval for TEC to respond to this type of emergency. Mr. Ervin was called by the EOD facility to request assistance for the Naval Installation at Crane, Indiana. Mr. Ervin authorized a 4-man team to be dispatched by light aircraft to Crane NAD. At 1300 hrs, Phillips Army Airfield (MAJ Lynn) was alerted requesting an aircraft to transport the team and equipment to Monroe County Airport, 25 miles north of Crane NAD. Phillips AAF responded with a C47 and crew for a 0700 hrs takeoff from Weide AAF on 24 May 1974. In the interim the EOD Unit Commander at Crane NAD was telephoned. CW2 John Cribbs verified the information already provided by the EOD facility. In addition, CW2 Cribbs informed TEC that an attempt was made to neutralize the agent in the filled bombs. He stated that a chemical expert, Mr. Sanchez, from Naval Ordnance Systems Command in Dahlgren, VA, who was responsible for the operation with Mr. John Fitch, Industrial Hygienist, Crane NAD, attempted to neutralize the agent contained in the bomb which had been opened at a plug. Their neutralization technique consisted of two personnel holding the bomb over a 55-gallon drum containing 10 percent HTH (High Test Hypochlorite) and allowing the agent to drain into the decontaminating solution. This method became impractical because of the difficulty in holding the bomb as well as the heat and rate of reaction of the agent with HTH. At this time assistance in dealing with the situation was requested by CW2 Cribbs through EOD channels. The site was secured and assistance was awaited.

2. Personnel.

Deployment of TEC support included four personnel from Edgewood Arsenal. Included in the deployment were:

Rank	Name	Position
1LT	Jonathan M. Coleman	Team OIC/EOD Officer
SSG	William E. Baker, Jr.	Team NCOIC/EOD Supervisor
SP5	Dennis E. Heinssen	Chemist/Chemical Decon Spec
SP4	Gene S. Holland	EOD Specialist

3. Equipment.

Due to the large quantity of liquid blister agent on material and terrain within the excavation site, adequate personnel protection was required to seal, decontaminate, and package the three mustard-filled bombs and to decontaminate the remaining empty bombs and surrounding terrain. The personnel protective equipment utilized by the TEC team consisted of the following:

Coveralls, toxicological agent protective (TAP)

Apron, TAP

Hood, TAP

Boots, TAP

Protective mask, M9A1

Gloves, TAP

Impregnated undergarments

In addition to the equipment provided by the USA Technical Escort Center, Crane NAD provided:

Containers, to contain filled bombs

Containers, for mixing decontaminants and decontaminating equipment and material

High Test Hypochlorite, decontaminant

Heavy duty plastic bags

Fire Department engine, water source

Ambulance and medical support

4. Command and Control.

Command and control at the incident site was the responsibility of CW2 John Cribbs, EOD Unit Commander, Crane NAD, who reported directly to Captain McCarty, Captain of Crane NAD.

Upon arrival of the TEC team, CW2 Cribbs delegated control at the incident site to 1LT Coleman, the TEC Team OIC.

Crane NAD provided radio and telephone communications.

5. Execution.

a. Preparation. USA Technical Escort Center maintains a 24-hour-a-day response capability for chemical accidents/incidents; therefore little preparation time was required. The necessary equipment was packed in two escort footlockers which were easily transportable on a C47 aircraft.

b. Overview. Upon arrival at Monroe County Airport near Bloomington, Indiana, the TEC team was met by members of the Crane NAD EOD Unit who provided transportation to Crane NAD. At approximately 1045 hrs, 24 May 1974, TEC arrived on station at Crane NAD. The team reported to Captain McCarty, Captain of Crane NAD, with CW2 John Cribbs, EOD Unit Commander. Captain McCarty and CW2 Cribbs briefed the TEC team on the situation and requested that the TEC team provide assistance in rendering the area safe, by containing the spill and packaging the mustard-filled bombs.

The situation at the site when the TEC team arrived was essentially unchanged except that the plug where the agent had been poured was replaced with a wooden plug.

c. Concept of Operation. During the briefing held on 27 May 1974, it was agreed that the TEC team would make a reconnaissance of the site and, based on this reconnaissance, develop and execute a course of action.

Upon arrival at the site, a traffic control point was established at the intersection of the main road and the access road to the site. No one was to be allowed into the area except those approved by CW2 Cribbs. The access road came to within 75 meters of the excavation site. At this point on the access road we established a command post upwind of the site.

The reconnaissance showed that the burial site was located within a fenced area marked "Mustard Burial Site." The excavation pit was

located in the center of this fenced area. On the left side of the pit was three 55-gallon drums, one of which contained the casings of the empty bombs. The other two drums contained decontaminating solution. A third drum was located in front of the pit. This drum also contained empty bomb casings. On the ground to the left of the pit was located three bombs. These three were liquid filled. One of them had a hole near the base which was plugged with a wooden stake. This bomb also appeared to be leaking from the burster well in the nose. The second bomb was intact but also appeared to be leaking at the burster well in the nose. The third bomb was intact and did not appear to be leaking anywhere. On the ground around the three bombs was a considerable amount of liquid agent in pools and soaked into the ground. Use of M8 paper and the blue band tube tests from the M18 kit confirmed this. Also in the immediate vicinity was a steam generator unit and a tractor backhoe.

The TEC team established a hot line just inside the fenced area upwind of the excavation site. Containers provided by Crane NAD were brought to the hot line to package the bombs. In addition, equipment for sealing the bombs was also brought. A plastic sheet was laid on the ground where the packaging took place. This was to prevent the containers from becoming contaminated on the outside.

Each of the filled bombs was decontaminated on the outside, and, if evidence of leakage was present, the area was sealed with plaster of paris gauze. All filled items were then double wrapped in plastic bags and put into 8-inch propellant charge cans and sealed. These items were then taken to a storage igloo by the Crane NAD EOD Detachment.

The empty bomb casings were also placed in 8-inch propellant charge cans. These cans were filled with 10 percent HTH solution and were left in the burial area. The used drums and material at the site were put into the excavation pit and HTH solution added. The earth that was contaminated with mustard was flushed with an HTH solution, then dry HTH was spread over the ground and water was used to soak the decontaminant in.

6. Recommendations. The TEC team recommended:

a. That the area be soaked with decontaminating solution periodically.

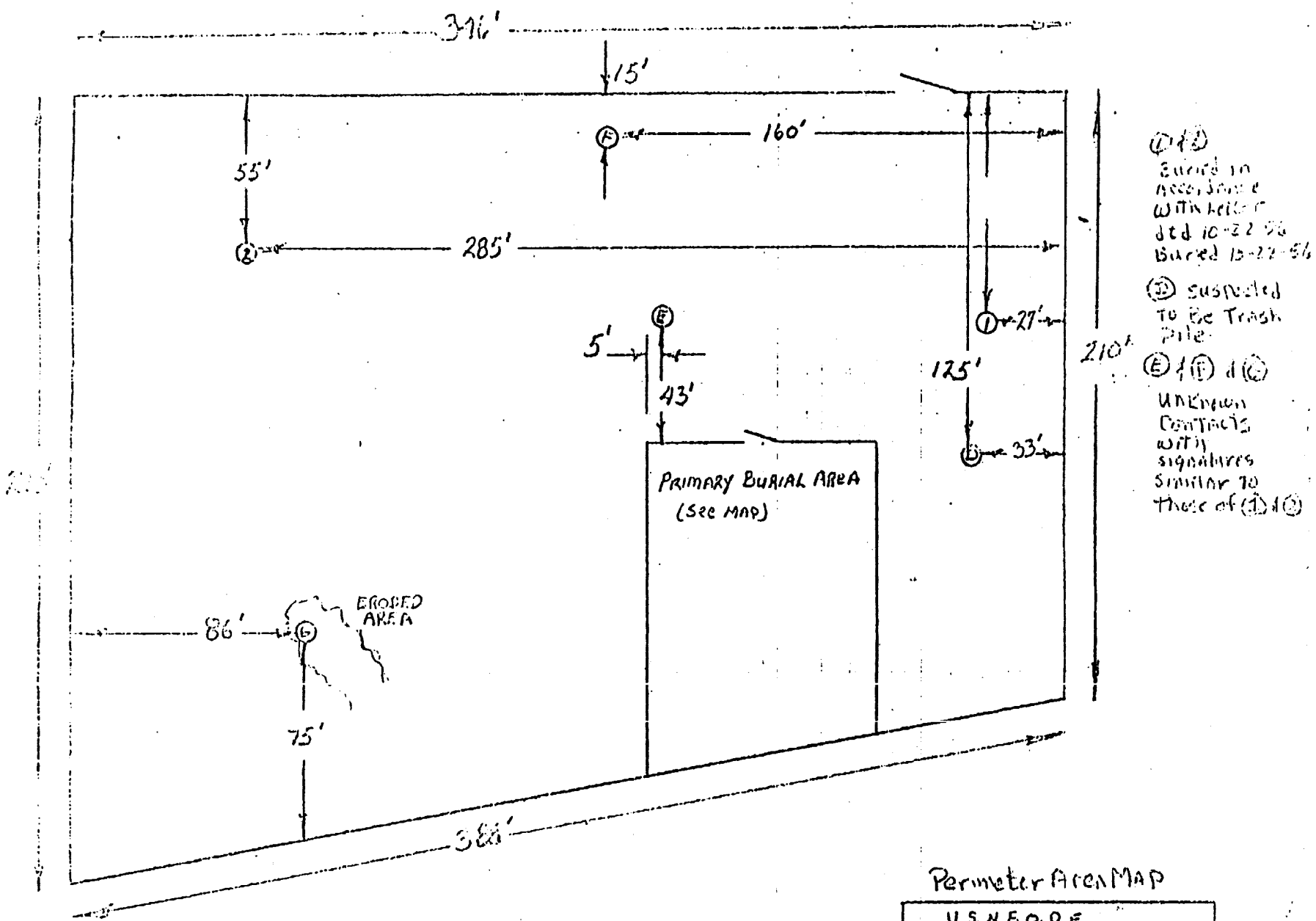
b. That no further excavation be allowed in this area until an approved disposal method is adopted.

Prepared by:

JONATHAN M. COLEMAN
1LT, CmlC
Chief, Plans & Operations Branch

Approved by:

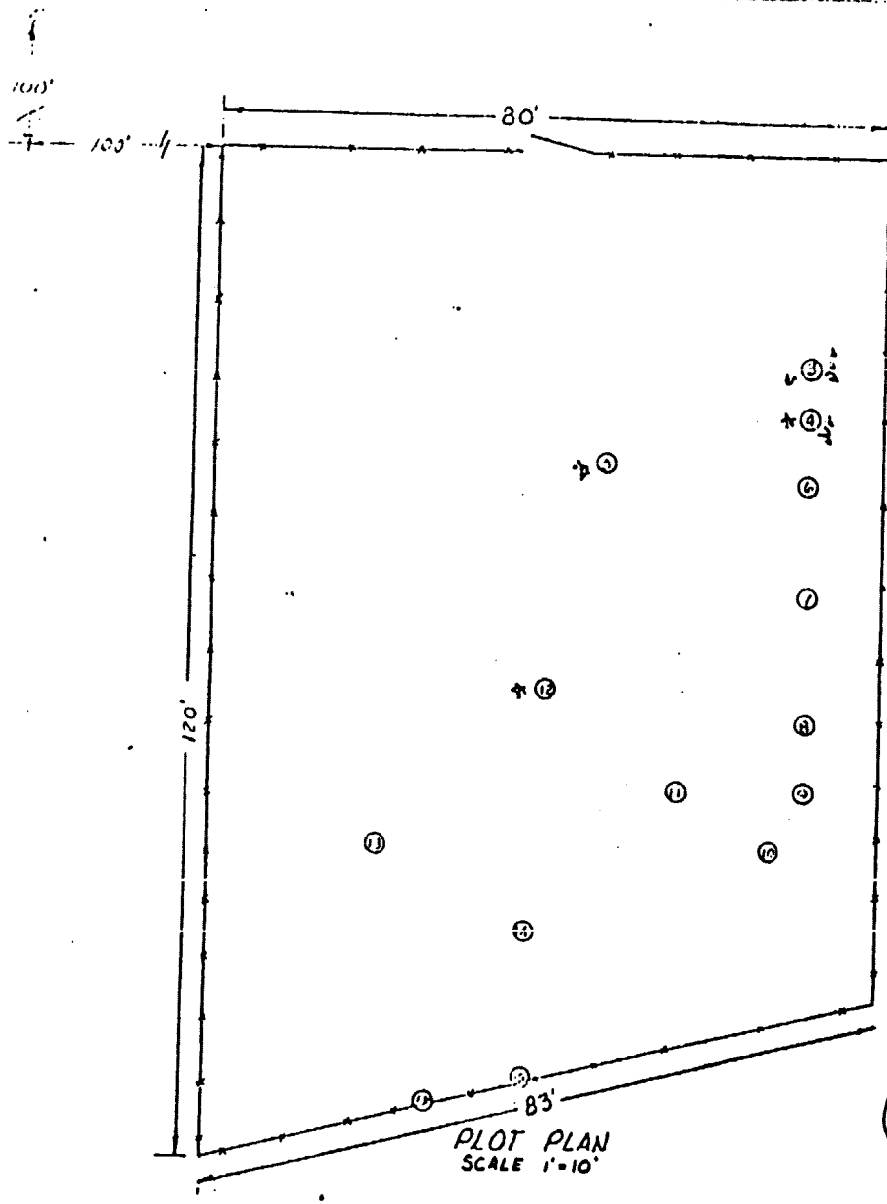
JAMES L. TEMPLETON, Jr.
LTC, CmlC
Commanding Officer



Perimeter Area MAP

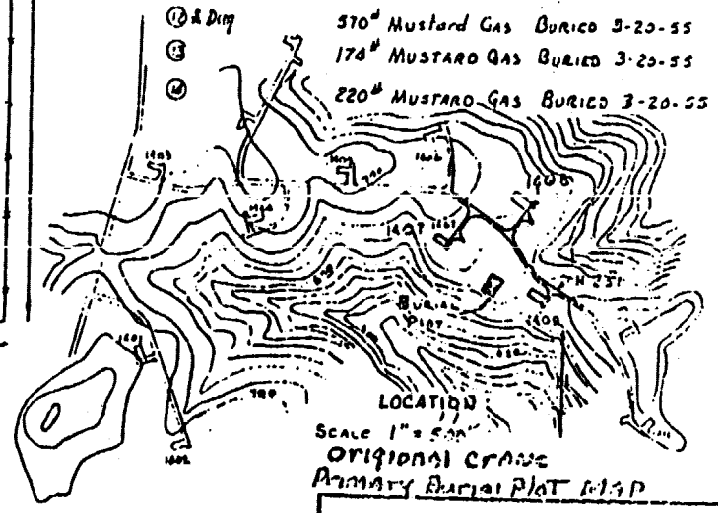
U. S. N. E. O. D. F

MUSTARD GAS BURIAL PIT
VERIFICATION SKETCH
8 MARCH 1977
J HEESEY



PLOT PLAN
SCALE 1"=10'

SIGN LOCATION	DESCRIPTION
①②	BURIED IN ACCORDANCE WITH PARA 3 OF LETTER DATED 10-22-56 J15-9 (302) JCD-NEW BURIED 10-22-56
③ & Dug	15# THORIUM NITRATE BURIED 6-57
④ & Dug	500# ILLUMINANT COMP BURIED 1-57
⑤ & Dug	50# MUSTARD GAS BURIED 3-20-55
⑥	BURIED IN ACCORDANCE WITH PARA. 3 OF LETTER DATED 10-22-56 J15-9 (302) JCD-NED BURIED 10-22-56
⑦⑧⑨⑩ (Weathered but believed the same)	BURIED IN ACCORDANCE WITH PARA 3 OF LETTER DATED 10-22-56 J15-9 (302) JCD-NEB BURIED 10-22-56
⑪	110# Mustard Gas BURIED 3-20-55
⑫ & Dug	570# Mustard Gas BURIED 3-20-55
⑬	174# MUSTARD GAS BURIED 3-20-55
⑭	220# MUSTARD GAS BURIED 3-20-55



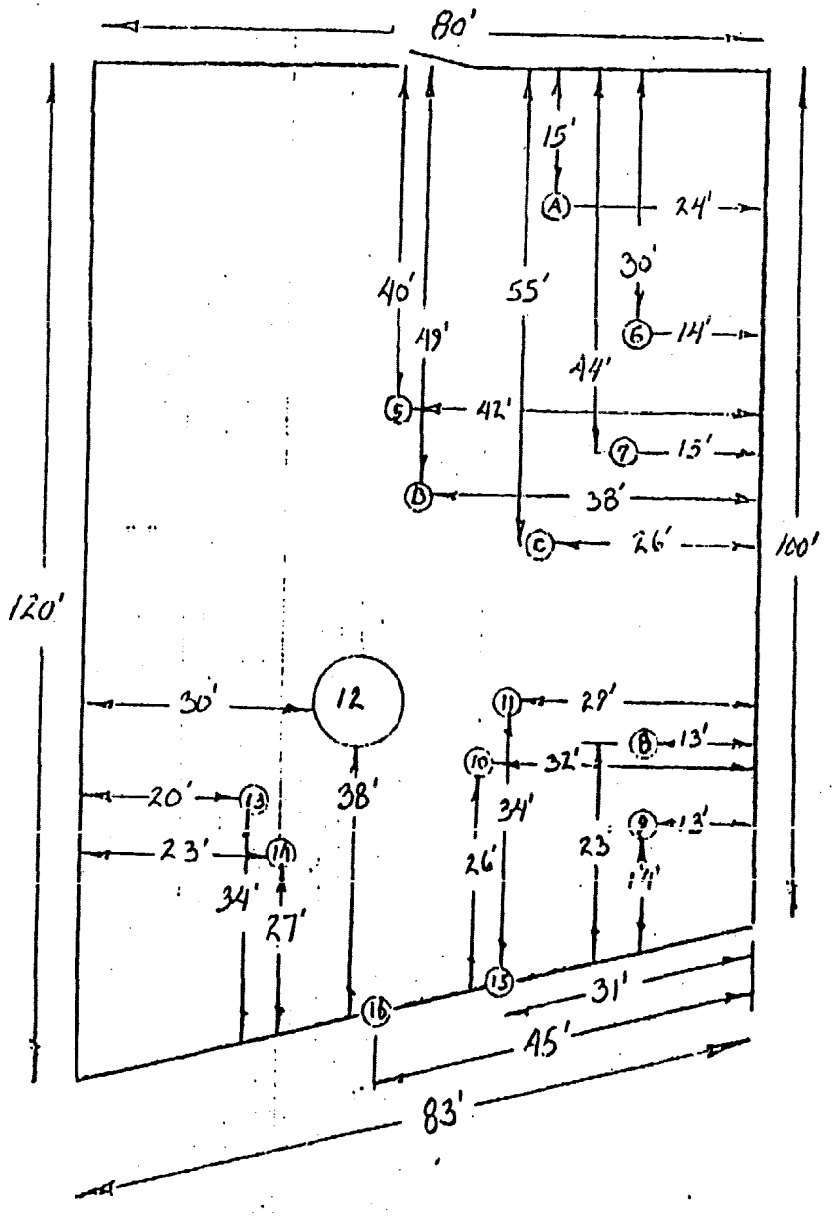
original crane
Primary Burial Plot map

U. S. N. A. D., CRANE, INDIANA

MUSTARD GAS BURIAL PLOT

P. W. SKETCH NO. 2388

APPROVED DATE



	DESCRIPTION
(1)(2)	BURIED IN ACCORDANCE WITH PARA 3 OF LETTER DATED 10-22-56 J15-9 (302) JCD-NEW BURIED 10-22-56
(3) * DUG	15# THORIUM NITRATE BURIED 6-57
(4) * DUG	500# ILLUMINANT COMP BURIED 1-57
(5) * DUG	50# MUSTARD GAS BURIED 3-20-55
(6)	BURIED IN ACCORDANCE WITH PARA. 3 OF LETTER DATED 10-22-56 J15-9 (302) JCD-NED BURIED 10-22-56
(7)(8)(9)(10) J15-16	BURIED IN ACCORDANCE WITH PARA 3 OF LETTER DATED 10-22-56 J15-9 (JCD) JCD-NED BURIED 10-22-56
(Weathered but believed the same)	
(11)	110# Mustard GAS BURIED 3-20-55
(12) * DUG	510# Mustard GAS BURIED 3-20-55
(13)	179# MUSTARD GAS BURIED 3-20-55
(14)	220# MUSTARD GAS BURIED 3-20-55
(A)(B)(C)	PREVIOUSLY UNMARKED

PRIMARY BURIAL AREA MAP
DATA CORRESPONDING TO
NAD CRANE SITE DWG 2288

U.S.N.E.O.D.F.

MUSTARD GAS BURIAL PLOT
VERIFICATION SKETCH
8 MARCH 1977
J. HEGGEY

APPENDIX G

MEMORANDUM DTD 21 JUNE 1974, FROM FCV TO FILE, REPORT OF TRIP TO NAD, CRANE

Dahlgren

21 June 1974

MEMORANDUM

From: FCV
To: File
Via: (1)FCX/V
(2)FC

Subj: Report of trip to NAD, Crane, Ind. on 11-24 May 74

Ref: (a) ltr, NAD Crane, 1 Nov 1973, 122H:JJF:bas 6260
(b) Proposal for Decontamination and Certification of Chemical Burial Site at NAD Crane - (SOP) - 10/10/73

Encl: (1) Corrosion Action on Hardware - M-70A1 Bomb; Chemical Type

1. PURPOSE: To render Technical Assistance on the Certification of a burial site at NAD, Crane as per request.

2. BACKGROUND: NWL, Code FC, was requested by reference (a) to provide a technical representative to act as a consultant and advisor during the inspection, decontamination, and certification of the chemical hardware burial grounds at NAD, Crane.

Due to delays in installation of a filtration system at NAD, Crane (Bldg. 12), the operation was delayed from Nov. 1973 until 13 May 1974. Proper documentation appeared to be in order and the SOP, reference (b), was approved through channels. Information on material, location, and quantities was reported with a historical sequence on page (1) of reference (b).

In general the site was divided into two areas; (a) 2 each sites - thorium/illuminant materials and (b) 5 each - chemical hardware burial sites. For safety reasons only limited personnel was to be permitted in the operational area. It was agreed that EOD team at NAD, Crane would assist if additional personnel were required.

Safety protective equipment and operational gear were obtained. Navy equipment was manned with cleared and certified operators. A total of fiv people would be in the area with a water-fire tank truck and safety observers as back-up emergency personnel/equipment outside the operational area.

The equipment to be used in the area was the following: (a) back-hoe and earth-mover (b) steam generator (c) electrical generator and (e) 3/4 ton 4 wheel drive truck. The materials on the site were the

following: (a) 200 lbs of HTH (bleach) (b) 200-400 gal. of water (c) 5 gal. detergent soap and (d) extra personnel protective gear (M-3 suit; aprons; M-9 protective mask; hoods; gloves; boots and coveralls).

The equipment and protective gear was operational checked prior to the start of the operation. All personnel was informed of the available safety and protective equipment with instructions on what to do in case of an accident.

Prior to the NWL representative's arrival and reporting for duty on 13 May 1974, most of the equipment and gear had been properly identified and tagged. A review was made of the SOP and additional coveralls and underwear were purchased at that time. Coordination with Public Works Department on the sequence to service the equipment was properly conducted prior to beginning the operation.

The only problem was the on-site use of the fire truck and tanker during normal working hours. The fire Dept. suggested the use of the small (jeep) truck for personnel decontamination and the tanker as a backup to supply additional water.

The Disaster Control Center made available M-8 Detector Paper and 4 each M-3 suits as back-up personnel gear. This additional gear was not used and was returned to the Disaster Control Center at the termination of the operation. Prior to beginning the operation it was agreed that working hours on the site would be from 0730 to 1400 including 2 hours for personnel decontamination and proper area and/or equipment certification on a daily basis. The time schedule would assure maximum support by everyone with time to render safe or fix any problem that could occur during the operational hours. The two hours during the afternoon would also provide time to clean and secure the protective gear for the following day.

Operation began as scheduled on 13 May 1974.

3. PERSONNEL CONTACTED AND AGENCIES REPRESENTED:

NAD Crane CDR Frank Foriddle, Ex. Officer - NAD Crane

Operational

1. Mr. John Fitch - Code 122H - Industrial Hygienist - Project Manager
2. WO-2 John P. Cridds - EOD - Officer in Charge
3. Mr. Bernard Butcher - Equipment Operator
4. Mr. Edward Walker - Equipment Operator
5. Mr. Ora Floyd - Equipment Operator (back-up)
6. Mr. Glenn M. Douglas - DMCM - EOD
7. Mr. Stering T. Nally - GMGC - EOD
8. Mr. R. Mischler - Safety Office - Observer

Others:

1. Mr. F. B. Sanchez - Technical Advisor - NWL Dahlgren
2. LT Coleman - Technical Escort - Officer in Charge - Edgewood Arsenal, APG, Md. 21210

4. BRIEF DISCUSSION OF EVENTS

During the first week, the operation went in a normal sequence. A total of seven drums were filled with thorium/illuminant materials, including some hardware. No ground contamination or residual material was detected after clean up operations were ended on Friday 17 May 1974. Equipment and protection gear were cleaned and/or secured for the week-end. No chemical operations were conducted during the week of 13-17 May 1974.

EOD personnel assisted in the location of the hardware with their metal detector. One small area near the fence gave a low detector response and was inline with what looks like an old fence, therefore, this area was not further investigated. Four locations outside the burial site and in a direct line with the inside location were marked for future investigation when operations resume late fall 1974. The detector indicated a single location and not very large in area. (It could even be a small nail).

On Monday 20 May 1974, operations were reviewed with the operational personnel and the largest single hardware burial area was chosen as the target site. Operation began after all safety equipment, materials and personal gear were in place. At 1230, the 1st bomb was discovered about 2 1/2 feet deep within a 10' x 6' x 6 1/2' hole. A total of 10 bombs were found in this particular location.

Protective plastic shielding was placed around the excavation. Initial surveillance indicated no ground or surface contamination. Laboratory results reconfirmed the findings. That afternoon the Command was informed and no immediate problem could be forseen. The Ex. Officer and the Ordnance Officer inspected the operational area on the following day, 18 May 74. EOD personnel were requested to assist in removing the nose plug of the bomb. All but one plug came out clean. One bomb appeared to have some over-pressure. Samples taken indicated residual "mustard" contamination. The bomb pressure was allowed to bleed very slowly to avoid ground contamination. It was during the bleeding period that the Ex. Officer and the Assistant Ordnance Officer inspected the area. Protective gear was issued and checked prior to their entering the area. No positive ground contamination or leaks were observed at this time. The procedure to recall EOD personnel to assist was explained to the Officers and no safety and/or operational problem could be forseen at this time.

Later in the afternoon the plug was removed and clean-out operations of the hardware were initiated. Seven bombs were cleaned but the eighth bomb began to drip and a sample indicated positive contamination. Due to the time, weather conditions, and a low supply of water, the operation was secured for the night. All bombs (hardware) were returned to the hole containing a bleach solution (70 lbs/250 gal water + 4%). The area was cleared and no ground contamination was detected. (NOTE: Plastic sheets were contaminated but rendered safe prior to ending daily operations.) Operations were secured about 1440 hours. EOD personnel were notified that their assistance would be required during the morning (next day) to remove the hardware from the hole and to remove the tail plug. EOD personnel agreed to render assistance. Up to this point only traces of contamination were evident. The laboratory results confirmed positive material; however, it also appeared to be in a semi-degradation state (40% ± pure).

The following day operation sequences were explained in detail. The following recommendations were made by the NWL representative.

a. One forward team with full protective gear, Class A*
b. One back-up team, Class B**
c. One decon man, Class B
d. One safety observer, Class C***
e. Two operators, Class C
f. One fire truck operator, Class D****

*Class A - Full protection, **Class B - Arpon, hood, etc., ***Class C Mask; coverall gloves etc. and ****Class D - Coverall and mask only; gloves optional (all personnel issued protective boots or foot covering gear.)..

Operation went very slow (15 May) because of bad weather conditions. The hardware was pulled to the surface, one by one, with a hook. Drums with 4% bleach solution were pre positioned near the hole to decon any contamination on the hardware.

The bottom plug could not be removed with the use of hand tools. It appeared to be welded or pressed in place. Seven of the bomb's hardware were placed in 55 gal. drums containing bleach solution. The other three appeared too heavy; therefore, it was assumed that they contained residual material. The bombs (3 each) had two plugs, one on the forward end near the nose and one on the rear 4 inches away from the tail plug. The rear plug was carefully forced in on one bomb and a dark brown liquid came pouring out. The M-8 paper indicated that it was mustard. Approximately 2 quarts of this liquid were placed in a 55 gal. drum containing bleach solution. The other two bombs were not touched outside of having the nose plug removed on Tuesday. The rear hole (liquid fill plug) was temporarily secured with a wood plug and the area cleaned or rendered safe. The operation was stopped.

All personnel and equipment were cleaned. No contamination was present on operational personnel. All personnel gear was deconned, washed, and rinsed to assure complete detoxification. A meeting was called at the Ex. Officer's office to plan the next sequence of operations.

The following recommendations were made by the NWL representative:

(1) Clean the hardware, pour residual mustard in a separate container, clean and detox hardware, neutralize the liquid mustard, re-bury the hardware, and decon the surface area.

(2) Wrap hardware in plastic bags or a container fitted with a bleed-cap and re-bury. Clean and detox area and fill excavation until the late fall.

(3) Wrap hardware with plastic or bleed type containers (3 rounds only) and place in igloo, clean and detox area, and refill the holes.

The EOD personnel indicated that per instructions they were only to render the area safe. It was recommended by an EOD-man (WO-2 Gridds) that step (2) or (3) be done. He had some question whether step (1) could be really done under the law (PL 91-121, 81-441, 91-191). The NWL representative was familiar with the law and suggested nothing in (1) was outside the law. However, if detoxification of the material occured, an information copy with details of the operation had to be forwarded through channels to Congress as per PL 91-441. They still objected, therefore, it was agreed that steps (2) or (3) would be done and that no detoxification of material would take place at this time.

Due to a lack of available trained personnel as a back up team and as recommended by ORD-048 and ORD 046 the Technical Escort Team, Edgewood Arsenal, Md. was called into the operation. At this time the operation became an EOD function and the NWL representative's services were no longer needed. A complete briefing on what could go wrong was presented to EOD personnel and Mr. Fitch. The following recommendations were made:

(a) If containers were to be used, a bleed-off should be made and utilized in conjunction with some type of filtration system. (M-11 canister could be used.)

(b) Do not use bleach slurry, but rather bleach solution (4% or less, by volume.) Slurry or powder bleach will burn in direct contact with mustard.

(c) The hardware, should be placed in a shallow burial hole with a normal bleed system. An igloo could be used, but it would not be admissable. (Reason: The mustard was not pure.) Indications from laboratory analysis made it clear that the material was in a degradation sequence. Pressure from the neutralization reaction or decomposition gases could over pressurize the container. Normal earth would handle any small amount of material that could escape through the gasket seals. However, if an igloo is to be used, some type of surveillance program should be initiated (especially through the hot summer months).

All necessary g and safety equipment were ch ked by the NWL representative for contamination. No contamination was present and the protective gear was transferred to EOD personnel.

The NWL personnel had an exit interview with the Ex. Officer and it was agreed by the OX and ORD-048 that NWL advisory services were no longer required at this time. The operation at this point was transferred to the U.S. Army Technical Escort and EOD personnel.

6. RECOMMENDATIONS:

1. That, in view of the findings, the additional four burial sites should be done during late fall. (Temp. 40-60°F).

2. That the following additional equipment and personnel should be requested prior to starting on the additional burial sites:

a. 5 each chemically-trained EOD personnel, to assist present EOD team at NAD, Crane.

b. 2 each, M-9 Decontamination trucks or 3 each M-12 Decontamination equipment.

c. 4 each, SS-316 55 gal. drums or 8 each, SS-316 30 gal. drums.

d. 1000 lbs. of HTH

e. 12 each, M-3 suits and 12 each, chemical aprons.

f. 12 each, additional M-9 Protective Masks with 48 each, spare, M-11 canisters.

g. 12 each, rubber latex surigcal type gloves.

h. Revised SOP to include detoxification of residual mustard contamination with proper authorization.

i. 24 each containers, 54" x 10".

The operation can be conducted in a safe manner using present U.S. Navy personnel with technical assistance, if required, by NWL Dahlgren, Va.

7. CONCLUSIONS:

1. That U.S. Navy EOD personnel, with technical assistance, can do the operation during the late fall when the temperature is between 40-60°F.

2. That, in view of the corrosion problem with the hardware as explained in Enclosure (1), detoxification of the item is indicated. Further retention of the items for future detoxification is not recommended or desired.

3. That the present law (91-121,91-441) allows the detoxification of leakers, especially in the condition of deterioration of both the hardware and original material.

4. That this operation was done according to the SOP: however, modifications are required to include detoxification.

F. B. Sanchez

F. B. SANCHEZ

The M70 A1 persistent gas bomb case is fabricated from seamless steel tubing. The steel is, more than likely, a low or medium-carbon steel and the bomb is fabricated by cold nosing or spin forming, followed by stress relieving, phosphate-primer coating, and painting. Other components such as the burster well initiation, etc. are added and the final assembly is the M70-A1 persistent gas bomb.

Some M70-A1 bombs were disposed of by burial in the soil/over a period years, the exterior paint deteriorated due to aging and corrosive chemical attack caused by moisture contacting the surface of the bomb and general akaline condition of the red sandstone, clay soil.

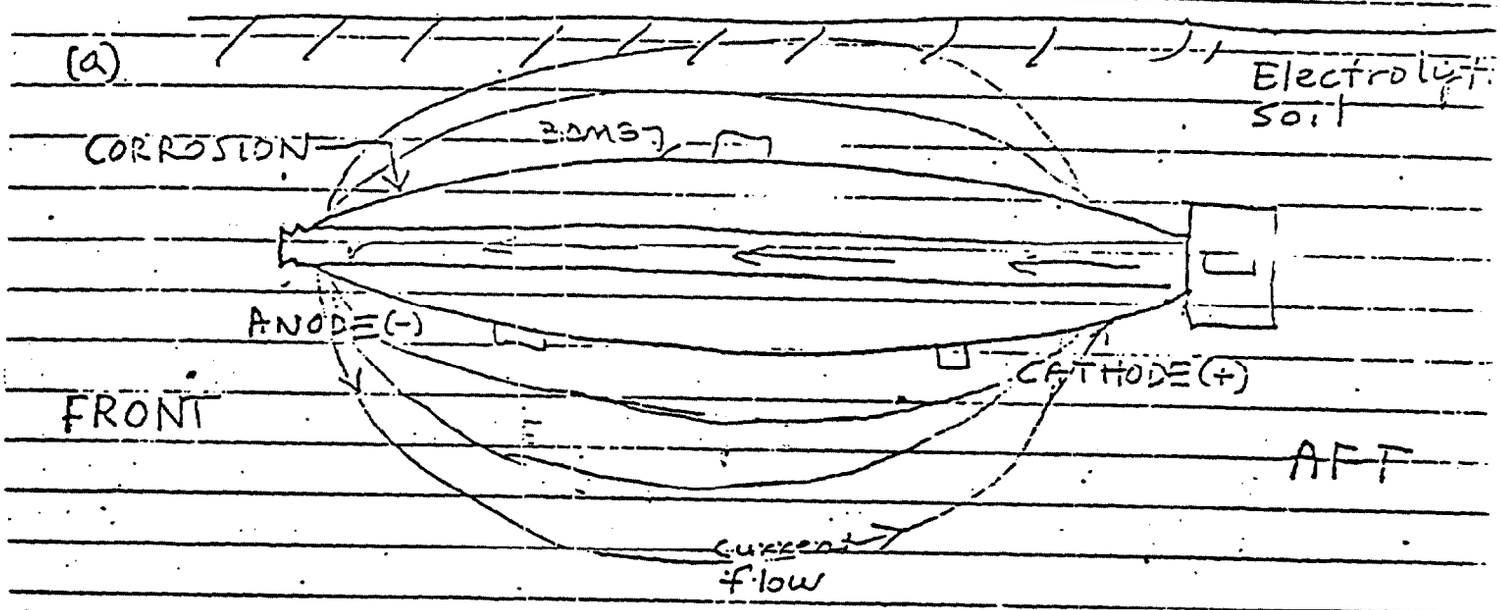
It is possible that this corrosive environment chemically attacked the bare steel surface, after tha paint was removed, causing general pitting, flaking and sloughing of corrosion products (i.e., rust) off the exterior of the bomb. It is also possible that intergranular corrosion occurred through the wall of the bomb over this extended period of time. This could be verified by nondestructive testing.

The nose section of the bomb will probably corrode faster than the aft section due to the effects of cold working even though a stress-relieving operation was conducted. The accelerated corrosion is due to the relatively higher strained condition of themetal and its higher free energy state causing a higher potential region to interact with the soil environment.

If the bomb was buried in the soil it is possible to develop electro-chemical corrosion similar to that depicted in the sketch below:

Electrochemical corrosion tends to accelerate corrosive action and will occur in some instances when only chemical corrosion will not, due to the added electrical energy.

(a)



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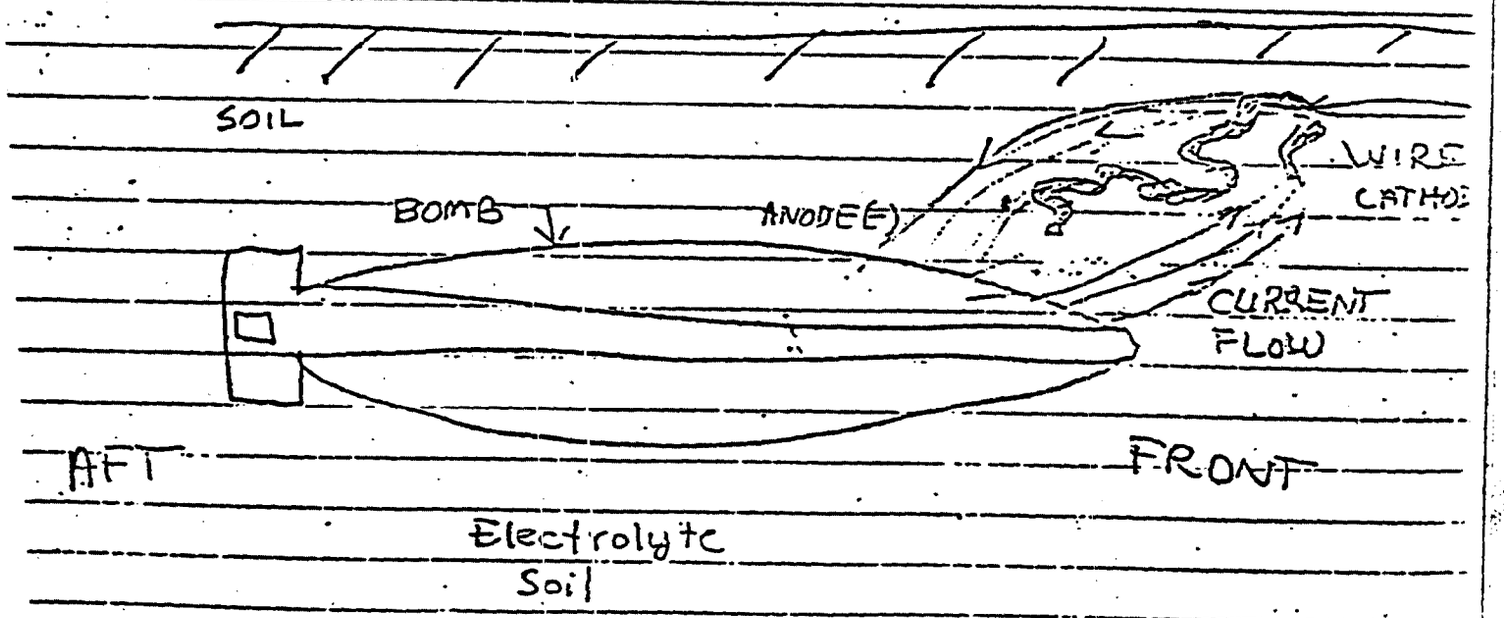

APPENDIX H

AFTER ACTION REPORT
CHEMICAL BURIAL GROUND EXHUMATION REPORT
dtd OCTOBER 1980

AFTER ACTION REPORT

NAVAL WEAPONS SUPPORT CENTER
CRANE

CHEMICAL BURIAL GROUND EXHUMATION PROJECT

OCTOBER 1980

AFTER ACTION REPORT

Chemical Burial Ground
Exhumation Project

Naval Weapons Support Center
Crane, IN 47522

Prepared By: Dale L. Groh
Dale L. Groh (Safety Engineer)

Reviewed By: John P. McDonald
John P. McDonald (Safety Director)

Reviewed By: Cecil E. Barlow
LTJG Cecil Barlow (EOD Crane Detachment)

Approved By: Kenneth P. Hughes
CAPT Kenneth P. Hughes (Commanding Officer)

October 1980

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I. EXECUTIVE SUMMARY

A chemical Burial Ground was established in the late forties or early fifties for disposal of leaking mustard agent aerial bombs. The Department of Defense Explosive Safety Board directed in 1973 the exhumation of the land area to remove any chemical material. A project was initiated in 1974 in compliance with the DDESB directive. The project yielded a quantity of radioactive Thorium Nitrate and 10 mustard aerial bombs containing a small quantity of live agent. The project was halted at that time because the level of effort available was thought to be insufficient considering the material exhumed.

An Operation Plan was generated by NAVWPNSUPPCEN Crane in February 1980 to exhume all material associated with the Chemical Burial Ground. Execution requests were issued to the task forces by Naval Sea Systems Command in June 1980.

Exhumation of the Burial Ground by EOD Group Two personnel was initiated on 9 September 1980. The effort involved intensive work in the field until 24 September when the exhumation phase was considered complete.

The yield for the latest exhumation effort was: 6 empty M70A1 HD persistant gas bombs, one identification set containing a 6 oz. laboratory sample of HD liquid, an unidentified radioactive waste and a quantity (filling three 55 gallon barrels) of radioactive Thorium Nitrate containers.

This material was in addition to 10 empty to partially filled M70A1 HD gas bombs and a quantity of Thorium Nitrate containers unearthed during the 1974 project.

All chemical hardware was decontaminated/detoxified in accordance with provisions outlined by AR75-15. The land was certified in compliance with chemical certification procedures and certified free from radioactive materials.

The land area is now being restored to its natural condition.

II. HISTORY OF THE BURIAL GROUND

The Chemical Burial Ground was established in the late forties or early fifties, the exact date along with conclusive documentation of content have defied discovery. The strongest evidence supports the theory that 115 lb. aerial chemical bombs similar to that illustrated by Figure 1 were buried by Army Tech-Escort personnel during an inventory project. The burial effort supposedly was for material considered unfit and hazardous for transportation. It was understood that a disposal procedure was utilized which involved draining of the HD (Blister Agent) contents and introducing decontaminating material.

A quantity of radioactive waste material was buried at the site in the mid 1950's with the approval of NAVORD.

The Chemical Burial Ground is located in a relatively remote area of the government reservation. Figure 2 illustrates the area with respect to the boundary. The land surrounding the Burial Ground for a radius of several miles consists of heavy forest with few private residences. The Burial Ground is located in a magazine area as illustrated by a map of the area (Figure 3). The Burial Ground existed then as a fenced area with various signs marking the individual plots. Figure 4 illustrates the size of the area and the rough locations of the individual plots.

Interest in the Burial Ground was kindled in the 1970 to 1972 time frame as the nation in general reacted to environmental problems. NAVORD requested by letter dated 13 March 1972 that all burial sites be identified. The NAVWPNSUPPCEN Crane response to that request in November 1972, introduced representatives from NWL Dahlgren to the Crane Burial Ground problem. NWL Dahlgren personnel had previously completed an excavation effort of a Mustard Burial Ground at NAD Hawthorne. NAVWPNSUPPCEN Crane's response basically involved a request to excavate the Burial Ground in an effort to (1) relocate the radioactive wastes to a proper disposal area and (2) detoxify any chemical munitions/wastes recovered.

NAVORD approved the NAVWPNSUPPCEN Crane request with the stipulation that any effort to excavate the Burial Ground be carefully planned and documented with the documentation subject to review by NAVORD.

A chemical survey of NAVWPNSUPPCEN Crane was conducted by a representative (Dr. Scott) of the Department of Defense Explosive (Copies of four pertinent documents initiating the first Burial Ground effort are provided in Appendix A.)

Safety Board in March 1973. The recommendation of that survey to excavate all materials and to certify the land was endorsed by CNO and NAVORD in July 1973.

After an approved plan was established, a work force consisting of personnel from NWL Dahlgren and NAVWPNSUPPCEN Crane began an excavation effort in May 1974. The effort began with the excavation of the radioactive wastes, the location of which was documented. All radioactive waste material was thought to be successfully removed and the land certified. All radioactive material was sent to an NRC licensed Burial Ground in 1975.

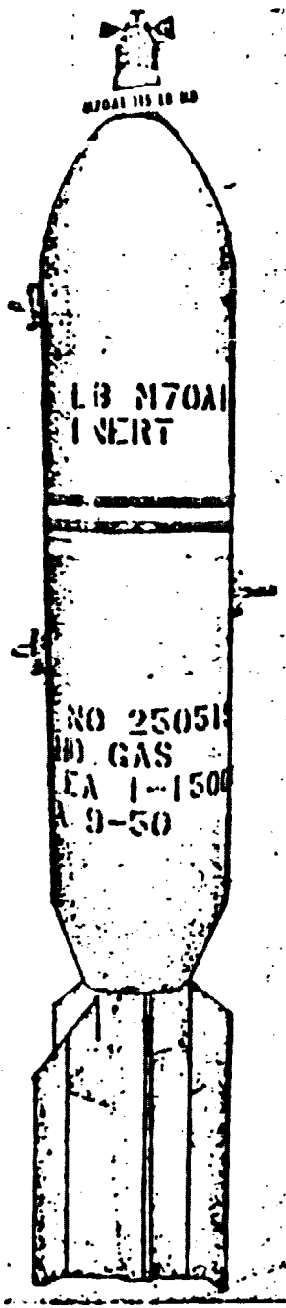
Work then began on a plot marked 550 lbs. Mustard Gas. According to past accounts of the burial procedure, the material expected to be unearthed should have been chemical munition hardware drained of agent. It was expected that a certain degree of land contamination could be present due to the persistance of mustard agent. Ten items of hardware were recovered from the plot in a deteriorated condition. Seven of the items were apparently drained; however, three items were found to be much heavier than the others and upon further investigation suspected to contain mustard agent in a deteriorated condition. The operation was then halted and an Army Tech-Escort unit requested to handle the disposition of the three items.

A Tech-Escort unit arrived at NAVWPNSUPPCEN Crane and began work in May 1974 to overpack the three items. This process was completed using a plastic wrap and 8" propellant charge shipping containers. The overpacked items were then stored in a magazine with no other material. No other effort was expended on the project. Later efforts have centered on re-establishing the Burial Ground Exhumation Project recognizing that more unknowns could exist than previously thought. To that end, a survey was conducted in 1977 by EOD personnel using a magnatometer to locate buried metallic objects.

The area was replotted as illustrated by Figure 5 and an outer fence constructed to encompass the new contacts. Though the new contacts are curiously close to the original Burial Ground, because of the past history of the area before being a government reservation, it is possible that they are not chemical munition items.

An Operation Plan (OPLAN) available in Appendix A was generated in February 1980 describing a project to exhume all metal contacts identified and plotted in 1977. It was the intent of the project to rid the area of all chemical warfare materials and return the land to its original contition. In the process of restoration, proper

certification techniques were to be observed officially clarifying the final condition of the land for future reference. Requests by NAVSEA to execute the OPLAND were issued to the various forces, copies of which are included in Appendix B.



FOR OFFICIAL USE ONLY

M70A1 115 LB HD PERSISTENT GAS BOMB

FILLING - 27.0 Kg HD (BLISTER AGENT)

DIMENSIONS - 51½ in LONG; 8 3/32 in DIAMETER

USING SERVICE - USAF (LIMITED STANDARD)

THE BOMB BODY IS MADE OF STEEL. A TUBULAR BURSTER WELL EXTENDS THE LENGTH OF THE BOMB FROM A THREADED HOLE IN THE NOSE TO THE TAIL. WHEN THE BOMB IS RELEASED FROM AN AIRCRAFT, THE ARMING WIRE IS WITHDRAWN AND THE FUZE ARMING VANE ROTATES IN THE AIRSTREAM. AFTER THE REQUIRED NUMBER OF REVOLUTIONS, THE FUZE IS ARMED. WHEN THE BOMB STRIKES, THE FUZE FUNCTIONS, CAUSING THE BURSTER TO DETONATE. THE DETONATION RUPTURES THE BOMB BODY AND RELEASES THE FILLING.

FIGURE 1

M70A1 Aerial Bomb Data Sheet

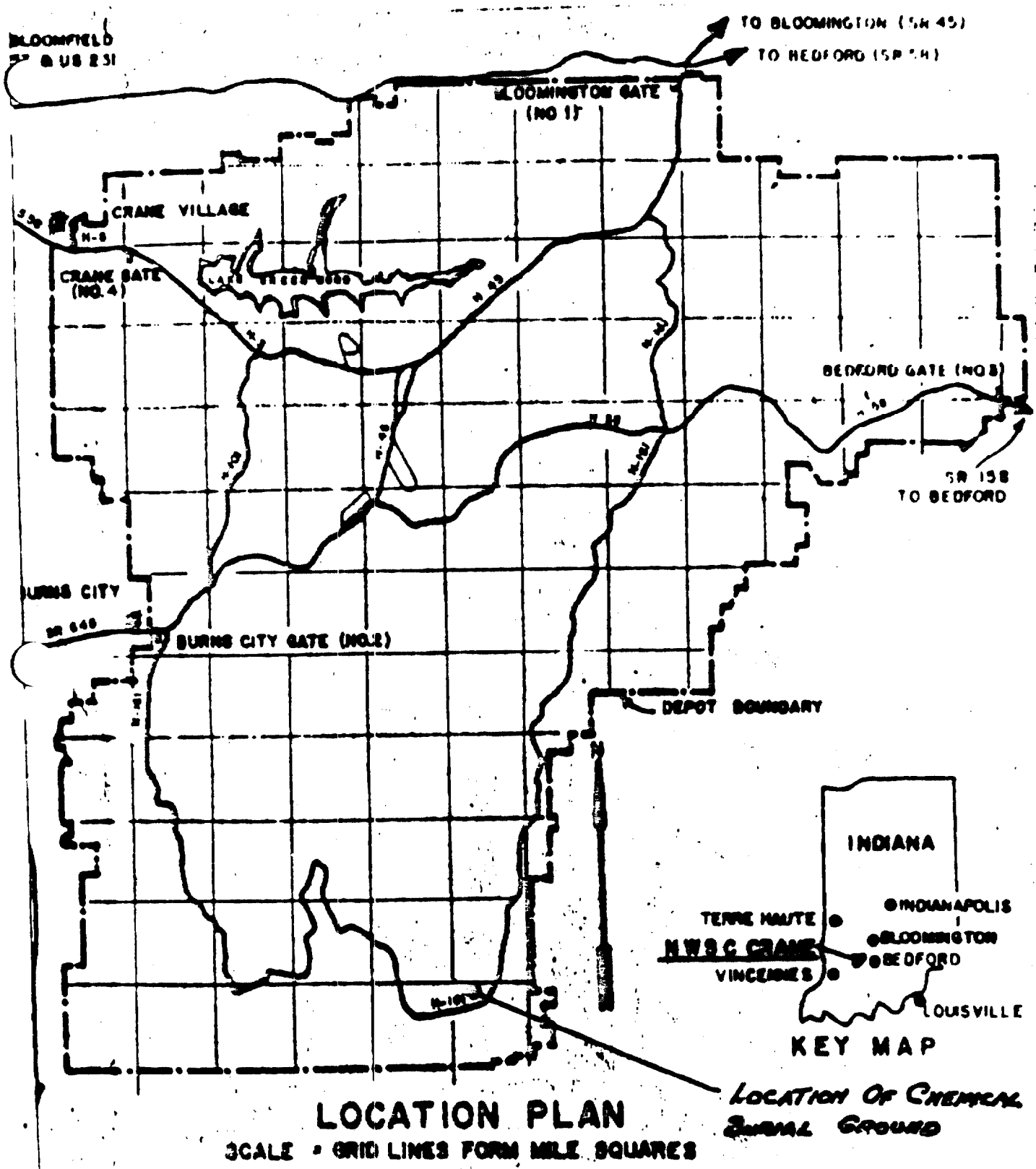


FIGURE 2

NWSC Crane Map

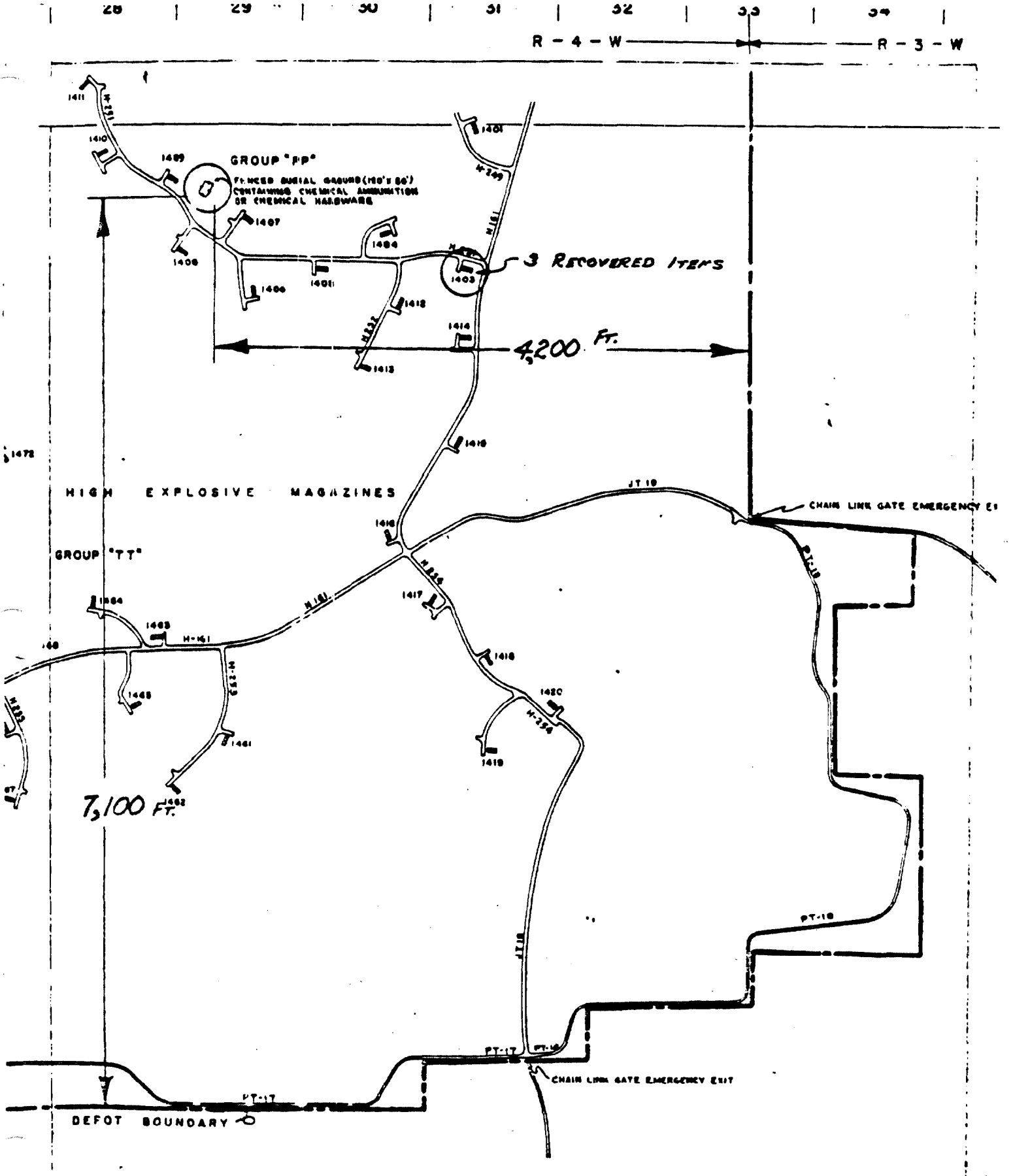


FIGURE 3

Magazine Group Map

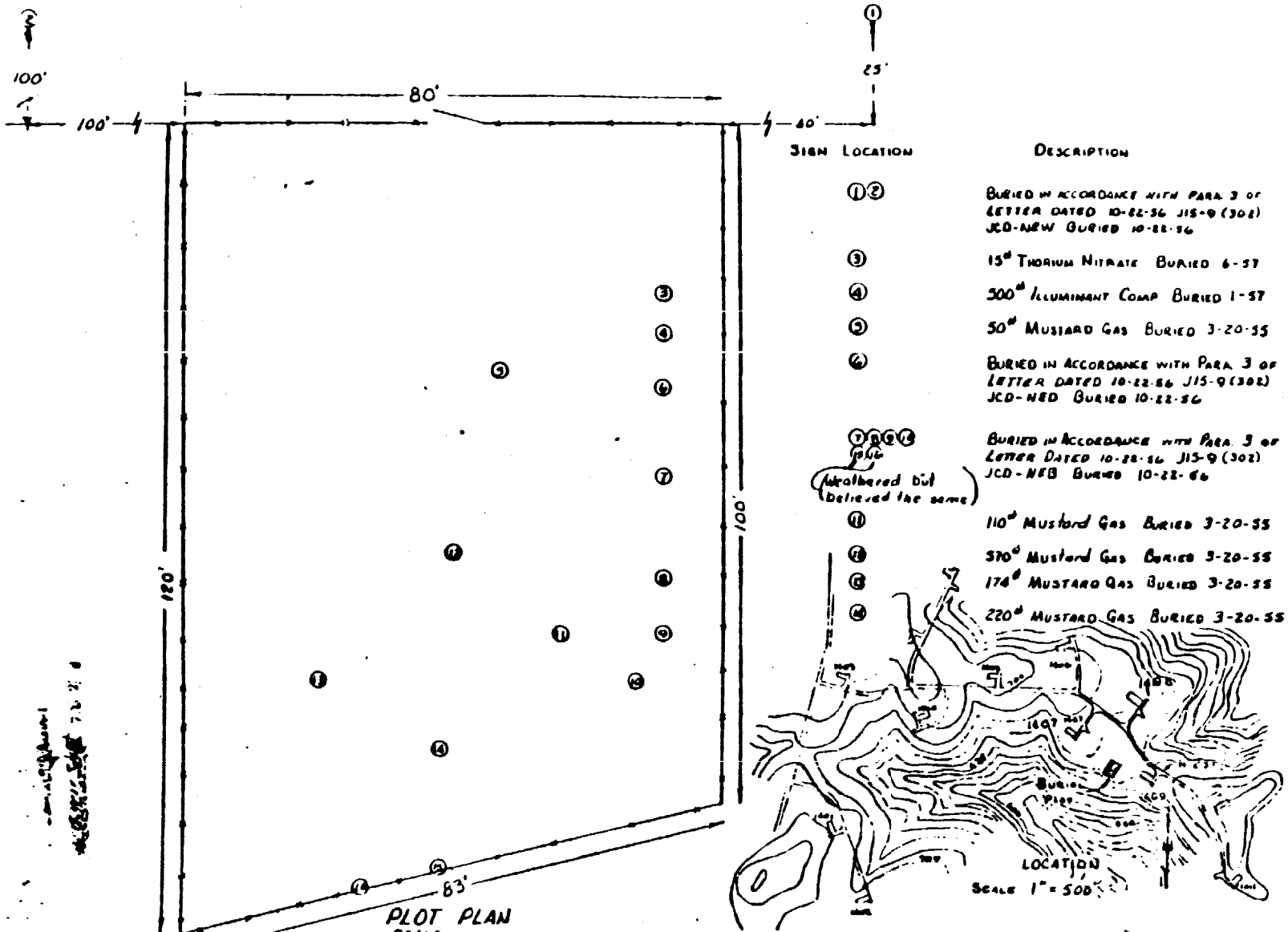


FIGURE 4

Original Plot Map

FOR OFFICIAL USE ONLY

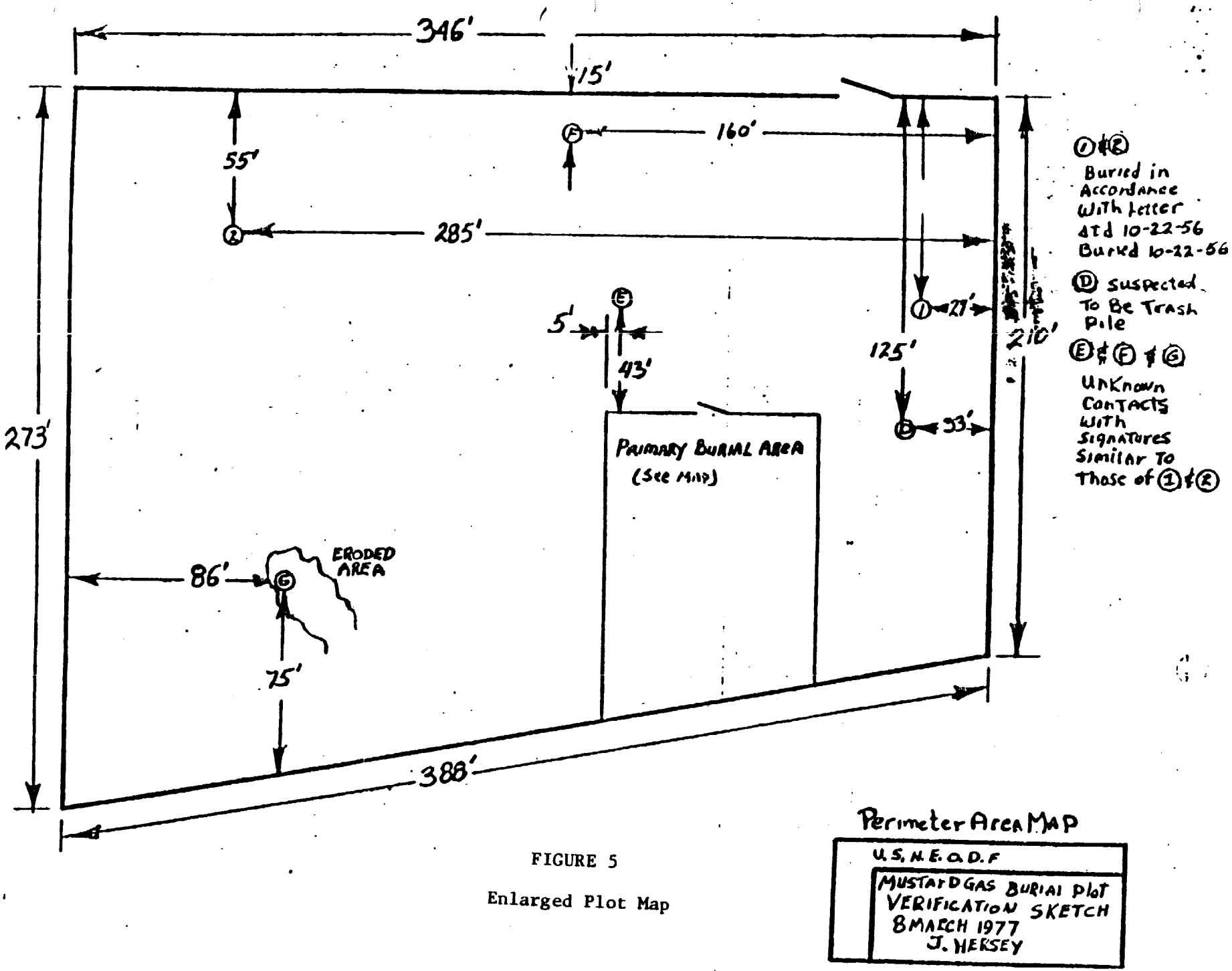


FIGURE 5

Enlarged Plot Map

FOR OFFICIAL USE ONLY

III. EXHUMATION PROJECT BRIEF

A. General

The exhumation effort primarily involved EOD Group Two and EOD Group Two Crane detachment personnel for the period 8 September 1980 to 17 October 1980. The effort was broken into several phases which will be treated separately in the following text. A synopsis of the On-scene Commander's Log is included as Appendix C. The standing Operating Procedures, written by the EOD facility for the exhumation effort, are included in Appendix D.

1. Support Staging and Land Survey

In order to qualify later samples of ground run-off water, samples of water running from the site, near the site and from an exhumation pit remaining after the 1974 effort were obtained. The locations of the various samples with respect to the Burial Ground are illustrated by Figure 6. The results of the analysis are available in Appendix E.

In addition it was realized during early planning efforts that a high degree of support for EOD forces in the field would be required. This support included field shelter, a command center, a steam plant, compressed air plant, electric power plant and various land improvements. The support effort is illustrated by Figure 7.

Previous efforts to locate buried metallic objects and past records resulted in a composite layout of all contacts illustrated by Figure 8.

EOD Group Two personnel performed a final survey during the week of 8 September 1980 utilizing a sophisticated magnatometer (Figure 9). The results of that effort which eliminated a large number of previously recorded contacts are illustrated by Figure 10.

2. Prove-out of Equipment/Process Technique

Because many of the proposed operational steps had not been verified by previous field experience, new equipment (designed and locally fabricated for this operation) was involved and many personnel had not had previous "hands-on" experience with this chemical material, a prove-out/pilot plant approach was utilized. The material utilized for this phase was first seven rusty and empty M70A1 bomb skins remaining from the 1974 exhumation project. These items were subjected to (1) a cutting process shown by Figure 11, (2) a steam-out process of the two halves shown by Figure 12, and (3) a long duration soaking of the hardware in decontamination as shown by Figure 13. Second, to verify that all decontamination equipment/processes were effective, three M70A1 bombs from the 1974 project that had exhibited

evidence of containing at least some live agent were subjected to the process steps outlined above. One of the three items did in fact contain some agent when opened for inspection. The content was approximately 3 gallons of oily material and heavy sludge. Because of the deteriorated condition of the hardware, the cutting, steaming and soaking process was employed for all three items. This decision, made by the Field Commander, was in concert with provisions of AR75-15. This was so because, in the opinion of the Commander, further handling of the items would prove unduly hazardous to personnel.

The success of the run-up effort resulted in the initiation of excavation work on remaining contacts.

3. Exhumation of Contacts

Exhumation of contacts was accomplished utilizing a hydraulic backhoe operated by EOD personnel in protective clothing (Figure 14). When an object was positively located, it was raised from the pit and transported to the process area (Figure 15) and the pit examined by magnatometer (Figure 16). This process continued until all metal objects were removed from the area.

The contacts expected to yield chemical munitions contained six M70A1 bombs full of holes and free of chemical agent. The items were processed in the same manner as the 10 previously exhumed (1974) items.

The remaining plots yielded a variety of material including one identification set (I.D. set) having a 6 oz. ampule of mustard agent. This material was apparently a laboratory sample and totally unlike standard I.D. sets. This material was processed in the same manner as the bomb hardware (Figures 17 and 18).

Material accounting for the major effort was a large quantity of radioactive Thorium Nitrate that had been a part of a research and development illumination project (Figure 19). The radioactive levels were found to be very low. Containers located were packed in waste barrels to await further transfer to an acceptable burial site.

The total yield for the area is illustrated as an overlay of the original contact plot map shown by Figure 20.

4. Area Clean-up and Decontamination

To insure that possible land surface contamination, process equipment contamination or support equipment contamination was properly treated, special provisions were employed. These provisions included spraying the land surface with decontaminant utilizing an M12 decontamination unit (Figure 21), transfer of processing liquids to the open pits for neutralization (Figure 22) and the installation of monitoring tubes (Figure 23).

The liquids derived from the process vat and the soaking tanks consisted of neutralized agent, HTH bleach compound and water. The solution was allowed to remain in a pit configuration shown by Figure 24. The solution was monitored until there was no indication of residual chlorine remaining. At that time the solution was released through a horizontal filter media constructed of sand and limestone. The filter is also illustrated by Figure 24. When no liquid remained in the pits, backfilling was accomplished. Certification of the procedures used to date for closing the chemical site is available in Appendix F.

B. Radioactive Material Disposition

Since one-half of the problem of the burial ground exhumation effort involved finding radioactive Thorium Nitrate illuminant composition, a separate effort was initiated to satisfy this concern. First, all excavated illuminant hardware and identifiable composition were placed in DOT approved, No. 17H, 55 gallon barrels by EOD personnel.

An effort approved by the Naval Energy and Environmental Support Activity's Radiation Affairs Support Office (RASO); and conducted after EOD Group Two forces had completed the chemical processing/ excavation phase involved the following steps:

1. Radiation survey of the excavation with surface scraping until predetermined radiation levels were measured. The scrapings were barreled in DOT approved 55 gallon barrels (Figures 25 and 26).

2. Radiation survey of the previously excavated soil (Figure 27) with removal and containerization of suspect soil.

Once acceptable levels were achieved, the pits were backfilled and the entire area landscaped and seeded as illustrated by Figure 28. Documentation of the effort with endorsement by RASO is included in Appendix E.

The barrels containing illuminating device hardware and soil contamination with radioactive Thorium Nitrate were stored in a magazine awaiting transfer to an approved burial ground.

C. Chemical Warfare Hardware Disposition

When all excavation and processing had been completed the decontaminated hardware (bomb halves) were removed from the soaking tank and subjected to two thermite granades (Figure 29). This process was used to insure detoxification of the hardware.

1. When the items cooled, they were packed in DOT approved 55 gallon barrels along with a quantity of vermiculite (Figure 30).

2. The containerized M70A1 bomb hardware was certified decontaminated/detoxified by NSWC Dahlgren personnel (document included in Appendix E). The barrels were baled to preclude possible misuse of the hardware (Figures 31 and 32) and landfilled (Figure 33).

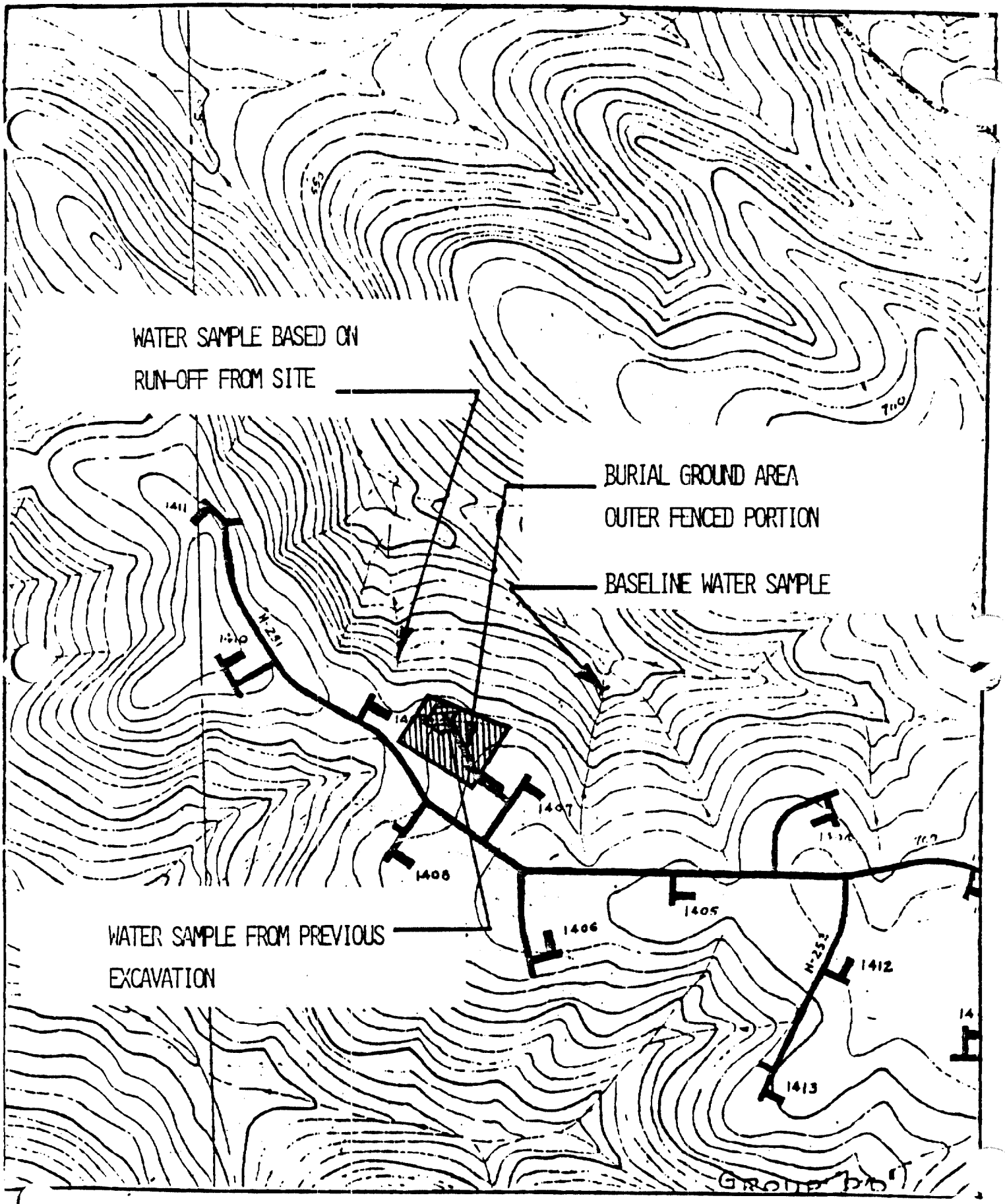


FIGURE 6

Water Sample Map

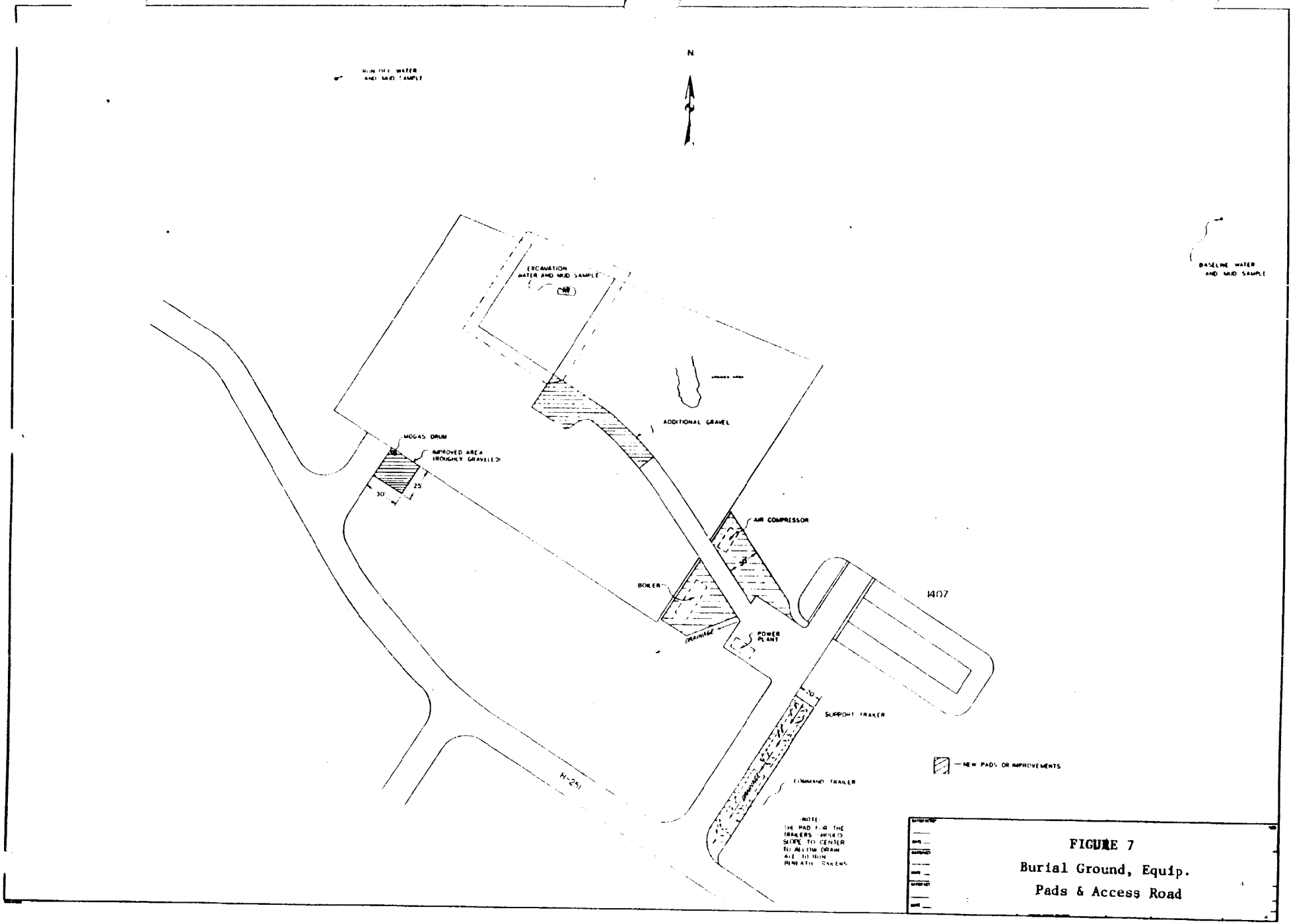


FIGURE 7

Burial Ground, Equip. Pads & Access Road

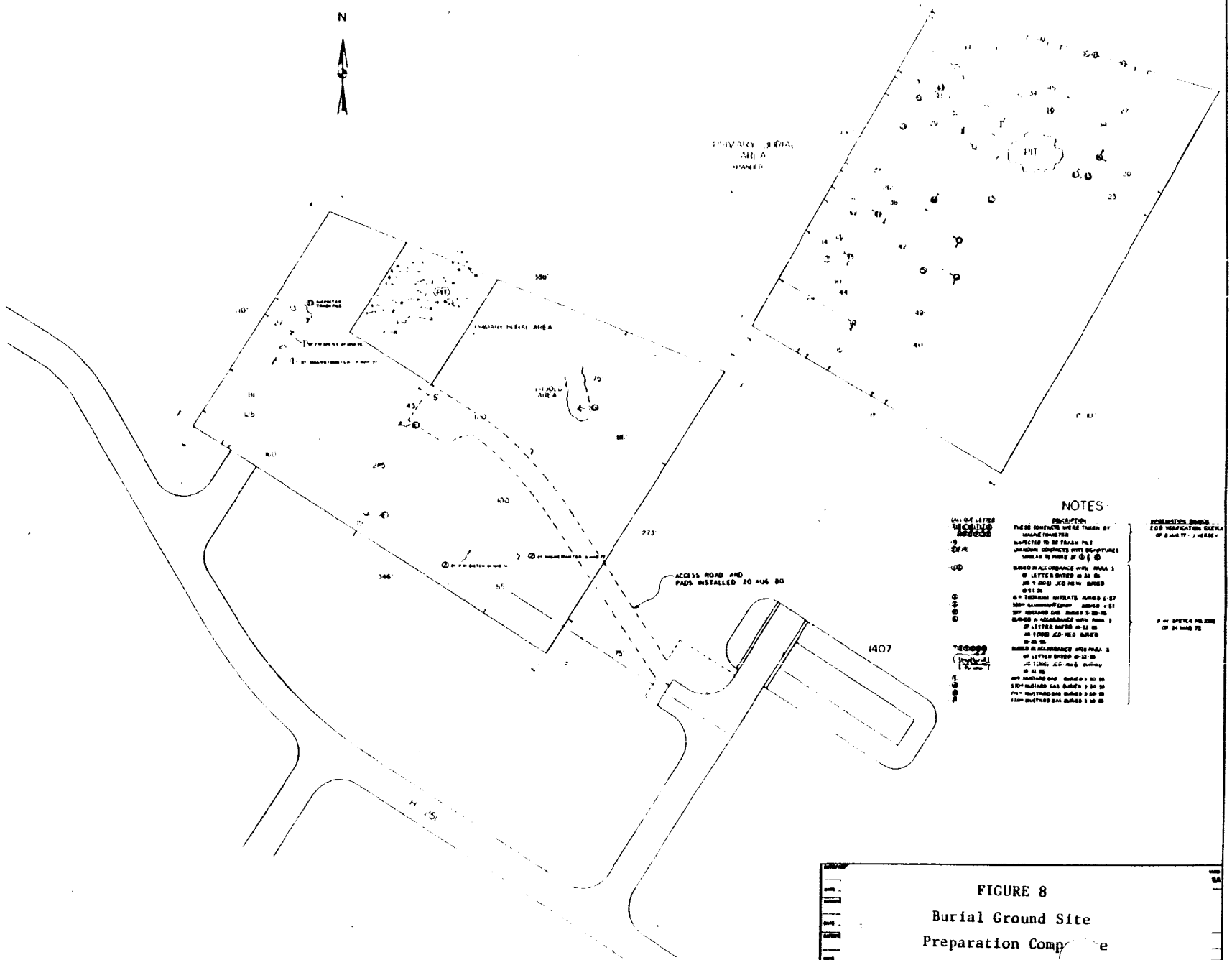


FIGURE 8

Burial Ground Site

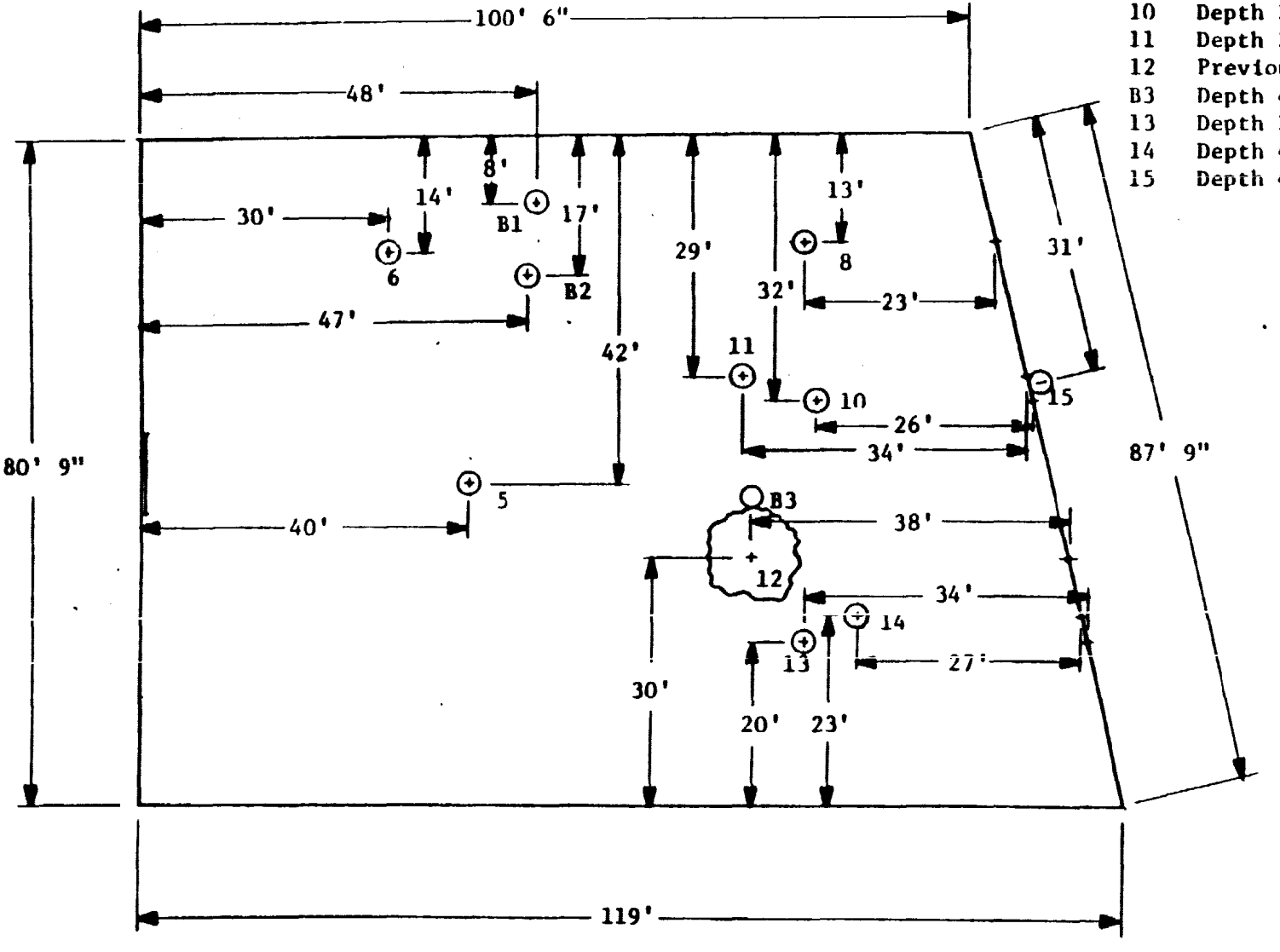
Preparation Comp[illegible]e

Figure 9

EOD Group Two personnel use of magnatometer

Note: All work of this type was accomplished prior to any possible exposure to live agent.

Plot	Description
6	Depth 2.3' + Debris
B1	Depth 2.4'
B2	Depth 2.8'
5	Depth 2.5'
8	Depth 4'
10	Depth 2.4'
11	Depth 2.4'
12	Previous Excavation
B3	Depth 4'
13	Depth 3.2'
14	Depth 4.8'
15	Depth 4'



SAFETY

DEPT.

PROJECT CHEMICAL BURIAL GROUND EXHUMATION

ENGINEER GROH

DATE 10-80

PLOTS INDICATED BY FORSTER 4022 LOCATOR 10 SEPT. 1980 DEPTHS BY 4/5 RULE

FIGURE 10

SKETCH NUMBER RECORD · 9ND-NADC 5211/2(1/70)

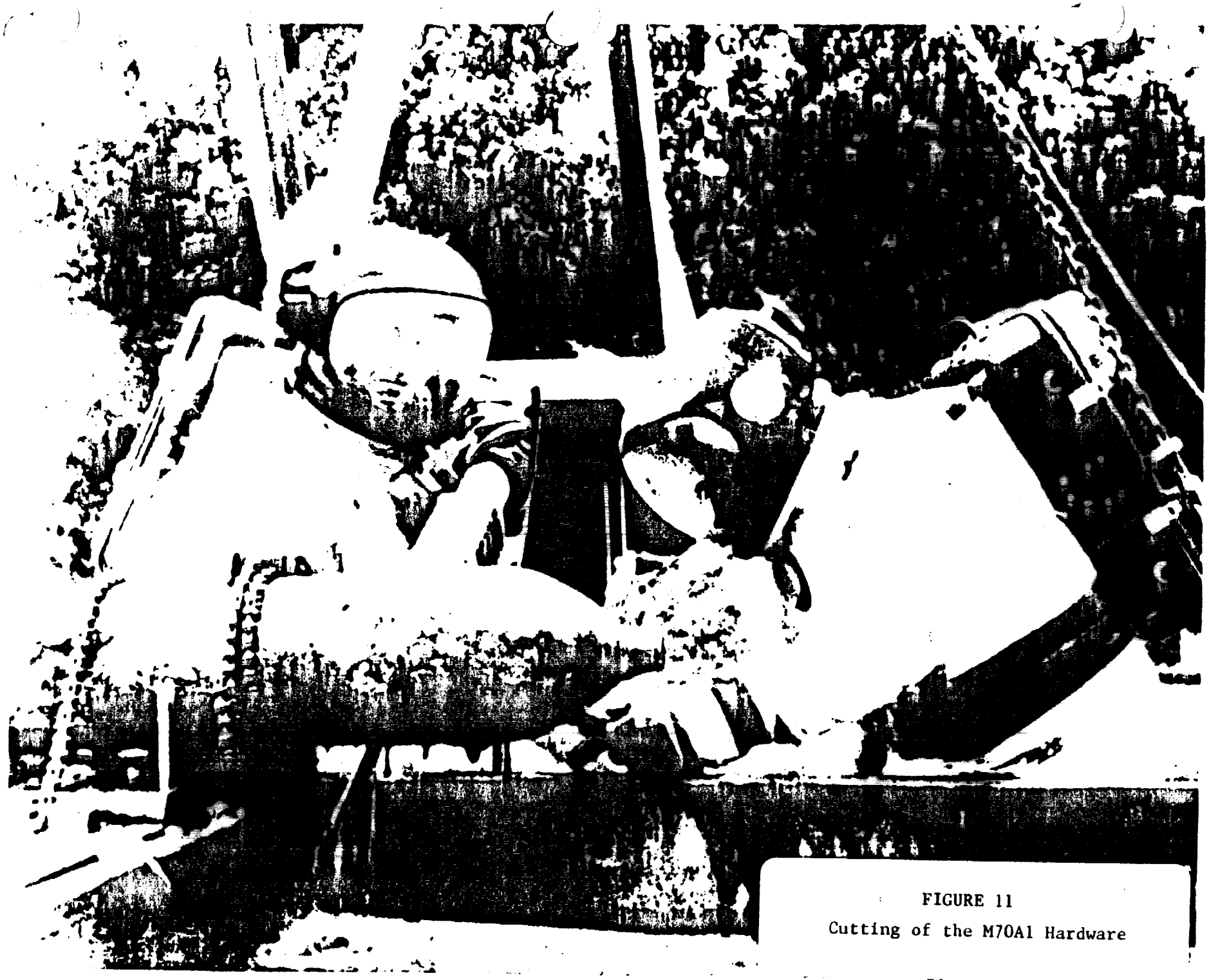


FIGURE 11

Cutting of the M70A1 Hardware

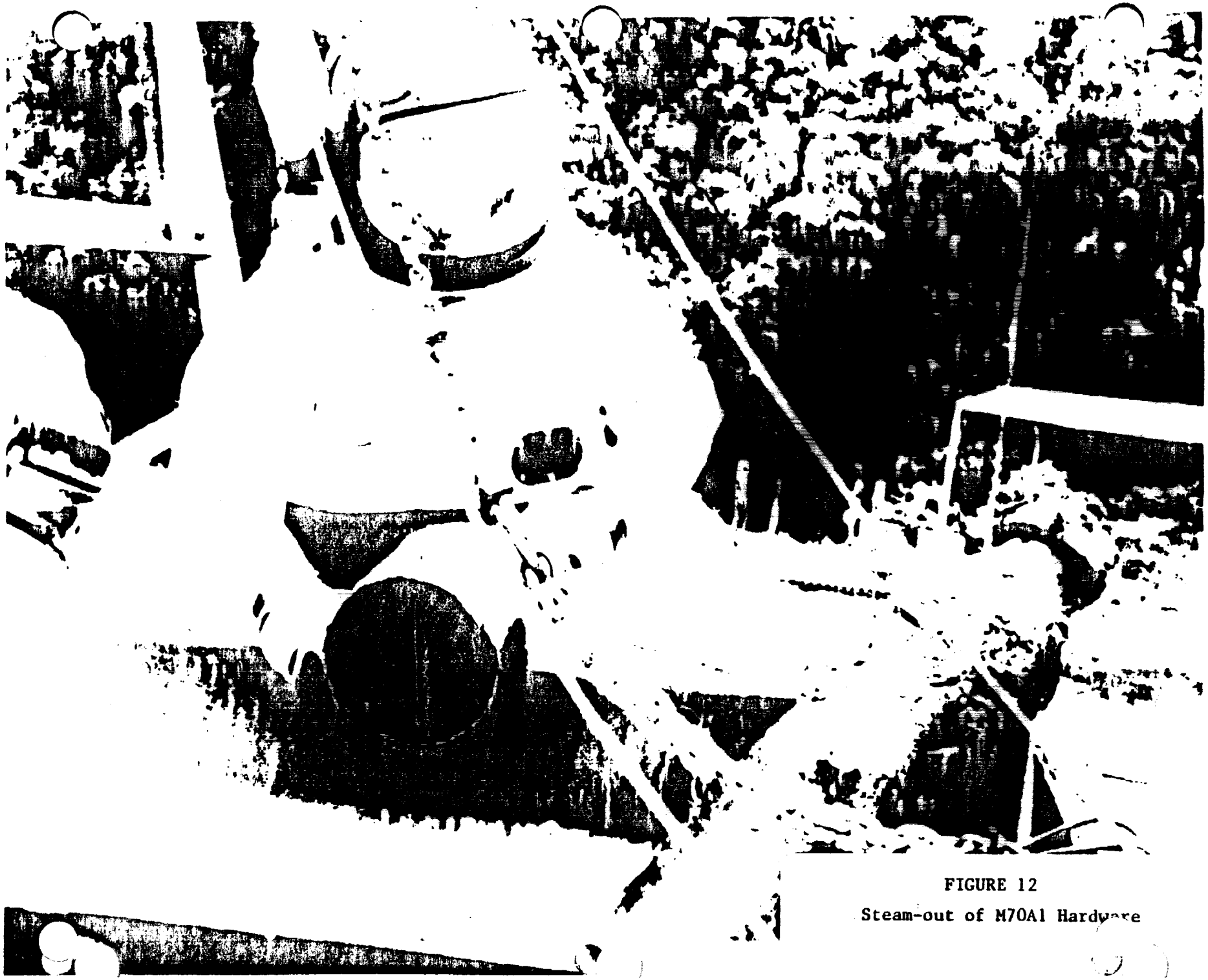


FIGURE 12

Steam-out of M70A1 Hardware

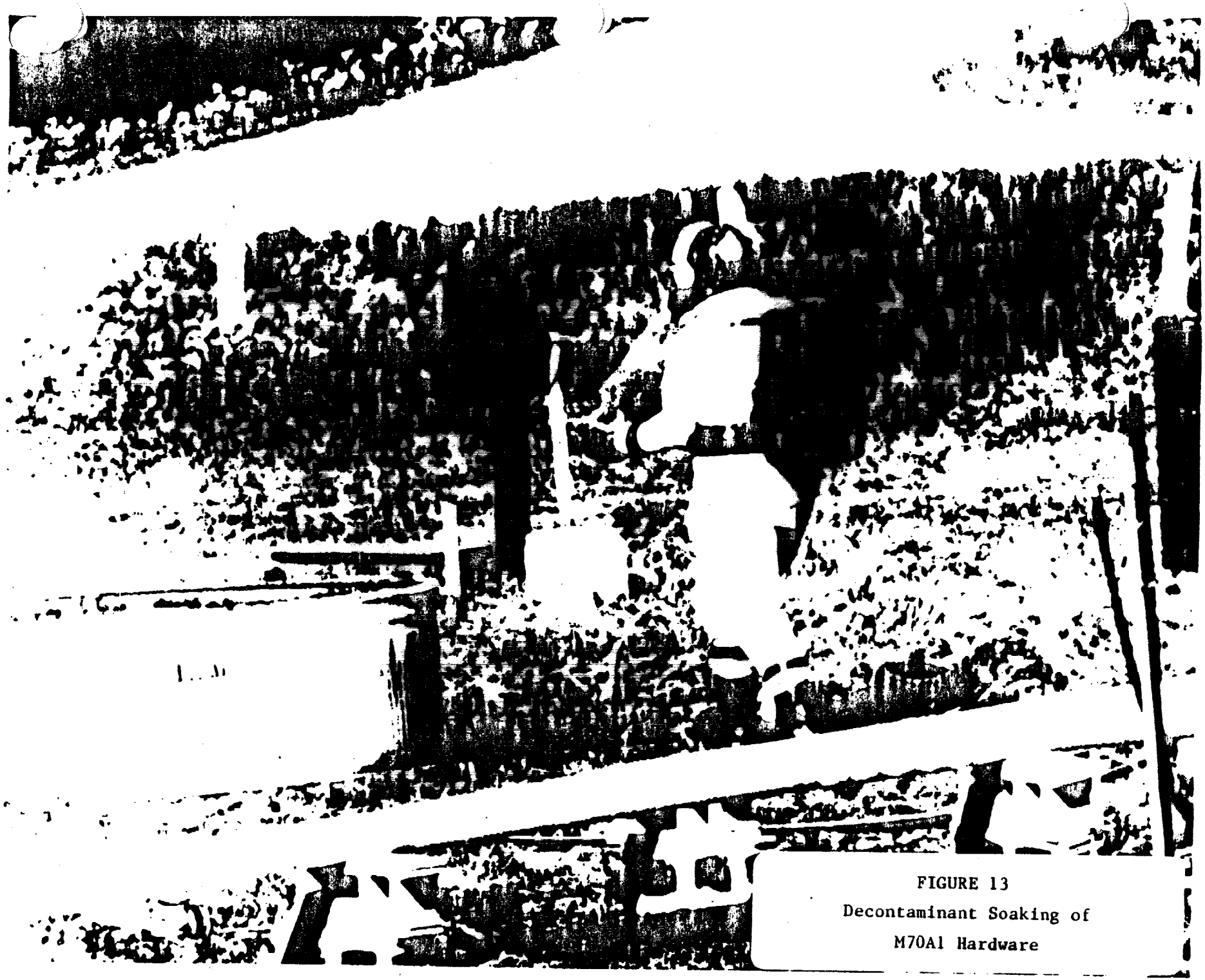


FIGURE 13
Decontaminant Soaking of
M70A1 Hardware

FIGURE 14

Digging of Identified Plots

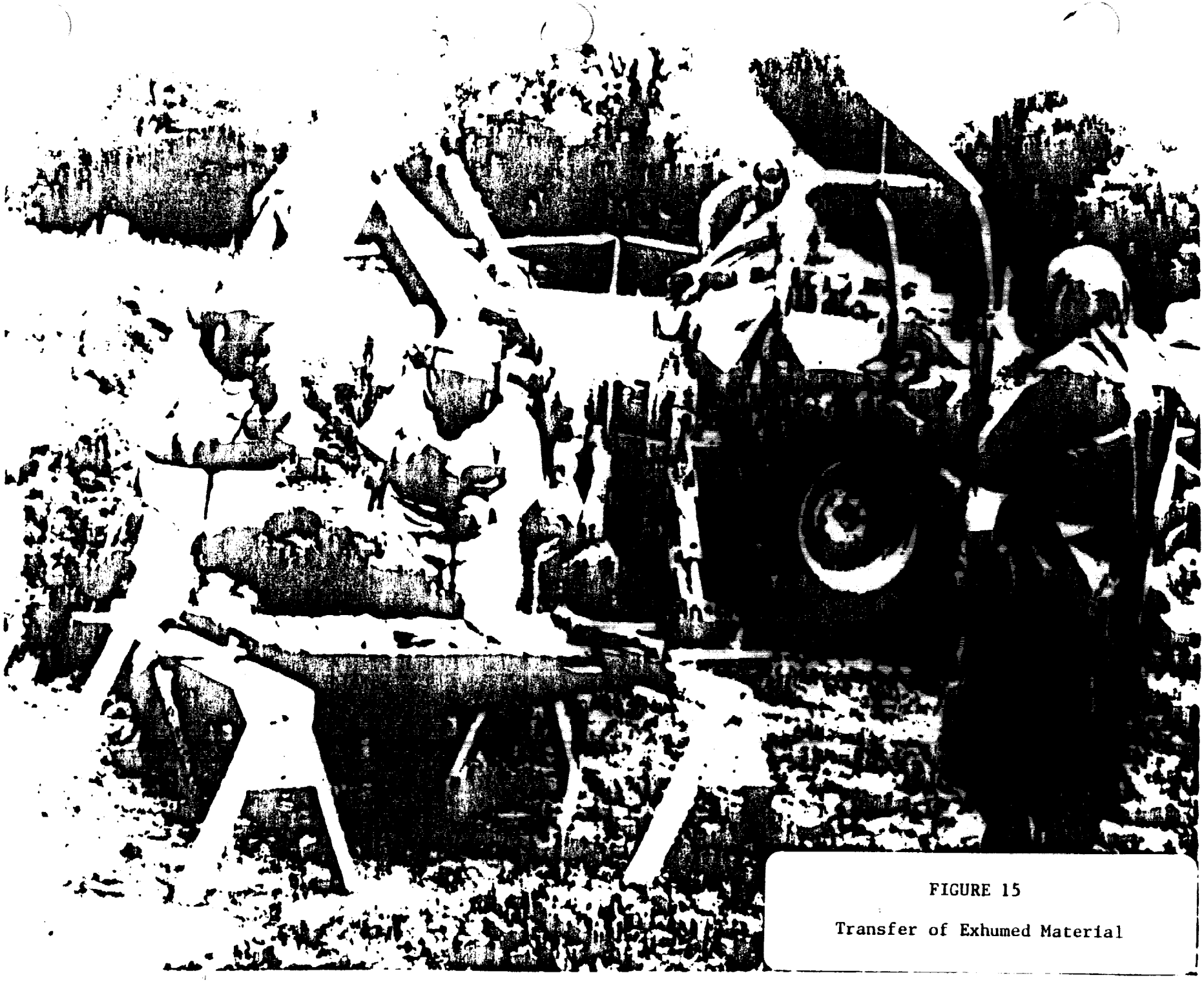


FIGURE 15

Transfer of Exhumed Material

FIGURE 16

Re-examination of Excavati
By Magnatometer

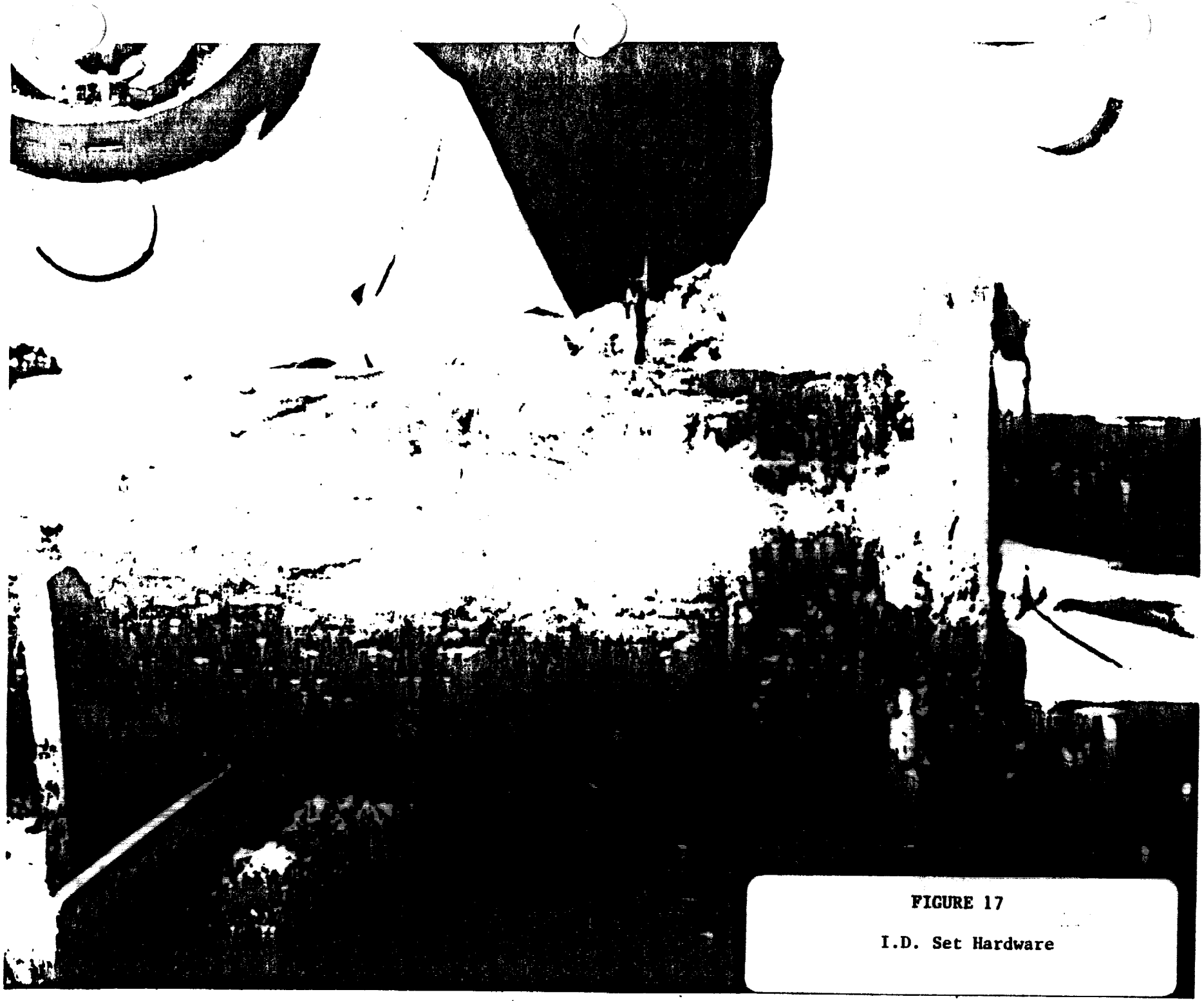


FIGURE 17

I.D. Set Hardware

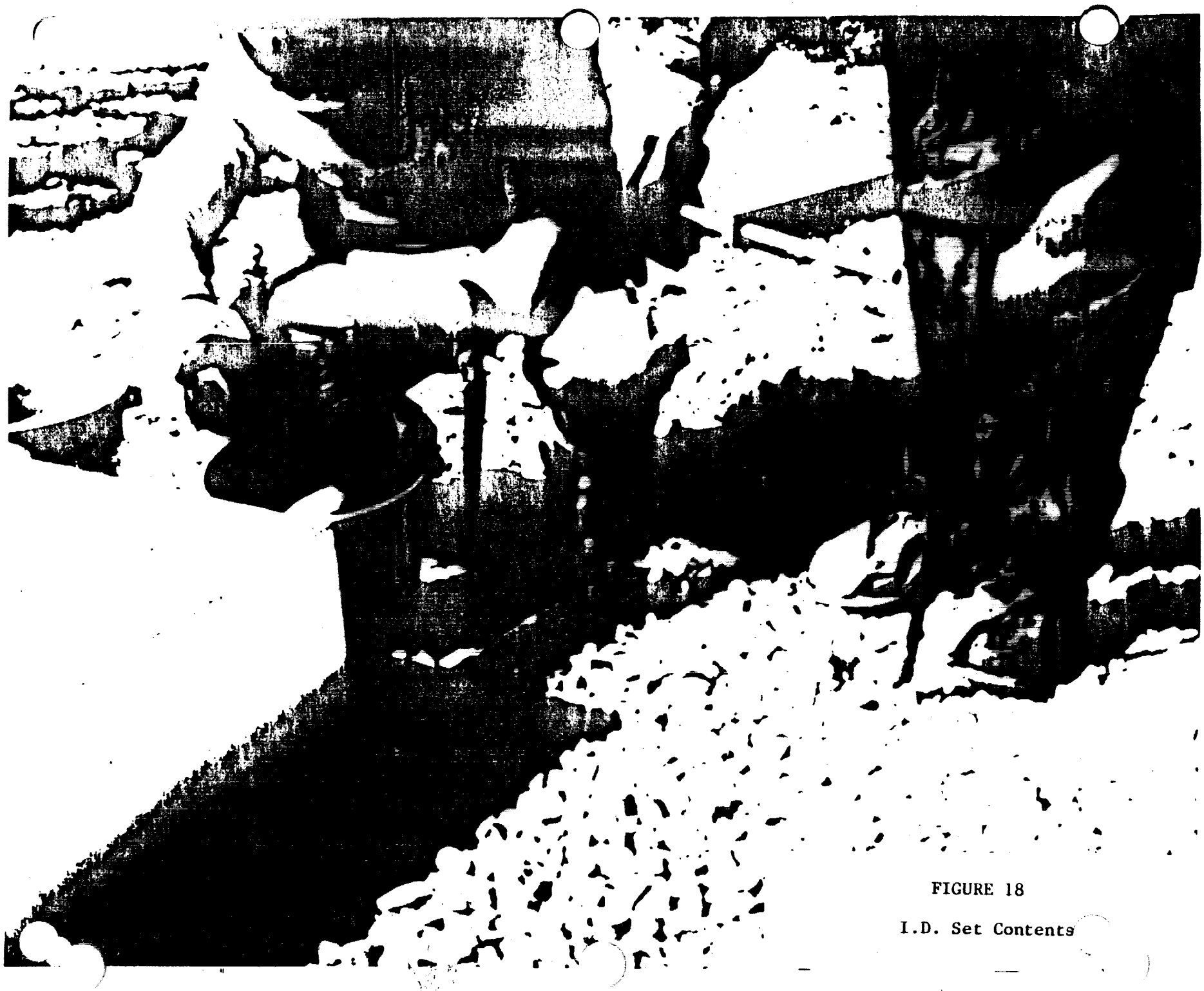


FIGURE 18

I.D. Set Contents

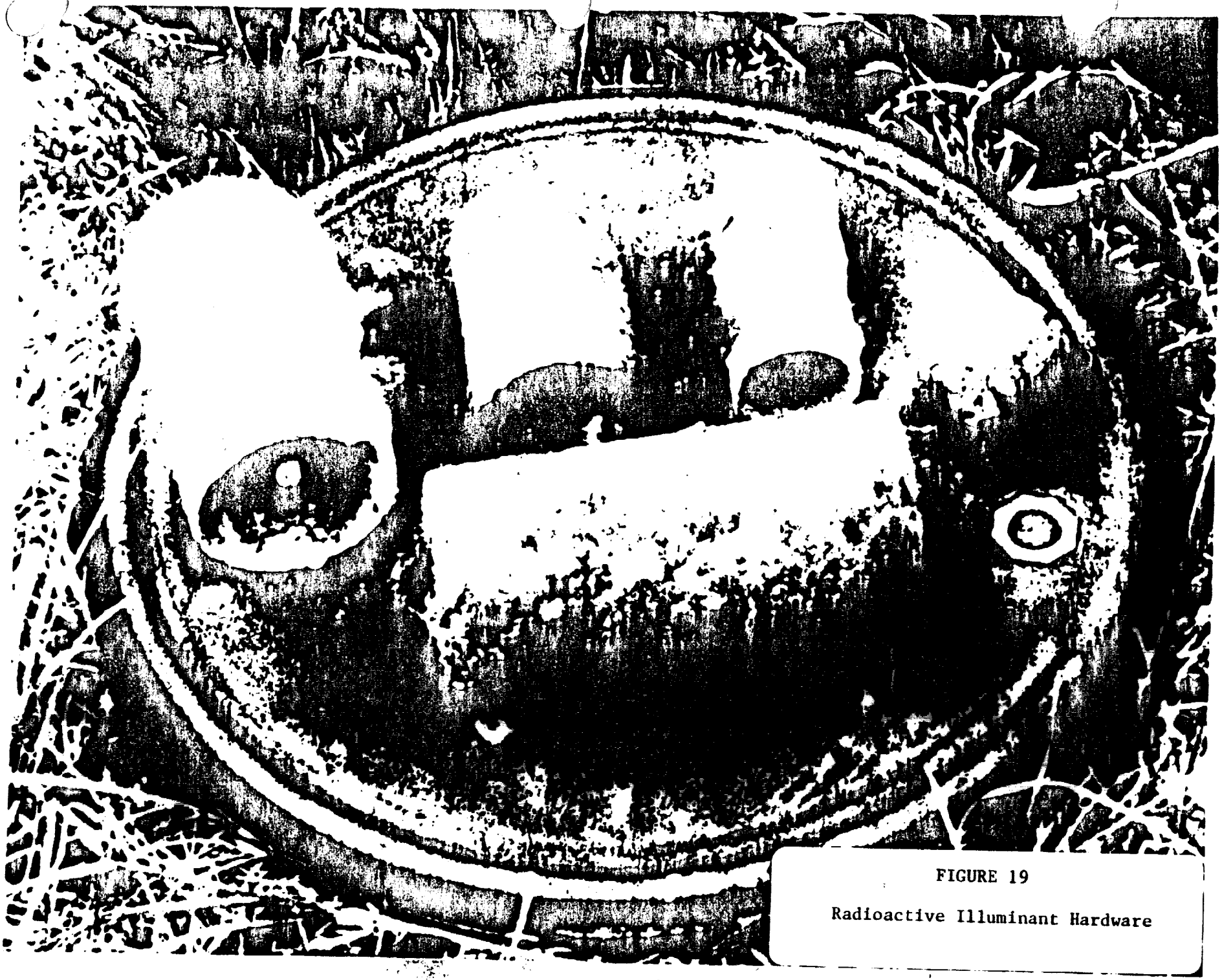


FIGURE 19

Radioactive Illuminant Hardware

SAFETY DEPT.

PROJECT CHEMICAL BURIAL GROUND EXHUMATION

ENGINEER ROH

DATE 10-80

SKETCH NUMBER RECORD - 9ND-NADC (211/2(1/70)

Plot	Description
6	Depth 2.3' + Debris
B1	Depth 2.4'
B2	Depth 2.8'
5	Depth 2.5'
8	Depth 4'
10	Depth 2.4'
11	Depth 2.4'
12	Previous Excavation
B3	Depth 4'
13	Depth 3.2'
14	Depth 4.8'
15	Depth 4'

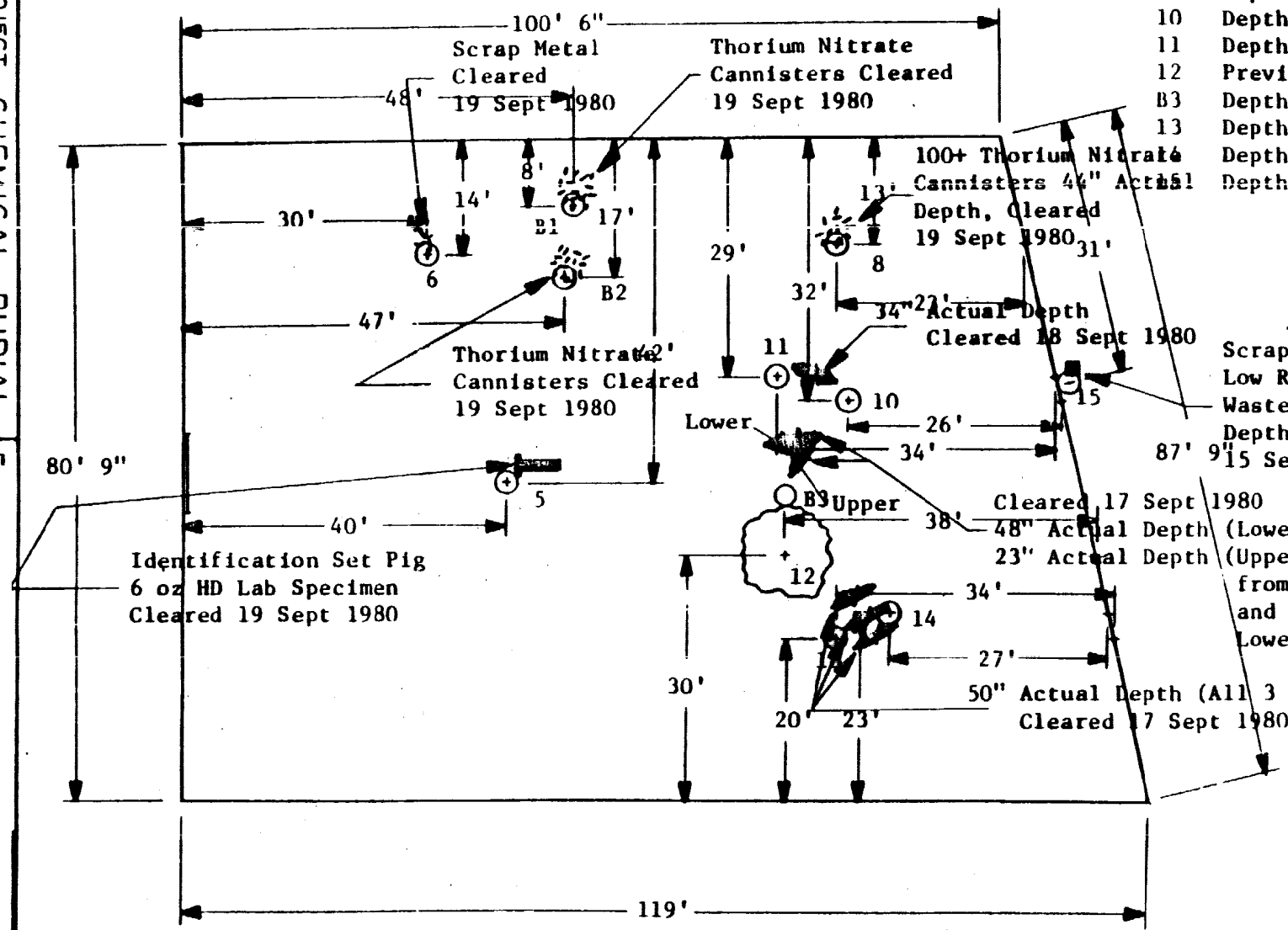


FIGURE 22

Burial Ground Yield Overlay

FIGURE 21

Land Decontaminant Application

FIGURE 22

Transfer of Decontamination Liquor to Exhumation Pits

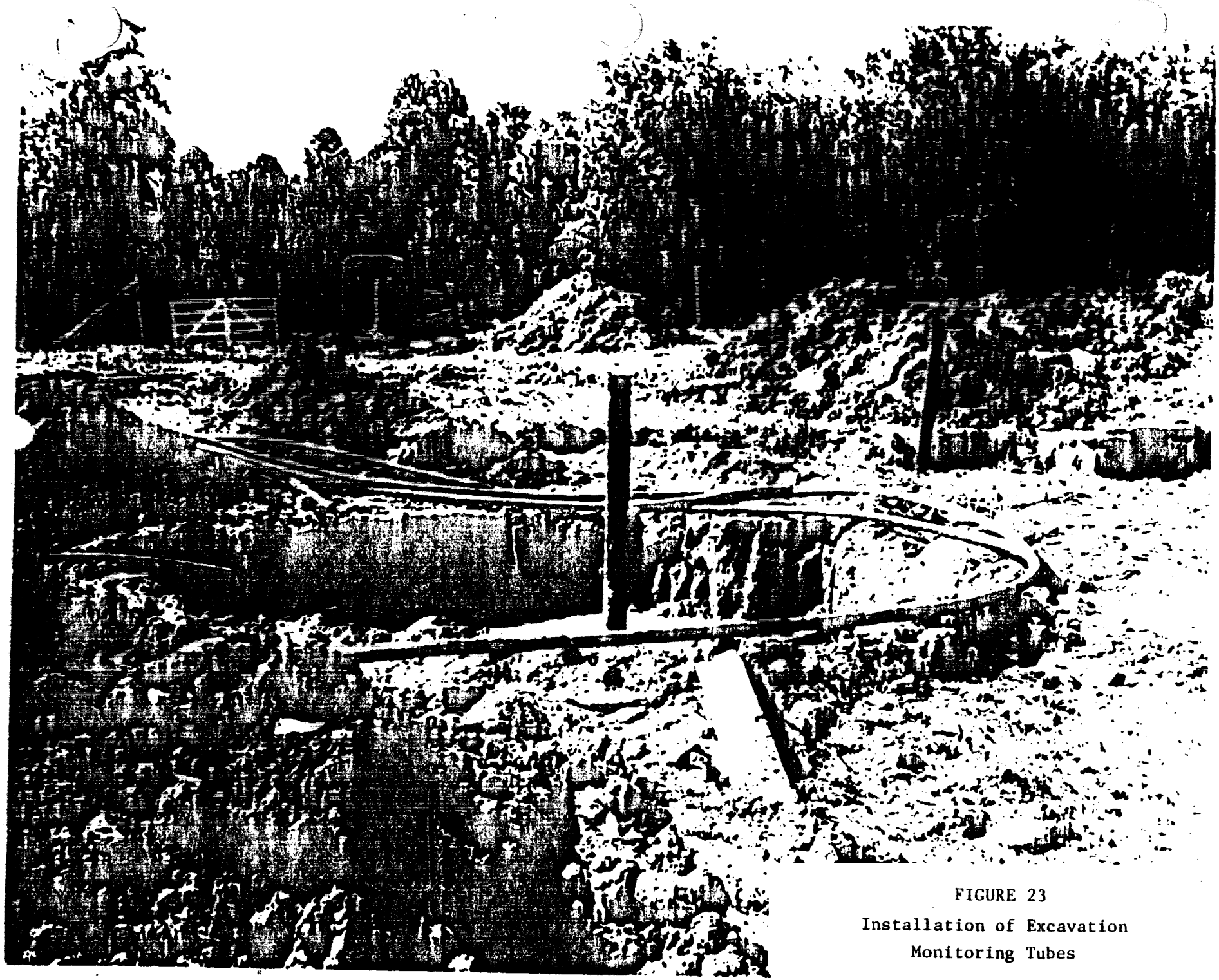
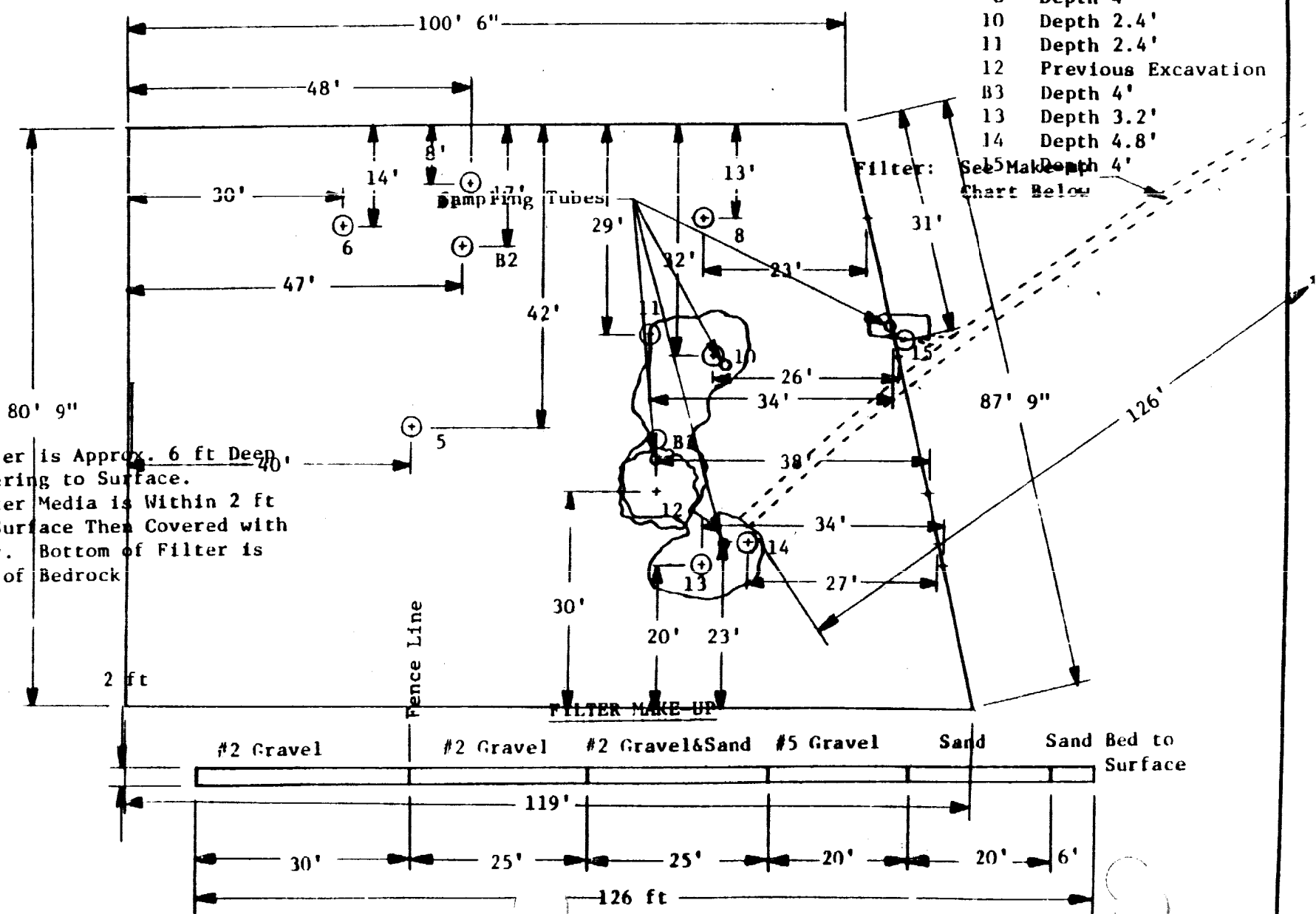


FIGURE 23
Installation of Excavation
Monitoring Tubes



SAFETY DEPT.

PROJECT CHEMICAL BURIAL GROUND EXHUMATION

ENGINEER GROH

DATE 10-80

PLOT PLAN PREPARED BY

SKETCH NUMBER RECORD - 9ND-NADC 5211/2(1/70)

FIGURE 24

Final Pit Configuration Overlay

FIGURE 25

Radiation Survey of Pits

FIGURE 26

Containerization of Radioactive Soil

FIGURE 29

Detoxification of M70A1 Hardware

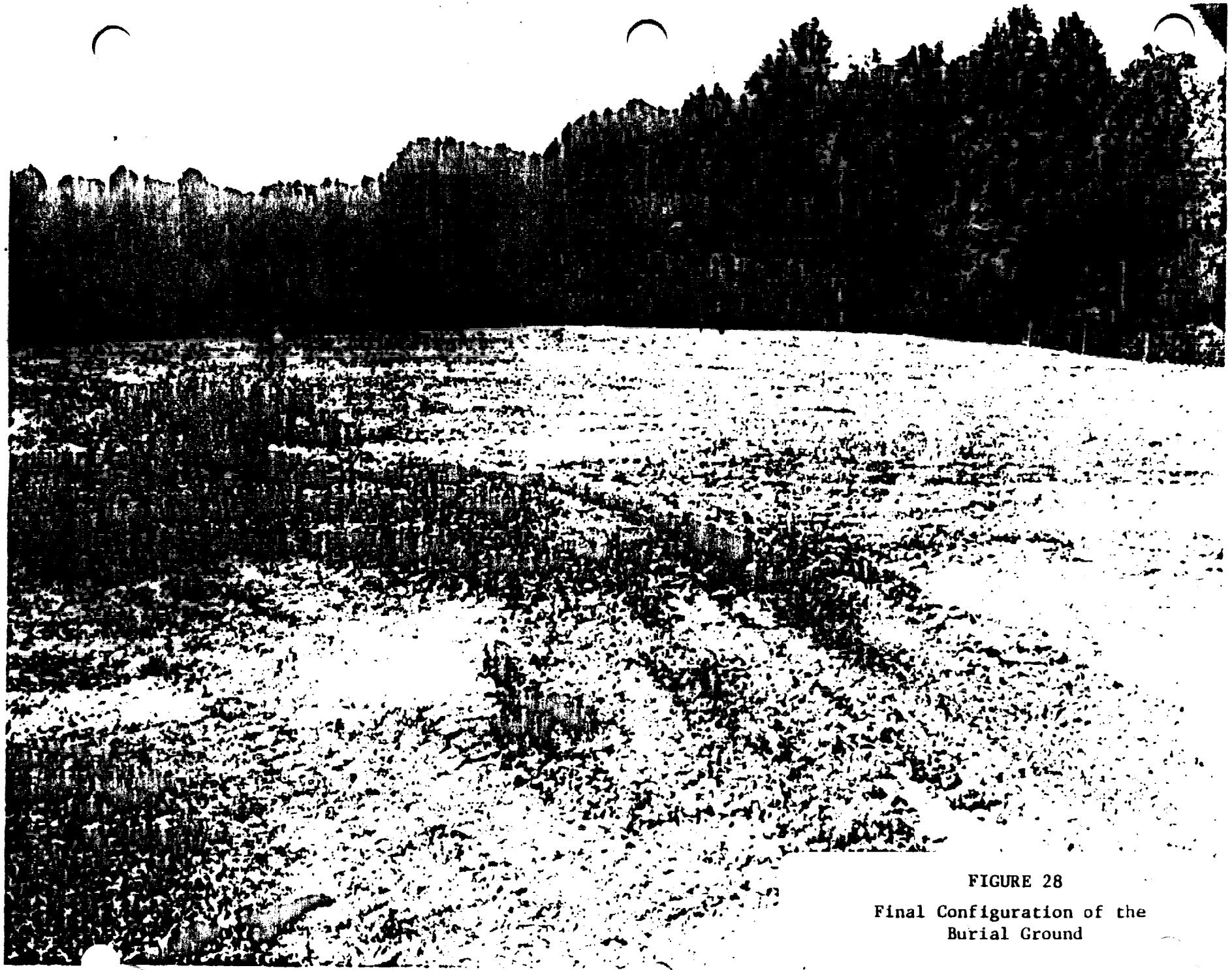


FIGURE 28

Final Configuration of the Burial Ground

FIGURE 30

Containerization of M70A1 Hardware

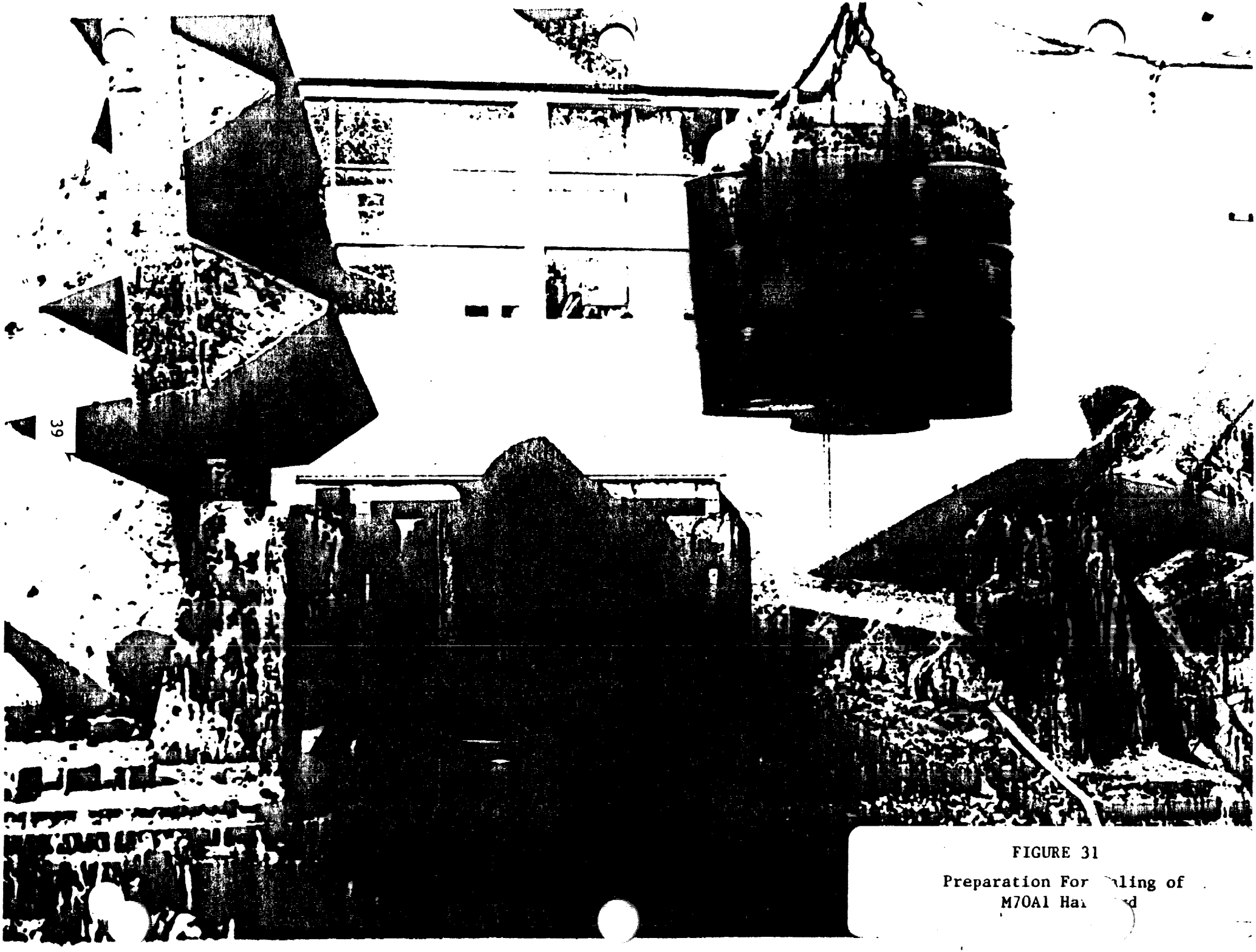


FIGURE 31

Preparation For ling of
M70A1 Ha d

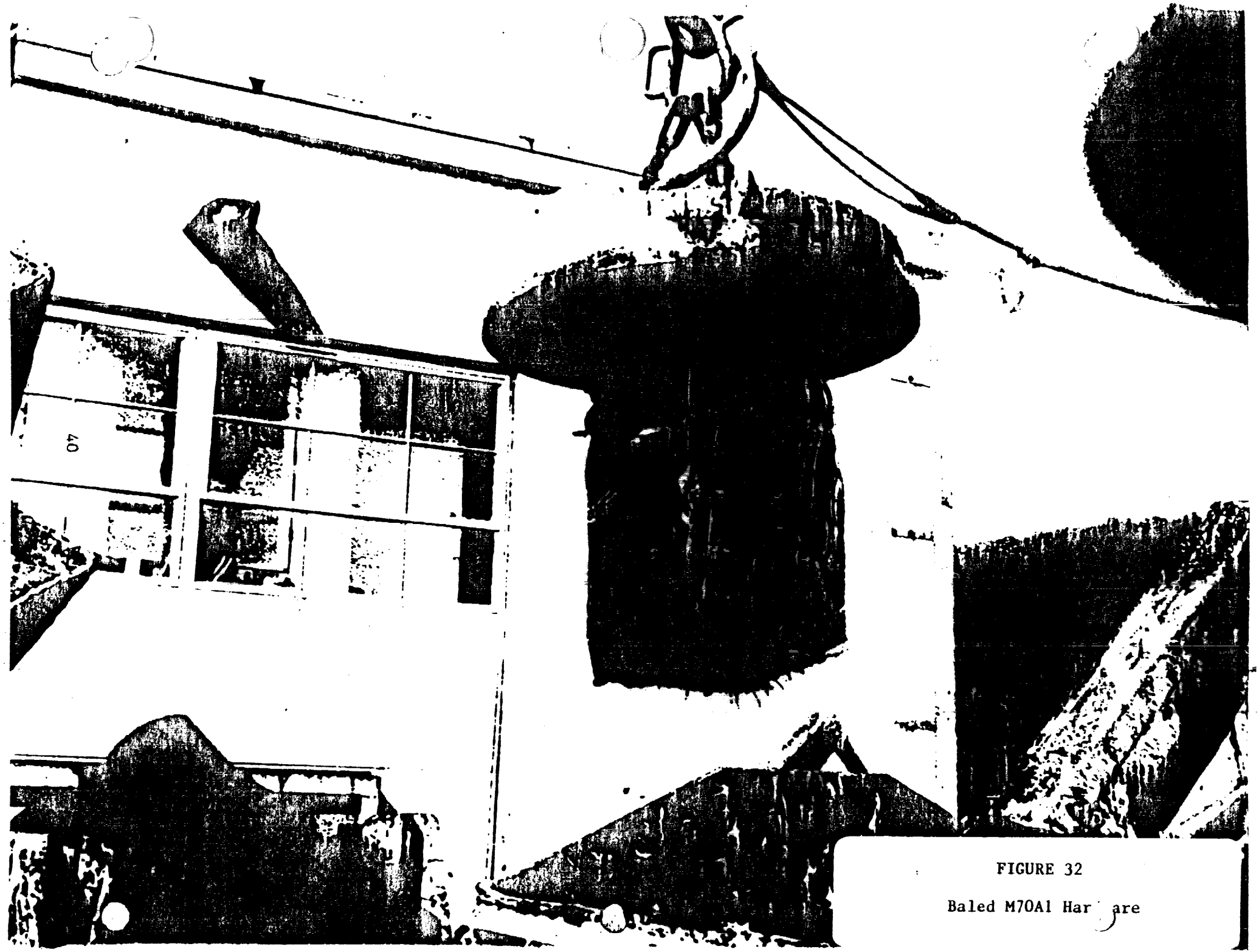


FIGURE 32

Baled M70A1 Hardware

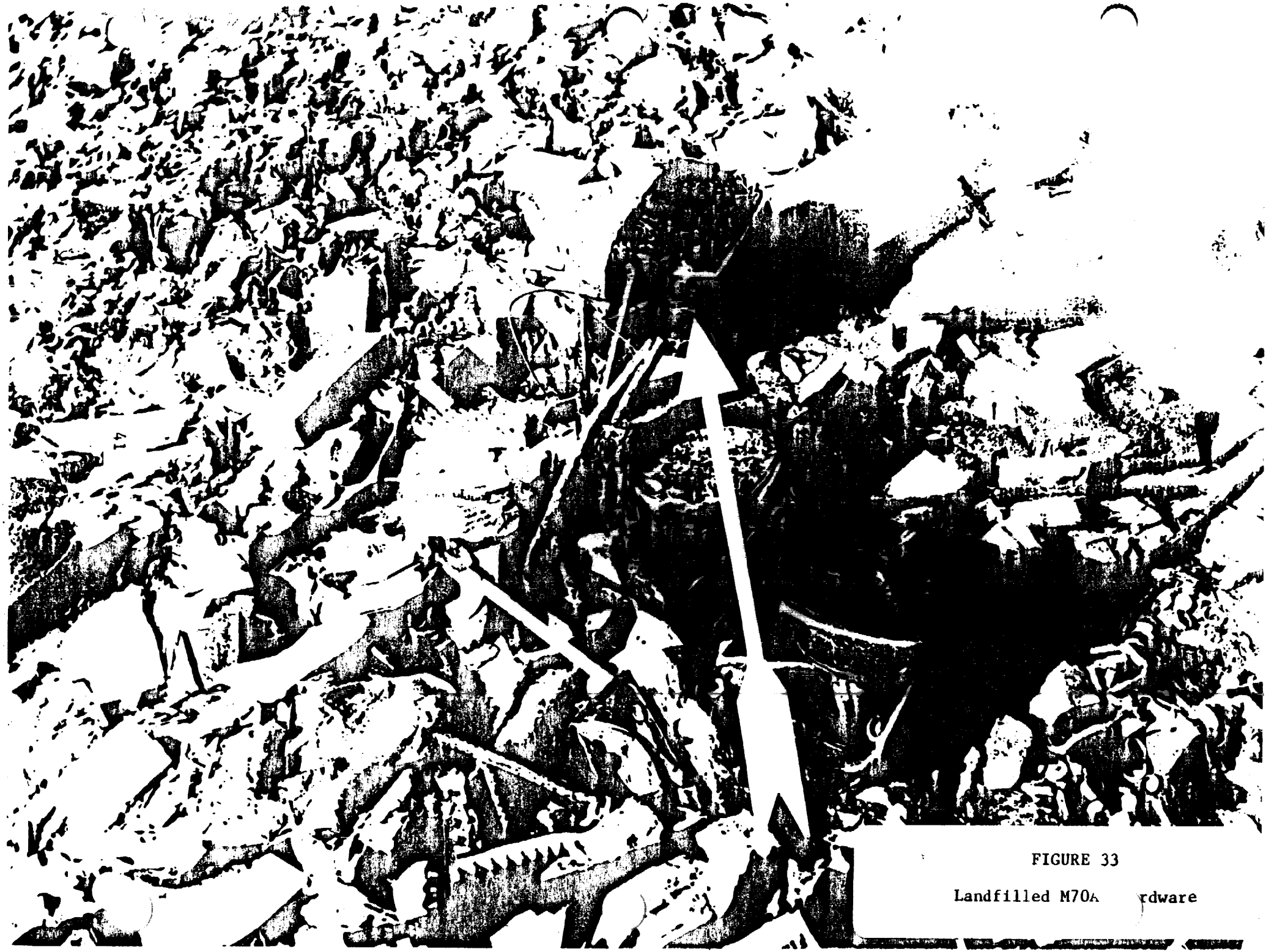


FIGURE 33

Landfilled M70A rdware

IV. CONCLUSIONS

The completion of the exhumation project for the Chemical Burial Ground marks the attainment of a major milestone for NAVWPNSUPPCEN Crane. Since the types, conditions and locations of all buried objects were unknown, based on previous records, the results of the project have formed a basis for a number of conclusions.

A. The fear that there was hazardous materials buried outside of the primary Burial Ground (inner fence area) was unfounded. The metal contacts plotted in 1977 were found to be barbed wire and other junk.

B. The plots marked "mustard" of various pounds (110 lbs., 220 lbs., 174 lbs., etc.) yielded a total of six items which were identified as empty M70A1 aerial bombs. There appeared to be no connection between the pounds of material recorded and live agent found.

C. The agent of the chemical warfare bombs recovered apparently had been subjected to a draining/decontamination process prior to burial. This is so because:

1. Fifteen of the sixteen items recovered (based on the 10 items from 1974 and the 6 items from this project) were empty except for mud.

2. No trace of agent was found in the soil surrounding the bomb cases.

3. Holes of a similar nature, as if intentionally punched, were found in each item.

D. The bulk of the material buried was illuminating device hardware/composition remaining from a research and development project.

E. The area was apparently considered a viable location for "troublesome" materials. This is so because:

1. An I.D. set with a nonstandard load was recovered.

2. An unidentified quantity of radioactive waste was located apart from the other material in a configuration illustrating a simple "stack type" burial.

F. The three items suspected of containing mustard (full amount) were found to contain approximately 3 gallons, 1 1/2 gallons and none respectively. None were found full therefor it appears that they were partially overlooked during the initial effort.

G. The bulk of the metal contacts recorded during the 1977 survey were found to be junk or other barbed wire.

H. The area appears to be capable of being returned to its original condition since no evidence was found of agent contamination.

V. POST PROJECT ACTION

The completion of the exhumation and initial land restoration effort eliminates the major portion of the Chemical Burial Ground project. There are, however, several action items that will require efforts in the next two years. This is so because of the environmental aspects of the problem.

The Burial Ground currently remains fenced utilizing the area's outer "farm-type" fence. It also is posted "Restricted Area, Keep Out". The fence and signs will remain until all future monitoring confirms the absence of chemical contamination.

Water samples will be taken periodically from the three sample tubes and analyzed for comparative purposes with the baseline readings. It is anticipated that within two years (assuming no adverse sample readings) the land can be certified free of chemical contamination. When this milestone is reached, a decision will be made pertaining to the removal of fences and signs.

The location of the Burial Ground with references to the clean-up/ certification procedures utilized will be permanently recorded on official maps of the Center.

The low level radioactive material will be transferred to an approved site for retention.

VI. PROJECT COST STATEMENT

The following costs were incurred in the process of retiring the Burial Ground. Since some action will be undertaken in coming months to insure that contamination does not exist, the figures shown therefor represent that expended for the primary effort and not for the total project. The amount shown, however, can be considered the major expenditure for the project.

A. FY 80 Funding Expended

1.	Materials for the Project	$ 10,000.00
2.	Public Works Support	38,192.63
3.	Security Support	13,567.37
4.	Explosive Ordnance Disposal Group Two and Facility Support	10,000.00
5.	NSWC Dahlgren Support	12,000.00
6.	Crane WQEC Support	2,000.00
7.	Crane Army Ammunition Activity Support	5,640.00
	Total FY 80 Funding	$91,400.00

B. FY 81 Funding Expended

1.	Public Works Support	15,000.00
	Total Project Cost	$106,400.00

VII. LIST OF KEY PARTICIPATING PERSONNEL

The following is a list of personnel that contributed significantly to the Burial Ground exhumation project. It does not include a great number of public works employees who tirelessly supported the effort in a manner that brought about a timely completion of the primary effort.

A. EOD Group Two Personnel

LCDR M. A. MURRAY, USN
LT D. MOXIE, USN
CWO-3 J. D. BARTLESON, USN
AOCS L. K. SCHUCKER, USN
CMCS M. L. CLARK, USN
AOC G. E. MOCK, USN
AS1 F. H. JENSEN, USN
TM1 M. E. WILLIAMS, USN
GMG2 M. U. FAHRENHORST, USN
GMG2 G. D. COWAN, USN
EOCN C. J. McCOLLUM, USN

B. EOD NAVWPNSUPPCEN Crane Detachment Personnel

LTJG C. E. BARLOW, USN
GMCM R. L. FOSTER USN
MN1 G. W. ZAHNISER, USN
EM1 M. B. Mc SHERRY, USN
AO1 S. K. LARMON, USN

C. EOD Facility Personnel

MAJ J. W. SCHMID, USA
PH1 H. W. MATHIS, USN

D. NSWC DAHLGREN Personnel

Filipe Sanchez
Aubrey Trigger

E. OESO Indian Head Personnel

I. Tominack

F. NAVWPNSUPPCEN Crane Personnel

1. Code 01 (Administration)
   R. L. McGarvey

2. Code 04 (Safety)
   J. P. McDonald
   D. L. Groh
   M. L. Glaze
   E. A. Hildebrand

3. Code 09 (Public Works)
   LTJG R. J. BROWN, USN
   EO1 W. LITZLER, USN
   G. Richardson
   D. Laughlin
   H. Weathers

4. Code 10 (Security)
   E. L. Smith
   A. Yates

5. Code 12 (Medical)
   W. C. Coleman, D.O.
   J. J. Fitch

APPENDIX A

Operation Plan 2-80

DDESB-CB 3 July 1973

MEMORANDUM FOR THE CHIEF OF NAVAL OPERATIONS

SUBJECT: Naval Ammunition Depot, Crane, Indiana, Chemical Safety Survey Report

1. A chemical safety survey of NAD Crane was performed 21-23 March 1973 by Dr. Ralph A. Scott, Jr., Chief Chemical Scientist, DDESB. The purpose, observations, and conclusions were discussed with Captain R. L. McArthy, USN, Commanding Officer.

2. Findings, conclusions, and recommendations are as follows:

Mustard munitions placed in soil pits (Area 1407) approximately 26-27 years ago are to be recovered and the area certified free of chemicals and explosives contamination. Records associated with the inspection, decontamination, and certification of the burial grounds indicate unknowns with respect to both chemical agent and explosives content of munitions involved. An inadvertent explosion during recovery operations could result in the dissemination of toxic chemicals. It is recommended that the plan to recover the chemical munitions and to render the area innocuous should address SOP's to include personnel protection, authorized equipment, personnel and explosives limits, the use of "hot-lines" to prevent agent land contamination, documentation of the quantity of agent present during operations, disposition of recovered munitions, demilitarization certification, and the handling, detoxification, and agent detection. SOP's should be reviewed and approved at the appropriate levels within the Navy to assure adequacy of the various safety factors.

WILLIAM CAMERON III
Colonel, USAF
Chairman

cf:
NOSC(ORD-048)

7830

Enclosure (9)
Enclosure (1)
CNO ltr ser 411F/1071 of

DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON, D.C. 20350

8020
OND 048
S.L.W

IN REPLY REFER TO
Ser 411F/1

JUL 13 1973

From: Chief of Naval Operations
To: Commander, Naval Ordnance Systems Command

Subj: Chemical Safety Survey Report, NAD Crane, Indiana

Encl: (1) DDESB-CB memo of 3 Jul 73

ENCLOSURES RECEIVED

1. Enclosure (1) is forwarded for appropriate action as a matter under the cognizance of the Commander, Naval Ordnance Systems Command.

7 1973 0036

John N. Howard
By direction

Copy to: (w/encl)
CHNAVMAT
NAVSAFECEN
NAVORDSYSUPPOLANT

7-13-73

encl 10

Enclosure (.

Encl (1)

DEPARTMENT OF THE NAVY
NAVAL ORDNANCE SYSTEMS COMMAND
WASHINGTON, D. C. 20360

IN REPLY REFER TO
ORD-048E2/605:A

30 JUL 1973

From: Commander, Naval Ordnance Systems Command
To: Commanding Officer, Naval Ammunition Depot, Crane

Subj: Chemical Safety Survey Report, NAD Crane

Ref: (a) NAVORD ltr ORD-048E2/806:ANC of 7 Dec 72 (NOTAL)

Encl: (1) Copy of CNO ltr ser 411F/1071 of 13 Jul 73 w/encl

1. Enclosure (1) is forwarded for information and action as required. This Command concurs with the recommendations of reference (a). These recommendations should be made a part of the SOP(s) being developed for use during the decontamination of the Chemical Burial Grounds at NAD Crane. Reference (a) refers.

H. M. Roylance

H. M. ROYLANCE
By direction

Copy to:
NAVMAT
NAVSAFCEN
NAVORDSYSUPPOLANT

Enclosure (11)

DEPARTMENT OF THE NAVY
NAVAL ORDNANCE SYSTEMS COMMAND
WASHINGTON, D. C. 20360

IN REPLY REFER TO

ORD-048E2/8/
6260

5 NOV 1973

From: Commander, Naval Ordnance Systems Command
To: Commanding Officer, Naval Ammunition Depot, Crane, Indiana

Subj: Procedure for Inspection Decontamination, and Certification of Chemical Hardware Burial Grounds at NAD Crane

Ref: (a) NAD Crane ltr 122H:JJF: has 6260 undated

1. The subject procedure, forwarded by reference (a), has been reviewed and is hereby approved.

2. Approval is granted to implement the chemical hardware burial ground decontamination at the discretion of the Commanding Officer.

Copy to:
NWL Dahlgren (Code FCV)

H. M. ROYLANCE
By direction

Enclosure (

OPERATION PLAN 2-80

(CHEMICAL BURIAL GROUND EXHUMATION PLAN)

NAVAL WEAPONS SUPPORT CENTER

CRANE, INDIANA 47522

FOR OFFICIAL USE ONLY

OPERATION PLAN 2-80

(CHEMICAL BURIAL GROUND EXHUMATION PLAN)

NAVAL WEAPONS SUPPORT CENTER
CRANE, IN 47522

Prepared by: _____
DALE L. GROH (Safety Engineer) NAVWPNSUPPCEN Crane

Reviewed by: _____
JOHN P. McDONALD (Safety Director) NAVWPNSUPPCEN Crane

Reviewed by: _____
MAJ JOHN SCHMID (EOD Facility)

Reviewed by: _____
FELIPE B. SANCHEZ/AUBREY TRIGGER (NSWC Dahlgren)

Approved by: _____
CAPT KENNETH P. HUGHES (Commanding Officer)
NAVWPNSUPPCEN Crane

1 APRIL 1980

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OPERATION PLAN 2-80 (Chemical Burial Ground Exhumation Plan)
Time Zone: ZULU

1. SITUATION:

a. Background:

(1) A Chemical Burial Ground was established in the late forties or early fifties, the exact date along with conclusive documentation of the content, have defied discovery. The strongest evidence supports the theory that 115 pound aerial chemical bombs similar to that illustrated by Figure 1 were buried by Army Tech-Escort personnel during an inventory movement project. The burial effort supposedly was for material considered unfit and hazardous for transportation. It was understood that a disposal procedure was utilized which involved draining of the HD (Blister Agent) contents and introducing decontaminating material. A quantity of radioactive waste material was buried at the site in the mid fifties, with the approval of NAVORD.

(2) The Chemical Burial Ground is located in a relatively remote area of the government reservation. Figure 2 illustrates the area with respect to the boundary. The land surrounding the Burial Ground for a radius of several miles consists of heavy forest with few private residences. The Burial Ground is located in a magazine area as illustrated by a map of the area (Figure 3). The Burial Ground existed then as a fenced area with various signs marking the individual plots. Figure 4 illustrates the size of the area and the rough locations of the individual plots.

(3) Interest in the Burial Ground was kindled in the 1970 to 1972 time frame as the nation in general reacted to environmental problems. NAVORD requested by letter of 13 March 1972 that all buried sites be identified. The Crane response to that request in November 1972, introduced representatives from NWL Dahlgren to the Crane Burial Ground problem. NWL Dahlgren personnel had previously completed an excavation effort of a Mustard Burial Ground at NAD Hawthorne, Nevada. Crane's reponse basically involved a request to excavate the Burial Ground in an effort to (1) relocate the radioactive wastes to a proper Disposal Area and (2) detoxify any chemical munitions/wastes recovered. NAVORD approved the Crane request with the stipulation that any effort to excavate the Burial Ground be carefully planned and documented with the documentation subject to review by NAVORD.

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(4) A Chemical Survey of Crane was conducted by a representative (Dr. Scott) of the Department of Defense Explosive Safety Board in March 1973. The recommendation of that survey to excavate all materials and to certify the land as demilitarized was endorsed by CNO and NAVORD in July 1973. After an approved plan was established, a workforce consisting of personnel from NWL Dahlgren and NAD Crane began an excavation effort in May 1974. The effort began with the excavation of the radioactive wastes, the location of which was documented. All radioactive material was sent to an NRC licensed burial ground in 1975.

(5) Work then began on a plot marked 550 pound mustard gas. According to past accounts of the burial procedure, the material expected to be unearthed should have been chemical munition hardware drained of agent. It was expected that a certain degree of land contamination could be present due to the persistence of mustard agent. Ten items of hardware were recovered from the plot in a deteriorated condition. Seven of the items were apparently drained, however, three items were found to be much heavier than the others and upon further investigation contained mustard agent in a deteriorated condition. The operation was then halted and an Army Tech-Escort unit requested to handle the disposition of the three items. A Tech-Escort unit arrived at Crane and began work in 24 May 1974 to overpack the three items. This process was completed using a plastic wrap and 8" propellant charge shipping containers. The overpacked items were then stored in a magazine with no other material. No other effort was expended on the project. Efforts to date have centered on re-establishing the Burial Ground Exhumation Project recognizing that more unknowns could exist than previously thought. To that end, a survey was conducted in 1977 by EOD personnel using a magnatometer to locate buried metallic objects.

(6) The area was replotted as illustrated by Figure 5 and an outer fence constructed to encompass the new contacts. Though the new contacts are curiously close to the original burial ground, because of the past history of the area before being a government reservation, it is possible that they are not chemical munition items.

b. General:

(1) The Commander, Naval Sea Systems Command, will grant authority to exhume buried chemical munition items from a pre-established burial ground, inspect for safety, prepare the items for safe storage and store the items above ground on the Center for later disposition to an Army installation.

(2) The exhumation effort will remove a potential source of toxic contamination from the earth and may relieve the Center of stringent safety and security requirements which accompany chemical material of this type in its present condition.

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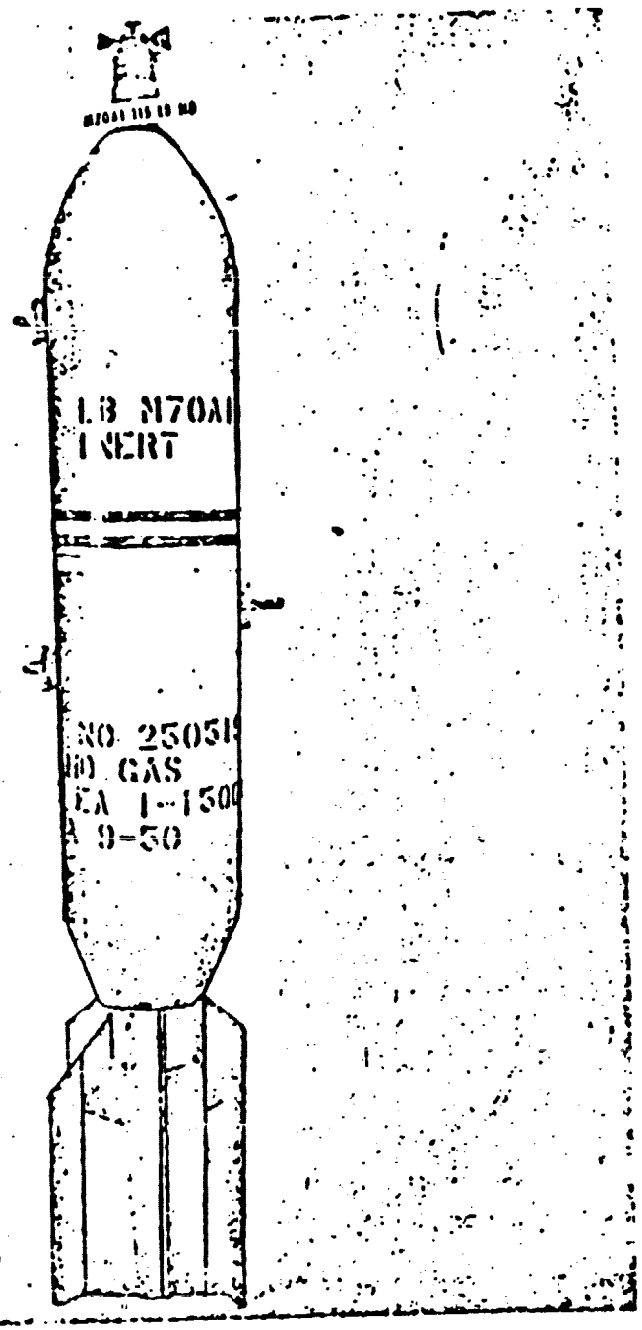

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M70A1 115 LB HD PERSISTENT GAS BOMB

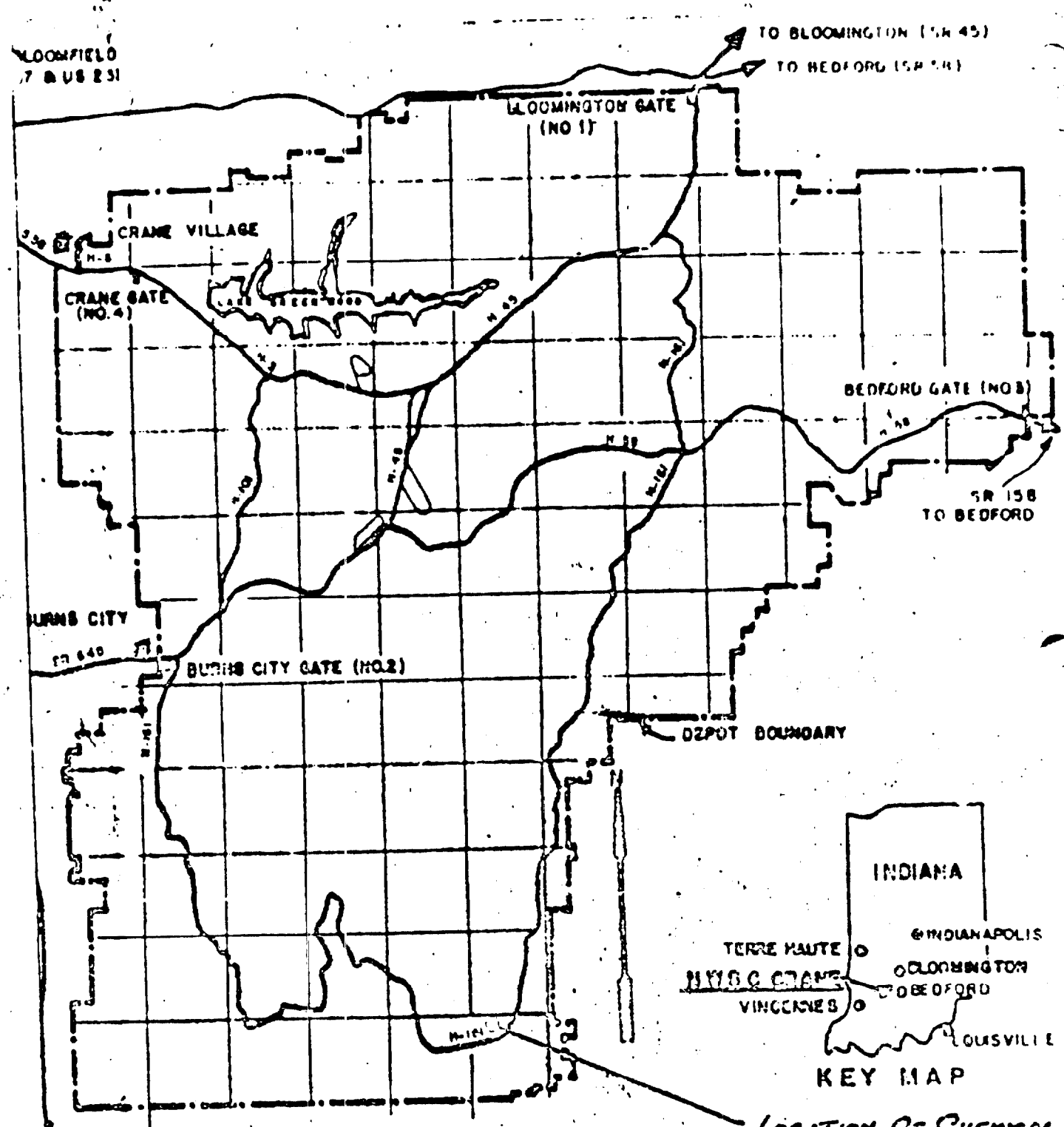
FILLING - 27.0 Kg HD (BLISTER AGENT)

DIMENSIONS - 51½ in LONG; 8 3/32 in DIAMETER

USING SERVICE - USAF (LIMITED STANDARD)

THE BOMB BODY IS MADE OF STEEL. A TUBULAR BURSTER WELL EXTENDS THE LENGTH OF THE BOMB FROM A THREADED HOLE IN THE NOSE TO THE TAIL. WHEN THE BOMB IS RELEASED FROM AN AIRCRAFT, THE ARMING WIRE IS WITHDRAWN AND THE FUZE ARMING VANE ROTATES IN THE AIRSTREAM. AFTER THE REQUIRED NUMBER OF REVOLUTIONS, THE FUZE IS ARMED. WHEN THE BOMB STRIKES, THE FUZE FUNCTIONS, CAUSING THE BURSTER TO DETONATE. THE DETONATION RUPTURES THE BOMB BODY AND RELEASES THE FILLING.

FIGURE 1



LOCATION PLAN

SCALE • GRID LINES FORM MILE SQUARES

FIGURE 2

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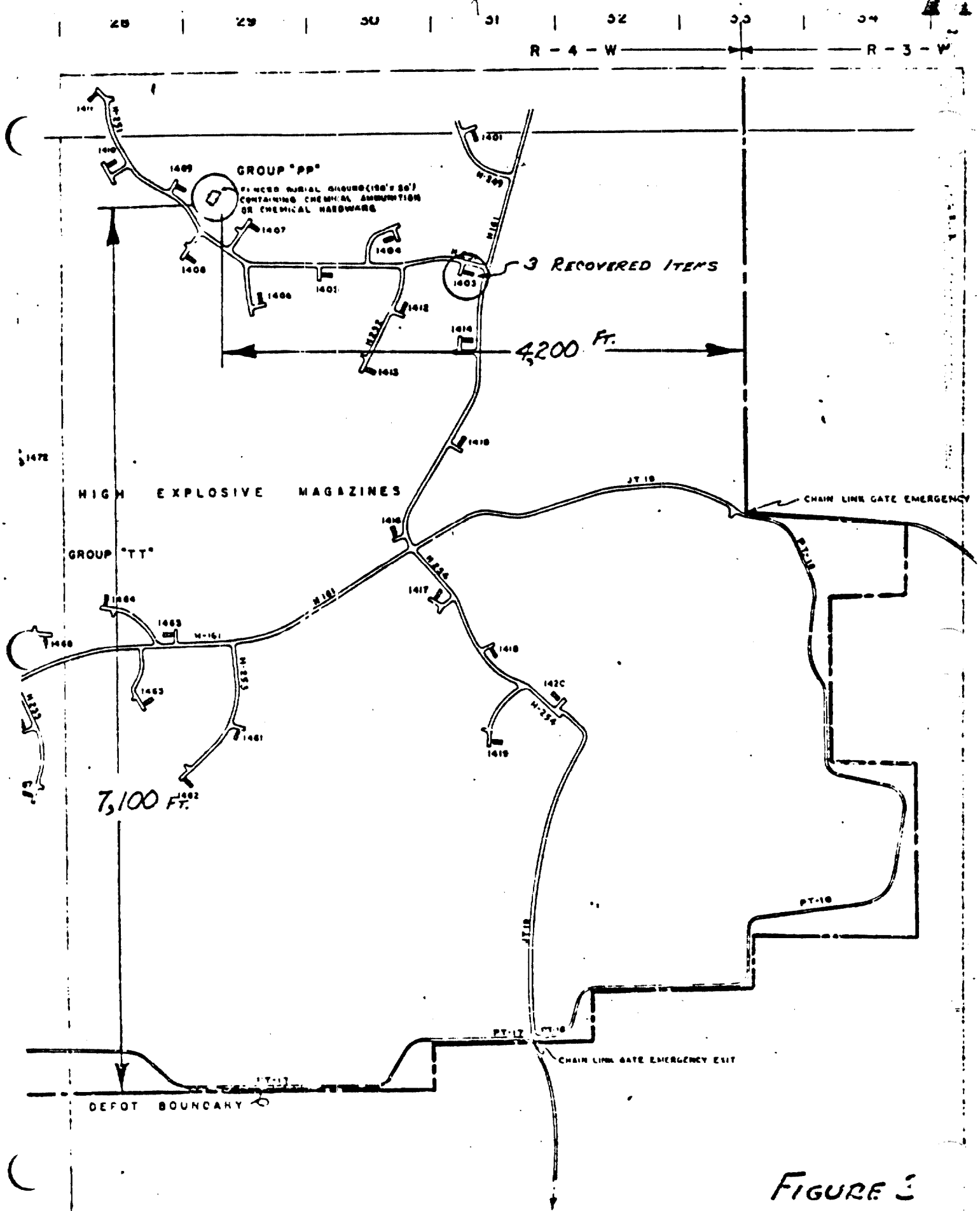

FIGURE 3

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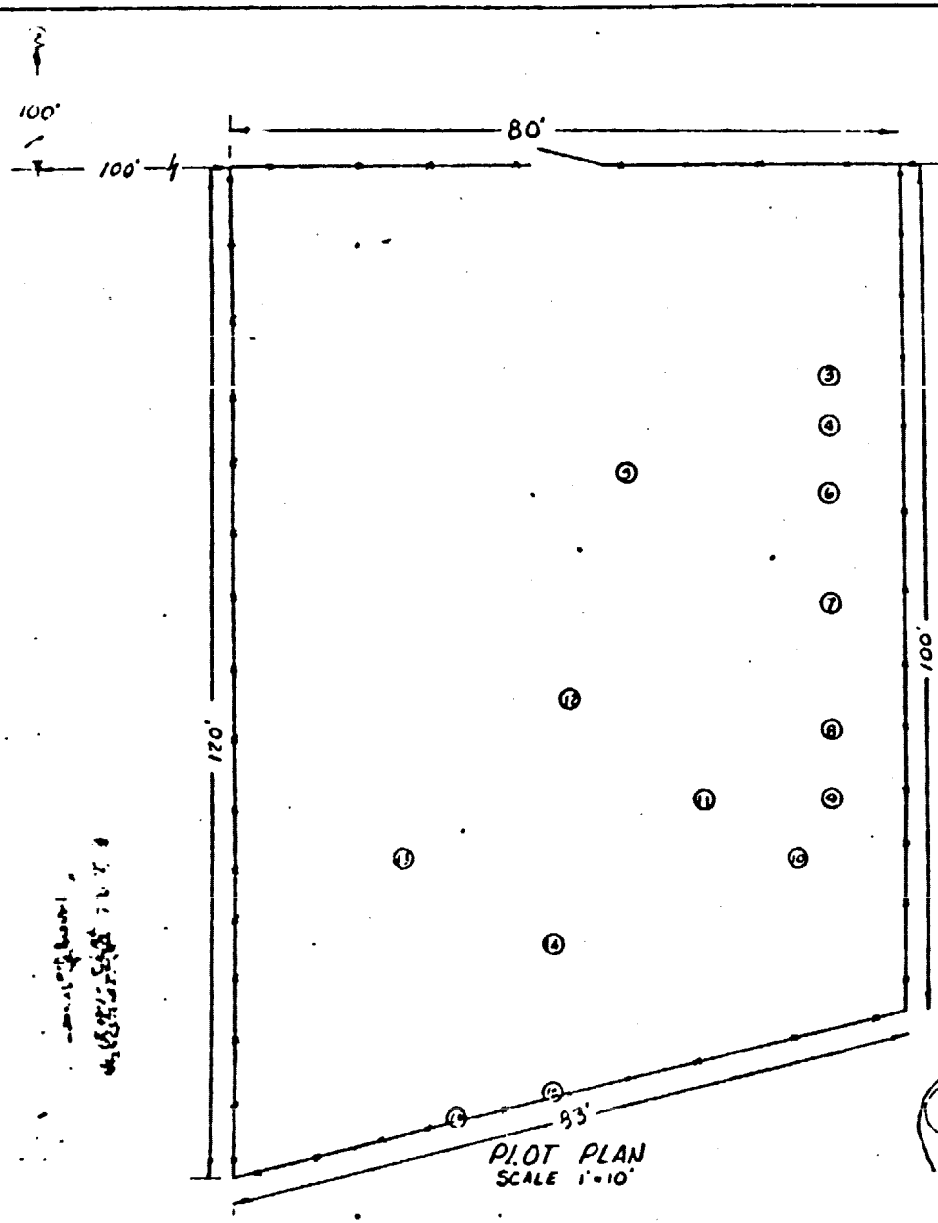
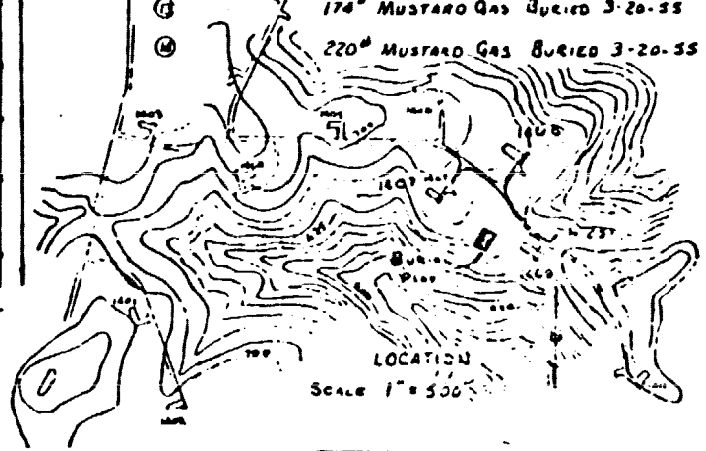


Sign Location	Description
①②	Buried in accordance with Para 3 of Letter dated 10-22-56 J15-9 (302) JCD-NEW Buried 10-22-56
③	15# Thorium Nitrate Buried 6-57
④	500# Illuminant Comp Buried 1-57
⑤	50# Mustard Gas Buried 3-20-55
⑥	Buried in accordance with Para 3 of Letter dated 10-22-56 J15-9 (302) JCD-NED Buried 10-22-56
⑦⑧⑨⑩	Buried in accordance with Para 3 of Letter Dated 10-22-56 J15-9 (302) JCD-NED Buried 10-22-56
(Weathered but believed the same)	
⑪	110# Mustard Gas Buried 3-20-55
⑫	510# Mustard Gas Buried 3-20-55
⑬	174# Mustard Gas Buried 3-20-55
⑭	220# Mustard Gas Buried 3-20-55



U.S.N.A.D. CRANE, INDIANA

MUSTARD GAS BURIAL PLOT

P.W. SKETCH NO. 2388

APPROVED: DATE:

FIGURE 4

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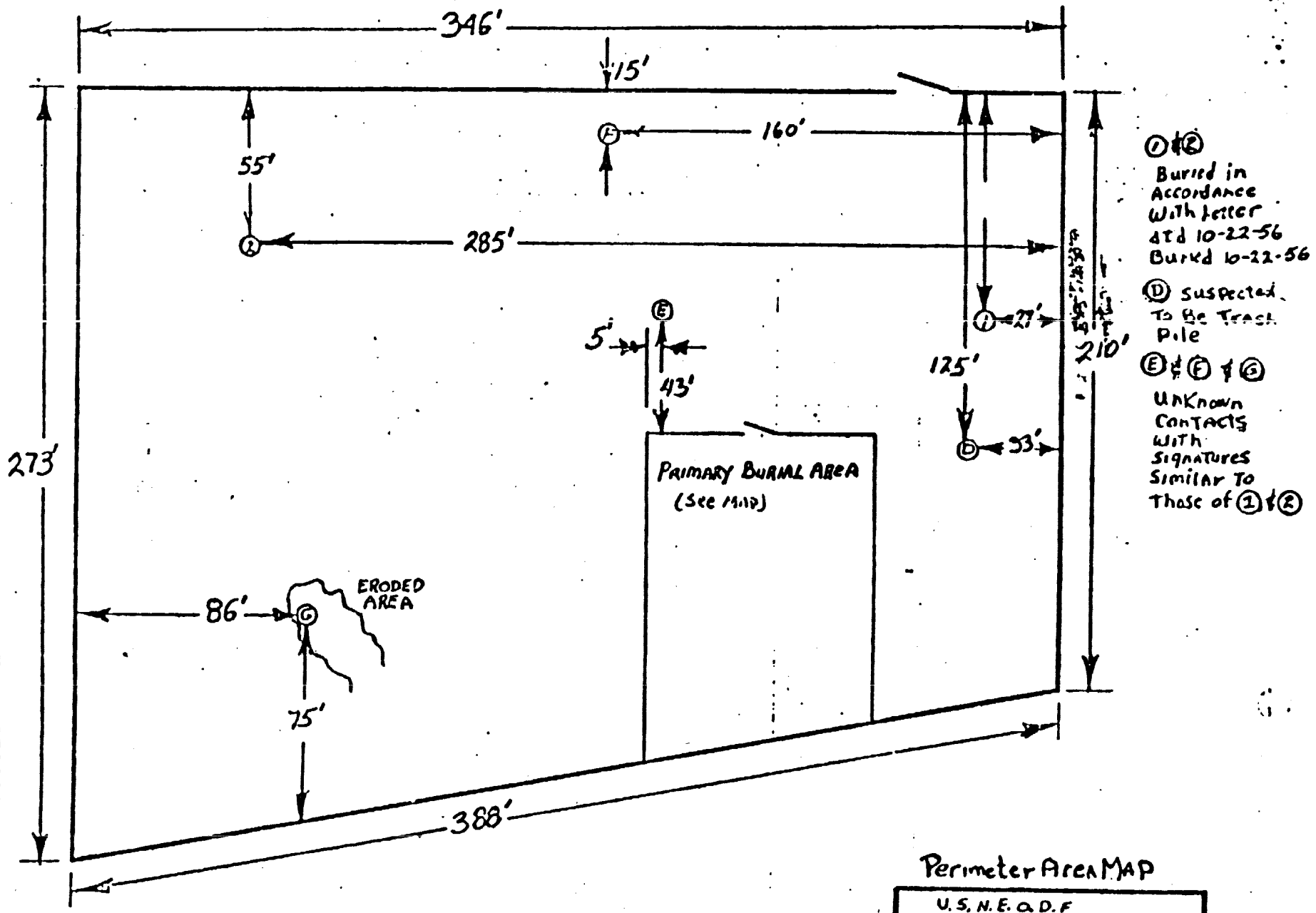

Perimeter Area MAP

U.S. N.E. & D.F

MUSTARD GAS BURIAL PLOT VERIFICATION SKETC
8 MARCH 1977
J. HERSEY

FIGURE 5

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c. Enemy Forces: Omitted. (See Annex A, Considerations Affecting the operation).

d. Friendly Forces: (See Annex E, Operation).

(1) Naval Weapons Support Center, Crane, Indiana (See Annexes B, D, F, G, H, I and J).

(2) Explosive Ordnance Disposal, Group II:

(a) Provides technically oriented work team for exhumation and detoxification effort.

(b) Provides on-site chemical accident/incident control and operates local personnel hotline.

(3) Explosive Ordnance Disposal Facility:

(a) Provides detailed SOP for excavation effort.

(b) Provides safety observer and technical adviser for operations in and near the designated hotline area.

(4) Naval Surface Weapons Center, Dahlgren, Virginia:

(a) Acts as on-scene safety observers adjacent to the hotline area.

(b) Acts as technical adviser to the NAVWPNSUPPCEN Crane Command Team in matters of personnel safety.

(5) OESO, Indian Head, Maryland, acts as technical adviser for matters relating to the environment and land recovery.

(6) Naval Sea Systems Command:

(a) Approves the OPLAN for execution.

(b) Provides funding for all forces involved in the operation.

e. Attachments and Detachments, Task Organization (See Annex B).

2. MISSION:

a. Exhumation, inspection and packaging of buried chemical munition items from a previously established burial ground will be conducted only after an execution order has been issued by Naval Sea Systems Command. When directed, a task force consisting of Explosive Ordnance Disposal, Group II, supported by NAVWPNSUPPCEN Crane, NSWC Dahlgren and OESO, Indian Head, Maryland, will exhume, inspect, clean/prepare, containerize and store chemical munition items found in a previously established chemical burial ground. In addition, chemical munition items previously exhumed and currently stored in a high explosive magazine are to be

unpacked, inspected, cleaned/prepared and repackaged for storage. The stored material will eventually be transported to an approved Army Decontamination Center such as Tooele Army Depot.

b. The entire operation is to be performed in full compliance with Public Law 91-441 as implemented by SECNAVINST 5510.29 which specifies the use of Army Regulation AR 75-15. Protective measures for all personnel will be in accordance with DARCOM Regulation 385-31.

3. EXECUTION:

a. The primary plan involves exhumation of four plots previously documented as containing mustard contaminated munition hardware. The total amount of mustard material indicated for the four plots is 500 pounds. The plan also involves safely packaging three munition items exhumed during a previous project and work with contaminated hardware unearthed during that earlier project.

b. Operational Phasing:

The exhumation effort has three basic operational phases required to complete the project:

Phase I - Examination and Preparation of previously exhumed contaminated hardware.

Phase Ia - Set-up of preparation tank and associated support equipment.

Phase Ib - Inspection, preparation and packaging of seven hardware items now located in Magazine 1403.

Phase Ic - Unpackaging, inspection, preparation and packaging three hardware items now located in Magazine 1403.

Phase II - Exhumation, inspection, preparation and packaging of buried items.

Phase IIa - Exhumation, inspection, preparation and packaging of buried items in four marked plots.

Phase IIb - Excavation and examination of a number of plots where metal contacts have been registered.

Phase III - Ground restoration.

Phase IIIa - Controlled decontamination of each excavation.

Phase IIIb - Backfill of excavations and the addition of sampling/monitoring tubes.

Phase IIIc - Restoration of vegetation and proper marking of area.

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(1) Phase I - Examination and preparation of previously exhumed contaminated hardware.

(a) Set up of the preparation tank and associated support equipment will be by NAVWPNSUPPCEN Crane Public Works personnel with guidance from EOD Group II personnel and NAVSURFWPNCEN Dahlgren personnel.

(b) EOD Group II personnel will remove seven items of contaminated hardware from Magazine 1403, transport the items approximately one-half mile to the main operation site, inspect the items and prepare/package the items in approved containers. The items will then be returned to Magazine 1403.

(c) EOD Group II personnel will remove three items of contaminated hardware from Magazine 1403, transport the items to the main operation site, unpack the items from their present containers (presently unacceptable for off-Center transport), inspect the items and take one of the following courses of action:

1 Place the item in an approved container supplied by NAVSURFWPNCEN Dahlgren if in the judgment of the on-scene Commander, the item is not deteriorated as described in Annex E, or,

2 Prepare the item by utilizing a decontamination tank and package in suitable containers if, in the judgment of the on-scene Commander, the item is of a deteriorated/unsafe condition.

(2) Phase II - Exhumation, inspection, preparation and packaging of buried items.

(a) EOD Group II personnel will excavate by means of a motorized shovel (backhoe) each of four plots currently marked as containing mustard agent. As each item is unearthed it will be transported to the process area (approximately 100 feet), cleaned of soil, examined and one of the following two courses of action taken:

1 Package the item in an approved container supplied by NAVSURFWPNCEN Dahlgren if in the judgment of the on-scene Commander, the item is not deteriorated as described in Annex E, or,

2 Prepare the item by utilizing a decontamination tank and package in suitable containers if, in the judgment of the on-scene Commander, the item is of a deteriorated/unsafe condition.

(b) EOD Group II personnel will excavate by means of a motorized shovel each of the plots remaining, as determined by metal contact signatures, where no records are available to show contents. As material is unearthed, it will be examined and disposition made as described in Annex E. Because of the prior use of the land (agricultural) and from previous excavations, it is anticipated that no further agent containing items will be unearthed. In the event that an item containing toxic material is unearthed, contingency procedures described in Annex E will be utilized.

(3) Phase III - Grounds Restoration.

(a) EOD Group II personnel will apply surface decontaminant to the sides of excavations found to be contaminated at the time of "opening." In addition, the decontamination wash solution utilized for any item removed and determined to be deteriorated will be pH adjusted and returned to the excavation. The solution will then be allowed to stand in the excavation until evaporation reduces the bleach level to acceptable limits as described in Annex E. A quantity of pervious material (limestone) will be placed in each excavation.

(b) EOD NAVWPNSUPPCEN Crane Detachment personnel will place a monitoring tube in the center of each excavation approximately 30 days after completion of the main exhumation effort and backfill utilizing the originally removed soil.

(c) NAVWPNSUPPCEN Crane Public Works Department personnel will restore the area by seeding and marking in accordance with Annexes L and M approximately 120 days after the completion of the main exhumation effort.

c. Operational Constraints:

(1) Specific requirements for Security, Safety, CAIC, Medical support, etc., are designated in listed Annexes to this OPLAN 2-80.

(2) Exhumation will not be accomplished during hours of darkness, conditions of adverse weather or in predetermined temperature extremes as described in Annex E.

(3) All support and response forces and equipment required to implement this OPLAN 2-80 will be prepared, staged and trained to perform their mission upon order.

d. Coordinating Instructions:

(1) Direct coordination between agencies and commands tasked under this OPLAN is authorized.

(2) Activities incurring administrative and operational expenses in support of this OPLAN shall record such costs which will then be reported in accordance with the provisions of Annex K.

4. SERVICE SUPPORT:

a. Supplies and Services. Tasked organizations are responsible for providing necessary supplies and services in support of this operation from available resources. Annex K prescribes procedures for obtaining funding to support requirements beyond that satisfied by available resources.

b. Administrative. Normal installation standard operating procedures will prevail.

5. COMMAND AND SIGNAL:

a. Command:

(1) NAVWPNSUPPCEN Crane Operation Coordination Center (OCC) Commander assumes operational control of the support elements tasked for utilization in all areas outside of the hotline area. EOD Group II Commander assumes operational control of all elements within the designated hotline area.

b. Signal:

(1) Communication to operational elements in the field will be by radio. All other communication for support purposes will be by landline.

ANNEX A (Considerations Affecting the Operation) to Operations Plan 2-80 (Chemical Burial Ground Exhumation Plan)

1. SITUATION: The execution of an operation as described by this OPLAN can be affected by various weather conditions considering the type terrain and soil conditions of the Center.

2. MISSION: The various situations that could affect the successful completion of the operation will be analyzed for effect and contingency plans will be formulated. Constant monitoring of conditions will be accomplished during the operation. An analysis of the Crane area is presented in Appendix 1.

3. EXECUTION:

a. Concept of Operations. At D-30 days an evaluation of the current weather patterns for the area will be made to determine extent of recent rainfall and temperature extremes. A forecast for the target execution time frame will be analyzed.

b. The various forces will be consulted and adjustments to the start date will be made to secure the most favorable conditions.

4. Service Support: Omitted.

5. Command and Signal. Omitted.

APPENDIX 1 - NAVWPNSUPPCEN Crane considerations.

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APPENDIX 1 (NAVWPNSUPPCEN Crane Considerations) to ANNEX A (Considerations Affecting the Operation) to Operation Plan 2-80 (Chemical Burial Ground Exhumation Plan)

1. WEATHER: The Crane, Indiana area is located near a principal storm track which originates in the mid-western states and moves across Southern Indiana, northwestern Kentucky and Ohio. The average wind velocity is six miles per hour with prevailing wind direction being from the southwest. The area receives a monthly 4 inches, plus average to above average, rainfall during the spring months of April and May. Thunderstorms occur during the spring and summer. Intermittent snowfall can be expected from December through February with some periods of heavy snow. Generally, the more favorable weather period is in October and November. Scheduling and allowing for a weather interference period would be the most favorable approach to accomplishing the exhumation project.

2. TERRAIN:

a. The Naval Weapons Support Center (NAVWPNSUPPCEN) Crane, Indiana, is located mainly in Martin County, Indiana, with small areas in adjacent Greene and Lawrence Counties. Highway U. S. 231, running north-south, parallels the western border of the Center and State Highway 45 and 58 run east-west paralleling the northern boundary of the Center. The Center encompasses some 62,463 acres, or approximately 100 square miles. This includes 60,660 acres of improved and unimproved grounds and 1803 acres occupied by roads, railroads, buildings and walks. Approximately 50,000 acres are timberland. Topography within the Center varies from gently rolling to rugged wooded hills. The highest point on the Center is 860 feet and the lowest point is 470 feet. The northwestern one-third drains west through Furst Creek into the West Fork of the White River, while the remainder of the area drains south and southwest through Boggs, Indian and Sulphur Creeks into the East Fork of White River. Due to the topography of the area, the drainage pattern consists of many small drainageways more or less in a treelike pattern.

b. The storage site is in a rolling, hilly area. The anticipated helopad on-load areas will be pre-selected hardstand areas located within one-half to three miles of the storage site.

c. Many small farming communities consisting of less than 100 persons each surround the Center, several within one mile of the boundary. In additon, larger communities consisting of Bloomfield (population 2,565) northwest of the Center; Loogootee (population 2,953) southwest of the Center, and Shoals (population 1,039) south of the Center, are within ten miles of the boundary. Three communities of more than 10,000 each are within 20 miles of the boundary; Washington (population 11,358) southwest of the Center; Bedford (population 13,087) east of the Center, and Bloomington (population 42,890) northeast of the Center.

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ANNEX B (Task Organization) to Operation Plan 2-80 (Chemical Burial Ground Exhumation Plan)

TIME ZONE: ZULU

COMMANDING OFFICER, NAVWPNSUPPCEN CRANE, OPERATION COORDINATION CENTER (OCC)
NAVWPNSUPPCEN-CO

Operations OIC	Commanding Officer EOD Group II
Safety Officer	EOD Facility
Security Officer	NWSC Code 10
Public Affairs Officer	NWSC Code 01
Disaster Preparedness Officer	NWSC Code 09D
Field Safety Monitor	NSWC Dahlgren

OPERATIONAL ELEMENTS	PROVIDED BY
Public Affairs	NWSC Code 01
Funding	SEA-6423
Material/Operation	EOD Group II, NWSC Code 09
Security	NWSC Code 10

RESPONSE ELEMENTS	
Safety, Chemical Accident/Incident Control	NWSC Code 04, NSWC Dahlgren, EOD Group II, NWSC Code 09
Medical	NWSC Code 12

APPENDIX

1 - Operational Elements.

2 - Response Elements

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APPENDIX 1 (Operational Elements) to Annex B (Task Organization) to Operation Plan 2-80 (Chemical Burial Ground Exhumation Plan)

1. Public Affairs NWSC-01 will disclose information pertaining to the operation only in the event of a chemical accident/incident in which personnel injury is involved or life/property external to the Center boundary is threatened.

2. Funding NWSC-02 will establish charge numbers to collect labor and material charges in accordance with ANNEX K.

3. Exhumation/Preparation EOD Group II, NWSC-09, NSWC Dahlgren

a. EOD Group II will:

(1) Exhume material from the burial ground utilizing a combination of mechanized and manual methods.

(2) Examine/inspect exhumed material and segregate for disposition in accordance with AR 75-15.

(3) Prepare material for packaging according to the results of paragraph (2) above.

(4) Package material.

(5) Set packaged material aside for storage.

(6) Treat the individual excavation with a controlled amount of decontaminant.

b. NWSC Crane-09 will:

(1) Prepare the site initially by removing gross vegetation.

(2) Provide equipment/facilities to support the EOD Group II effort.

(3) Supply containers for the packaging of decontaminated hardware.

c. NSWC Dahlgren will:

(1) Provide containers to package material exhumed and considered to be in a safe condition for shipment.

4. Security NWSC-10 will provide security and control for the exhumation effort through the storage effort.

APPENDIX 2 (Response Elements) to Annex B (Task Organization) to Operation Plan 2-80 (Chemical Burial Ground Exhumation Plan)

1. Safety, Chemical Accident/Incident Control EOD Group II, EOD Facility, NSWC Dahlgren, NWSC-04 and 09

a. EOD Group II will provide primary response in the event of a chemical accident/incident.

b. EOD Facility will provide representative to monitor and support EOD Group II functions inside a designated hotline.

c. NSWC Dahlgren will provide technical assistance to the EOD Group II Commanding Officer.

d. NWSC-04 will monitor activities in all areas outside the designated hotline area in accordance with Annex G.

e. NWSC-09 (Disaster Preparedness Teams) will provide secondary "On-Call" response in the event of a chemical accident/incident beyond the control of EOD Group II personnel in accordance with Annex H.

2. Medical NWSC-12 will provide medical personnel, facilities and assistance in accordance with Annex I.

ANNEX C (Material Subject to the Exhumation Project) to OPLAN 2-80 (Chemical Burial Ground Exhumation Plan)

1. SITUATION: See basic plan.

2. MISSION: Identify and specify the chemical material involved in the operation.

3. EXECUTION:

a. Physical characteristics of the chemical agent involved in the project are provided in Appendix 1.

b. Physical characteristics of any other material which may be buried are at this time unknown. In the event that a chemical containing item other than that anticipated is unearthed, contingency plans described in Annex E will be executed.

4. SERVICE SUPPORT: Omitted.

5. COMMAND AND SIGNAL: Omitted.

APPENDIX

1 - Physical Characteristics of M70A1 115 pound HD persistent gas bomb.

2 - Physical Characteristics of Mustard (HD).

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APPENDIX 1 (Physical Characteristics of M70A1 115 Pound HD Persistent Gas Bomb) to ANNEX C (Material Subject to the Exhumation Project) to OPLAN 2-80 (Chemical Burial Ground Exhumation Plan)

1. Nomenclature: M70A1 115 pound HD persistent gas bomb.

2. Filling: 27.0 kg HD (Blister Agent).

3. Dimensions: 51 1/2 inch long; 8 3/32 inch diameter; .224 inches skin thickness.

4. Current Condition:

a. The bombs that have previously been exhumed are without a tail fin, fuze or burster. The bombs are badly corroded and in one of two conditions:

(1) Drained of mustard agent but contaminated hardware.

(2) Filled with deteriorated agent of less than 30 percent strength.

b. From a detailed literature search it has been determined that the bombs were shipped without fuzes and without bursters. For this reason the primary operational steps were established in accordance with this assumption. Contingency plans based on standard EOD procedures are available for any item not buried in accordance with the recognized assumptions.

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APPENDIX 2 (Physical Characteristics of Mustard (HD)) to ANNEX C (Material Subject to the Exhumation Project) to OPLAN 2-80 (Chemical Burial Ground Exhumation Plan)

1. Mustard is a persistent and powerful blister agent. Both liquid and vapor cause intense inflammation which may blister the skin or mucous membrane with which they come in contact. Mustard acts as a cell poison on all tissue surfaces contacted. The first symptoms of mustard poisoning usually appear within four to six hours. The higher the concentration, the shorter the interval of time between the exposure to the agent and the first symptoms. Exposure results in conjunctivitis (inflammation of the eyes); erythema (redness of the skin) which may be followed by blistering or ulceration; and inflammation of the nose, throat, trachea, bronchi or lung tissue.

2. Physical Properties:

a.	Chemical name:	2,2' dichloro-diethylsuffide
b.	Chemical formula:	$(ClCH_2CH_2)_2S$
c.	Molecular weight:	159.08
d.	Vapor density (air = 1.0):	5.4
e.	Liquid density at 20°C:	1.27 gm/cc
f.	Freezing point:	14.5°C
g.	Boiling point:	202.8°C
h.	Vapor pressure at 20°C:	0.072 mm Hg
i.	Volatility:	6.0 mg/m^3 at 20°C
j.	Odor:	Garlic

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ANNEX D (Operations Coordination Center) to OPLAN 2-80 (Chemical Burial Ground Exhumation Plan)

1. SITUATION: See basic plan.

2. MISSION: To establish an Operation Control Center (OCC) at NAVWPNSUPPCEN Crane to coordinate operations that support EOD Group II personnel involved in exhuming, inspecting, preparing and packing material outlined in Annex C. The Center will, in addition, control the use of back-up forces at the request of the (OIC) in case of a Chemical Accident/Incident (CAI) as outlined in Annex H and coordinate operations with NAVSEASYSCOM for information purposes.

3. EXECUTION:

a. Concept of Operations:

(1) The OCC will be established at NAVWPNSUPPCEN Crane, Building 8, which is currently the Safety Department.

(2) The OCC will serve as the communication hub for all activity during the operational phases of the project.

(3) The OCC will be capable of communicating with all key personnel outlined in Annex B by either radio or land line or both.

(4) In the event of a CAI , key personnel will be able to assemble at the OCC for consultation/action within ten minutes after the alert.

b. Activation and Operation:

(1) The OCC will be activated for routine operation on D-Day and manned in the following manner:

(a) Center Safety Monitor	NWSC-04
(b) Support Liaison	NWSC-09
(c) Field Safety Monitor	NSWC Dahlgren
(d) Environmental Monitor	OESO Indian Head

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(2) Upon notification of a CAI the following additional manning will be accomplished within ten minutes;

(a) Commanding Officer, NAVWPNSUPPCEN Crane or Executive Officer (CO discretion).

(b) Public Affairs Officer NWSC-01

(c) Disaster Preparedness Officer NWSC-09D

(d) Security Officer NWSC-10

(3) The OCC will be deactivated when the main exhumation effort by EOD Group II personnel is complete.

(4) The NAVWPNSUPPCEN Crane OCC Commander will submit an after action report to COMNAVSEASYSCOM within 10 working days after EOD Group II personnel have departed NAVWPNSUPPCEN Crane. The report will include an operational summary.

4. SERVICE SUPPORT:

a. Administration:

(1) All information that might be released to the news media will be approved by the NAVWPNSUPPCEN Crane OCC Commander.

(2) The NAVWPNSUPPCEN Crane OCC Commander will insure that SOPs for all personnel assigned responsibilities within the OCC are published covering all functional areas of responsibility.

5. COMMAND:

a. The OIC will have responsibility for normal operations at NAVWPNSUPPCEN Crane within the hotline area. The OCC Commander will have responsibility for normal operations in all areas outside the hotline area.

b. Upon activation, NAVWPNSUPCEN Crane will establish both telephonic and message communication with COMNAVSEASYSCOM.

c. Command responsibility during a CAI will be as outlined in Annex H.

6. SIGNAL: Primary communication between the field units and the OCC will be by radio. Radio emergency communication between OCC key personnel outline in Annex B will be by landline.

ANNEX E (Operation) to Operation Plan 2-80 (Chemical Burial Ground Exhumation Plan)

1. SITUATION. See basic plan.

2. MISSION: In accordance with guidance from NAVSEA, the overall mission is to exhume the buried munitions, clean/prepare the items for storage, and relocate them to a designated magazine. The ultimate goal is to transfer the munition to the Army for disposal.

3. EXECUTION:

a. Concept of Operations. Each operation will have an on-site commander and safety personnel available to assist as required. The two-man buddy system will be in effect during all chemical operations. Indoctrination and procedural run-through, as well as operational safety checks, will be accomplished prior to each operation. The safety equipment will be checked each day. This will include, but not be limited to the following: Personal safety gear, general health of the operators, equipment and decontamination (decon) materials, as well as all necessary support for that day's operation and emergency shutdown.

(1) Personnel safety gear required each day will be as follows:

(a) Coveralls.

(b) Boots.

(c) Gloves (rubber)

(d) Apron, M-3 suit or MODTEPS

(e) Hood.

(f) Two towels.

NOTE: Protective masks will be issued to each individual at the start of the operation and will be his responsibility until completion of the operation.

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(2) The following will be required each week:

(a) Medical check.

(b) New canister

(c) Work assignment.

(d) Progress and Operation update report to the Commanding Officer.

(e) Clean-up and equipment maintenance.

(3) Levels of Protection:

(a) Equipment Operators:

1 Boots.

2 Gloves.

3 Hood.

4 Coveralls.

5 M-9 mask.

6 MODTEP suit as appropriate.

(b) Safety/Decontamination/Medical Personnel:

1 Gloves.

2 Boots.

3 Coveralls.

4 Hoods.

5 M-9/M-17 mask.

6 Apron.

(c) Operational Personnel (including detoxification (detox) operation):

1 M-3 suit/MODTEP.

2 Gloves.

3 Boots.

4 Coveralls.

5 Underwear (long johns)

6 Hood.

7 M-9 mask or airpack.

b. Responsibilities:

(1) Commander NAVWPNSUPPCEN Crane - responsible for overall conduct of the operation and any change to the approved OPLAN.

(2) NAVSURFWPNCEN Dahlgren and EOD Facility will provide on-site technical engineering assistance and chemical safety operational instructions.

(3) Commander EOD Group II will be the operations OIC for this operation. He will assure the following:

(a) That all personnel involved in the operation that day are logged in and medically acceptable to perform the task.

NOTE: Disqualification of personnel will be by qualified medical personnel or, as required, by the safety people - Example of problem areas: (1) cuts, nicks, and open wounds, (2) dermatitis or allergies, (3) colds or bronchial problems, (4) others as expressed or required by the OIC/medical officer such as kidney, liver, emotional disorders, etc.

(b) That a team leader is designated for each operational team who will also serve as the field leader and safety operational person.

(c) Proper adherence to the Operational Plan and in case of an emergency, insure that proper decon procedures or detox operations take place without delay. Render safe condition must be assured prior to each day's close-out.

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(d) That detox and decon materials (liquid and/or solid) are disposed of in an acceptable manner. (Required pH will be 6.8 to 7.2.)

(e) Proper interface between operations to eliminate excess waste and also control solid and or liquid discharge from the operation.

(f) That a proper daily log be kept and that a daily sequence of events is outlined.

(g) That weather reports are obtained twice daily to assure proper weather patterns and conditions exist for the continuance of the chemical operations.

(4) The Safety Technical Team will: (NSWC Dahlgren and EOD Facility)

(a) Assure that all equipment and auxiliary materials and/or systems are operational.

(b) Control movement of equipment, personnel and material entering or leaving the site.

(c) Assure that proper detox is prior to moving any suspected contaminated materials out of the "hot-operational area."

(d) Assure that all deconned or detoxed material is properly labeled and placed in the prearranged drop area for final disposition.

(e) Assure that detox and decon materials (liquid and/or solid are disposed of in an acceptable manner. (Required pH will be 6.8 to 7.2.)

(f) Assure proper interface between operations to eliminate excess waste and also control solid and or liquid discharge from the operation.

(g) Keep a daily log and insure that a daily sequence of events is outlined.

(h) Obtain weather reports twice daily to assure proper weather patterns and conditions exist for the continuance of the chemical operations.

(5) The Team Leader who will work directly for EOD Group II will assure that:

(a) All equipment and auxiliary materials and/or systems are operational.

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(b) Movement of equipment, personnel and material entering or leaving the site is controlled.

(c) Proper detox is accomplished prior to moving any suspected contaminated materials out of the "hot-operational area."

(d) All deconned or detoxed material is properly labeled and placed in the prearranged drop area for final disposition.

(e) Detox and decon materials (liquid and/or solid) are disposed of in an acceptable manner. (Required pH will be 6.9 to 7.2.)

(f) Proper interface between operations to eliminate excess waste and also control solid and/or liquid discharge from the operation.

(6) NAVWPNSUPPCEN Crane Safety Liaision Officer will be appointed by CDR NAVWPNSUPPCEN Crane and act as a liaison between the CDR and the operational area. He will assist the operational commander in all support areas between the Center and the site.

(7) EOD Group II will provide operational supervision and additional teams to augment the NAVWPNSUPPCEN Crane EOD Detachment.

(8) Public Works NAVWPNSUPPCEN Crane will provide equipment as required through coordination with NAVSURFWPNCEN Dahlgren and COMEODGRU II. This equipment will be in excellent working conditions and receive priority of maintenance during the operation to insure only the best equipment is used.

c. Methodology:

(1) Safety Leader/OIC/Team will go through the checkout procedures prior to the operation.

(2) Once equipment and personnel are certified, the operation will proceed in the following manner:

(a) A personnel decontamination station will be established and equipped as follows:

1 One pound of HTH per 12 gallons water and .25 pounds of wetting agent per 12 gallons of water;

2 Brush with handle,

3 Sponges,

4 Rinse water,

5 Undress area.

(b) A hardware decon station will be established and equipped as follows:

1 Seven pounds of HTH and .30 pound of wetting agent in 12 gallons of water,

2 Brush with handles,

3 Steam connections,

4 Rinse water,

5 Extra HTH

6 Container for hardware.

(c) Auxiliary equipment pre-positioned prior to beginning the actual operation will include but not be limited to the following:

1 Medical emergency,

2 Electrical generator on line,

3 Steam generator on line,

4 Water tank with pressure 40 pounds min.- 60 pounds maximum. The back-up team will be in coveralls with mask and gloves available at their side.

NOTE: No one other than the backhoe operator, working team, and OIC/Safety person will be allowed within 50 ft. of the actual hot area. The clean area will be established and properly marked each day.

(d) Communication equipment will be checked prior to the start of the daily operation and will be for official use only.

(e) The work schedule for each team will be rotated in the following way: 3 hrs work/3 hrs stand-by and 1 hour decon/2 hour rest period. This will continue 7 days a week until project completion.

(f) Exhumation operations will be initiated from the far corner of the "suspected hot burial area" to the near corner. Equipment and materials will be pre-positioned each time the operational site changes with the exception of the auxiliary gear/equipment which will remain in the clean area at all times.

(g) Minor maintenance may be performed on a daily basis to equipment in the "hot area," but the buddy system will apply. No major maintenance will be initiated in the hot area. Should maintenance be required equipment or materials will go through proper detox/decon procedures prior to removal from the hot area.

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d. Actual Operation and Plan Procedure:

(1) On command of the OIC; the backhoe operator will begin the exhumation. He will dig down and scrape as he goes, under direction of the OIC.

(2) At the command of the OIC, the backhoe will stop, and the two chemical operators will descend into the hole. They will probe for metal contact and once contact is made continue the digging with shovels.

(3) Examination of the hardware will be accomplished; if not leaking it will be placed in the backhoe bucket; if leaking, it will be overpacked (plastic bags - 6 mil) and then lifted from the hole in the same manner.

NOTE: At the discretion of the OIC, each munition and/or hardware will be processed in this manner, and each hole emptied before proceeding to the next hole.

(4) Detox Vat - Each item of ammunition or hardware will be inspected as to its integrity; if in the judgment of the on-scene commander the condition is such that the safety of individuals handling the material would be adversely affected by further handling, the item will be detoxed and deconned. The provisions set forth in Army Publication AR 75-15 will be strictly observed during this phase. If detoxification is required, the following steps will be followed:

(a) Hardware will be steamed and detoxed by placing it into the vat for at least four hours.

(b) Proper pH levels will be maintained in the detox vat throughout the operation by adding HGH solution as necessary.

(c) Each excavation will be sprayed with a weak bleach and soap solution prior to ending daily operations.

(d) Should emergency stoppage be necessary everything must be secured, depending on the type of the emergency - at no time will the area be left without surveillance to eliminate intruders.

(5) Disposal/Dispositon of Materials. The disposal of agent will be done in the "hot area" via the detox vat. Deconned and detoxed liquid residue will be returned to the excavated hole. The residual hardware, if serviceable, will be overpacked. However, if damaged, badly corroded, or walls are weak, the ammunition will be detoxed and deconned.

(6) Emergency Procedures:

(a) Hot-area personnel will be deconned before leaving the contaminated section.

(b) Once properly deconned, first aid will be administered in the cold area. The injured person can then be transferred to the dispensary.

(c) Fire: All areas will be evacuated, "hot line"/hot area personnel will move down-wind from clean area, and decon themselves prior to going to the clean area. At no time will untrained personnel be allowed inside the hot area - fire fighters will be required to use air-type self-breathing apparatus to fight fires in this area.

(d) Electrical storm - All operations will be stopped and the area secured during electrical storms.

(e) Weather conditions above 80°F and below 32°F will be considered unacceptable for exacuation; however, detox/decon procedure may be done.

(f) If serviceable items are found, they will be isolated from the other items and handled separately. If the material/item contains explosives such as a fuse and/or burster the applicable EOD procedures will be followed. These are specified step by step in the operations SOP. However, as a minimum these items will be isolated and handled separately.

(g) Any unusual or unexpected items uncovered will also be set aside and treated in accordance with applicable EOD procedures.

NOTE: In accordance with TM3-400 May 57 pg 27, para 30a - "the M10 burster (which is used in the M70 series bomb) is shipped separately from the bomb." In Advanced Fuse & Explosive Ordnance Bulletin #5 of 1 Jun 44, pg 17 states that the M70 could be filled with lewisite, white phosphorus or gelled gas. Appropriate safety precautions for these possibilities will be taken.

4. SERVICE SUPPORT:

a. Billeting - NAVWPNSUPPCEN Crane will billet all personnel involved with this project. Each organization will notify NAVWPNSUPPCEN Crane at least 30 days prior to execution with the number of people who will be temporarily housed by Crane.

b. Medical support will be provided by NAVWPNSUPPCEN Crane in accordance with Annex I.

NOTE: The major hazard is HD, however, medical personnel will be capable of handling any chemical warfare material accident.

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c. Public Works - provided by NAVWPNSUPPCEN Crane Public Works Officer through his liaison. All equipment will be checked prior to issue to insure completeness and operability. It will be PW responsibility to transport the item from post to the operational area and also remove inoperable equipment from that area back to the post.

d. Photographic support to document this operation on film will be provided by the EOD Facility.

e. Liquid oxygen and liquid nitrogen will have to be procured several times during the operation. NAVWPNSUPPCEN Crane will coordinate this with a commercial source at government expense or any government location.

5. COMMAND AND SIGNAL:

a. Communications will be established by the Crane Safety Office between the post and the operational area. These will be by radio and a back-up system.

b. Communications within the area will be provided by the operational EOD teams.

c. The Commander NAVWPNSUPPCEN Crane is the overall supervisor of this operation.

d. The Commander EOD Group II will be the operations OIC in the field.

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ANNEX F - (Security) to Operation Plan 2-80 (Chemical Burial Ground Exhumation Plan)

1. SITUATION: See basic plan.

2. MISSION: To provide physical security and police support to Operation Plan 2-80 (OPLAN 2-80) Chemical Burial Ground Exhumation Plan.

3. EXECUTION:

a. Concept of Operation: The entire project will be accomplished within an area of approximately two square miles. Security will consist of perimeter guards and vehicle control points.

b. Responsibility:

(1) The responsibility for security during the project rests with the NAVWPNSUPPCEN Crane Security Department and the OCC Commanding Officer.

(2) The subject operational security forces will, as a minimum, consist of one, two-man Security Surveillance Team (SST); one, two-man Security Alert Team (SAT); one, three-man Security Back-up Alert Force (BAF); and one, ten-man Reserve Force (RF).

(3) The Guard Force will have a security clearance commensurate with the security classification of the material being guarded.

c. Security Force Requirements:

(1) Security Surveillance Team (SST) - a two-man team will provide continuous surveillance of the operating area. The SST will control access to the primary operations area and will observe operations within the hotline area coming no closer than 100 feet of the designated hotline.

(2) Security Alert Team (SAT) - A team of at least two persons which can assist the SST or other security forces and must be able to react to any on-site emergency within five minutes of notification.

(3) Back-up Alert Force (BAF) - A team of at least three persons in addition to the SAT, equipped and trained to reinforce the SAT and be positioned to assist the SST at any on-site emergency within 10 minutes of notification.

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(4) Reserve Force (RF) - A team of at least ten persons in addition to the SAT or BAF, equipped and trained to respond on-site within thirty minutes of notification. The team will be made up of Security guard personnel normally assigned other posts.

4. SERVICE SUPPORT:

a. Administration: See basic plan.

b. Individual Equipment: Security Reaction Forces (SST, SAT, BAF, RF) will be equipped as follows:

(1) Duty uniform.

(2) Helmet and liner.

(3) Canteen (water filled).

(4) Protective mask (M17, equivalent) (carried in mask carrier for immediate donning).

(5) Flak jacket.

(6) Radio.

(7) M13 decontamination and reimpregnation kit, standard first aid pouch.

(8) M14 rifle (or equivalent) - in addition to individual sidearms.

(9) 120 rounds (6 magazines) M14 ammunition, 17 rounds for sidearms.

c. Where possible, security personnel selected will have chemical security experience. Where this is not possible, specific training in chemical emergency procedures will be completed prior to the operation (designated EOD personnel may be utilized to give this training).

5. COMMAND AND SIGNAL:

a. Command: The NAVWPNSUPPCEN Crane OCC is responsible for security for the entire operation.

b. Signal: Each Security Team member will have a portable radio. At a minimum, each team will be provided with radio communication capability.

c. Equipment: Additional vehicles may be required. Public Works will provide additional vehicles as determined necessary by the Security Department.

NOTE: Post operation security will be in accordance with previously established plans for the burial ground and Building 1403. The degree of security required after the operation will be dependent on the condition of the material exhumed. In no case is it anticipated that the degree of security will be greater than that required prior to the exhumation effort.

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ANNEX G (Safety) to Operation Plan 2-80 (Burial Ground Exhumation Project)

1. SITUATION. See basic plan.

2. MISSION: When directed NAVWPNSUPPCEN departments will support EOD Group II personnel, NAVSURFWPNCEN Dahlgren personnel and OESO, Indian Head personnel to exhume, inspect/clean/prepare and containerize chemical munition items (1) buried in a previously established burial site and (2) previously exhumed and currently stored in a magazine. The project is to be conducted in a manner which precludes chemical exposure, affords maximum safety to personnel and property and which conforms to the intent of Public Law 91-441.

3. EXECUTION: Operations will be conducted in accordance with the Operation Plan (Annex E). All departments and agencies involved in the operation will be covered by plans/procedures in sufficient detail to bring about a smooth and well coordinated operation. Due to the recent involvement of the Center in Operation SETCON II, a number of department personnel are currently trained for operations such as the one outlined in this plan. In addition, training of new participants from each department as well as refresher training of previous participants will be conducted prior to the actual operation. Emergency procedures for all occurrences previously identified peculiar to this operation will be followed as described in Annex H. The following general safety measures will be observed during all phases of the operation:

a. A Standard Operating Procedure (SOP) will be prepared in advance for all steps of the operation including site preparation, exhumation, material inspection/cleaning/preparation, packaging, transportation, storage and site reclamation.

b. A site safety team made up of representatives of NAVSURFWPNCEN Dahlgren will monitor work within the hotline area. Technical input by the team will be utilized in the decision-making process for emergency actions.

c. A safety team made up of the Safety Director and a technical representative will coordinate the efforts of the NAVWPNSUPPCEN departments assigned to support the operation in the following specific manner:

(1) Insure that each department is aware of, understands and is able to complete its part of the movement plan.

(2) Insure that adequate protective equipment is available to each individual involved and that each individual is adequately trained in its use prior to execution of the plan.

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(3) Will continuously monitor all phases of the operation to verify compliance with previously approved procedures.

(4) Will coordinate the use of the previously trained disaster preparedness team utilized as a back-up force during the SETCON II operation.

4. SERVICE SUPPORT: The SETCON II operation has served as a training ground for the operation outlined by this document in the following support areas, all of which will be involved again:

a. Location of and training/retraining of personnel with all required protective equipment.

b. Orientation briefings of all personnel assigned with mustard agent information detail levels established in accordance with their assigned tasks.

c. Establishment of qualified instructors to carry out the various personnel training.

d. Provision of the approved type and number of support vehicles including decontamination, fire, medical and security, as well as two coordinating monitoring units for the various operational phases as described by Annex E. The security support for the operation is outlined by Annex F, the medical support by Annex I and the fire and decontamination by Annex H.

e. Provision of M17A1 masks and protective clothing to support personnel. This equipment is available from stock held in readiness by a disaster control organization.

f. Provision of emergency decontamination Center equipment for personnel as well as a means to handle and control emergency situations including decontamination of materials, vehicles, land areas, etc., utilizing EOD Group II personnel backed up by a previously-trained Disaster Preparedness Team.

g. COMMAND AND SIGNAL: Omitted.

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ANNEX H (Chemical Accident/Incident Control) to Operation Plan 2-80 (Burial Ground Exhumation Project)

1. SITUATION: See basic plan.

2. MISSION: To provide Chemical Accident/Incident Control (CAIC) response to any accident or incident which occurs during any part of the Operations Plan, Annex E.

3. EXECUTION:

a. Concept of Operation:

(1) Safeguards and procedures outlined by the OPLAN are designed to prevent a Chemical Accident/Incident (CAI) from occurring; however, if a CAI does occur, immediate action will be taken to save life, preserve health, and protect property. These emergency requirements and procedures will be henceforth known as a plan of Chemical Accident/Incident Control (CAIC).

(2) CAIC planning by NAVWPNSUPPCEN Crane will be primarily for all operational phases involved with the exhumation project outlined in Annex E.

b. Operational Requirements:

(1) Primary CAIC response will be with on-site EOD forces utilizing equipment supplied by NAVWPNSUPPCEN Crane for specific situations.

(2) Back-up on-call emergency CAIC forces will include security, fire-fighting and medical teams as outlined by Annexes F, G and I.

(3) Back-up on-call emergency decontamination forces will be provided as a function of the previously-trained Disaster Preparedness Teams.

c. Responsibilities:

(1) Primary CAIC Response - During all phases of the operation, the on-scene EOD Group II Commander will be responsible for initial emergency action in the event of a CAI. Immediate action will be taken by the on-site EOD Group II Team. Functions will include assessing the situation, isolating the incident and making an initial attempt to recover from the situation. Details on EOD Group II's emergency procedures are attached as Appendix 1.

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(2) Back-up response to CAI occurring at the site will be coordinated by the OCC utilizing the back-up forces (Security, Fire-fighting, Medical and Decontamination).

4. SERVICE SUPPORT:

a. Vehicular and equipment support requirements for emergency response forces will be furnished by NAVWPNSUPPCEN Crane as required.

b. Medical support will be as specified in Annex I to this plan.

c. Funding support will be as specified in Annex K to this plan.

5. COMMAND AND SIGNAL:

a. Chemical Accident/Incident (CAI) required accident reporting of an incident will be the responsibility of the NAVWPNSUPPCEN Crane OCC.

b. CAI communications in accordance with Annex D.

APPENDIX 1 (Chemical Hazard Overlay) to Annex H (Chemical Accident/ Incident Control) to Operations Plan 2-80 (Chemical Burial Ground Exhumation Project)

1. This appendix provides detailed figures for a contamination hazard overlay for the NAVWPNSUPPCEN Crane operation.

2. The high (worst case) and low (best case) parameters are given so any situation can be tailored to meet local conditions.

3. FM 9-15, EOD unit operations, is the basic reference and the following tables and figures were used: Table 4-1, page 4-16 and Figure 4-3, page 4-17. The total amount of HD contained in a functional M70A1, 115-pound bomb is 27.2 Kg or 59.84 pounds (rounded to 60 pounds). From previous experience with munitions that have been buried for prolonged periods, the HD deteriorates and less than 60 pounds is normally found. However, the worst case is 60 pounds.

4. Using 60 pounds as the source strength and 25 mg-min/m^3 as standard HD dosage (Table 4-1) and 10 mph as windspeed, the following figures were calculated from Figure 4-3:

Maximum Downwind Distance	Temperature Gradient
2230 meters	Inversion +3° (worst case)
610 meters	Neutral
130 meters	Lapse -3° (best case)

5. However, since these munitions have no bursters, the release of agent vapor would be minimal since the HD has very low volatility. Since the operation will be done during daylight hours during which a mild lapse condition normally prevails, recommend a figure of 600 meters be used as the downwind distance. This can be adjusted depending of conditions. Figure 6 illustrates the 600 meter zone with respect to the surrounding area.

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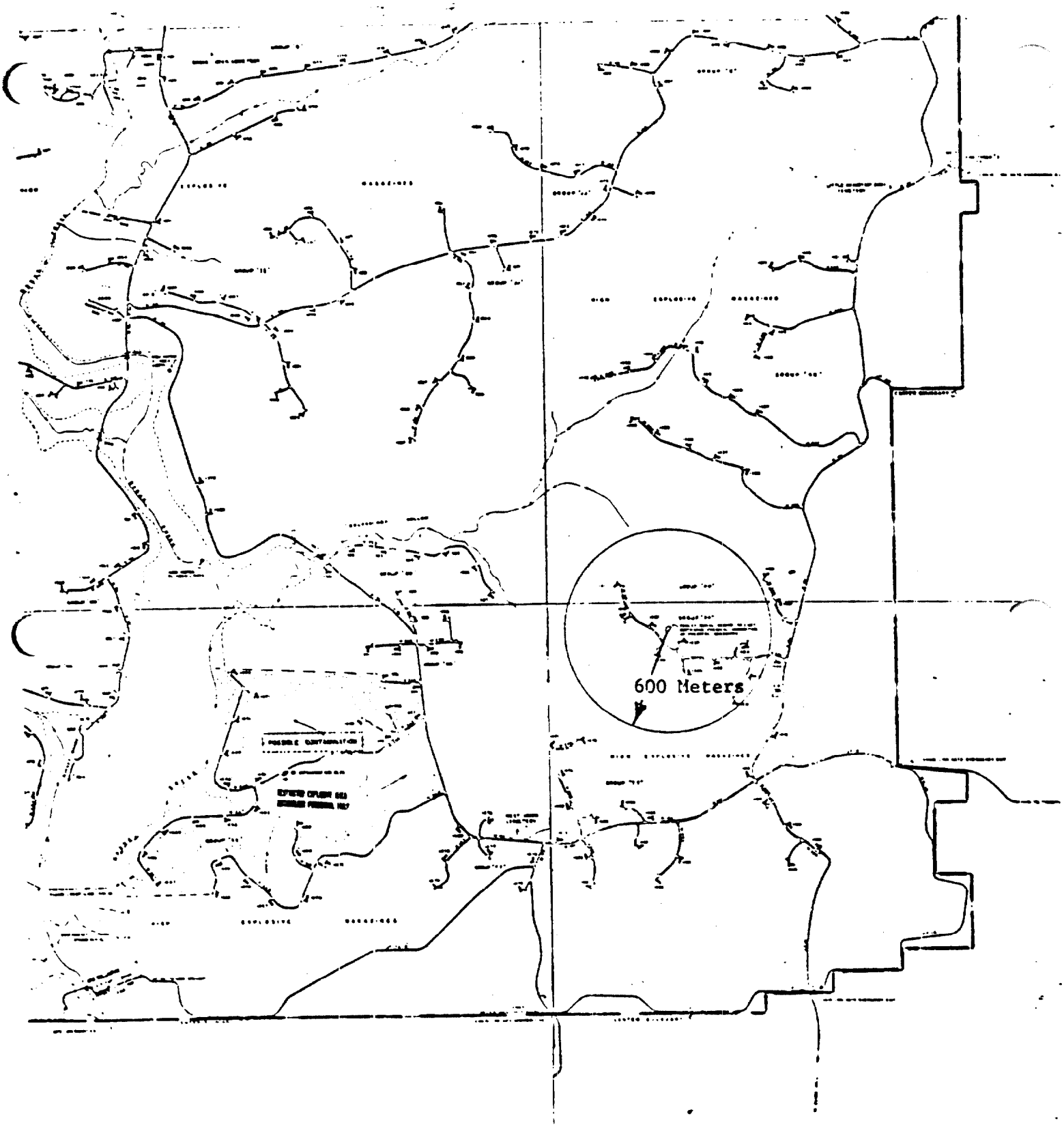

FIGURE 6

BURIAL GROUND DOWNWIND HAZARD
ZONE FOR HD CHEMICAL AGENT

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ANNEX I (Medical) to Operation Plan 2-80 (Chemical Burial Ground Exhumation Plan)

1. SITUATION: See basic plan.

2. ORGANIZATION:

a. Medical Troops: Naval Dispensary, Naval Weapons Support Center, Crane, Indiana.

b. Attachment of Medical Troops: Explosive Ordnance Disposal personnel.

3. MISSION: NAVWPNSUPPCEN Medical Department will provide medical support during the planning for, and conduct of, operations involving exhumation of chemical munition items from the chemical burial ground.

a. Provide hospital corpsmen on standby for the operations conducted.

b. During the movement and transfer phases of the operation, provide hospital corpsmen on standby or in the field, as required, for direct medical support and for the CAIC/Disaster Emergency Team, and an ambulance with resuscitation equipment manned with a driver and two hospital corpsmen to give first aid treatment as required.

c. Provide medical support in the event of a Chemical Accident/Incident in accordance with reference (b) and Annex H.

4. EXECUTION:

a. Concept of Operations:

(1) The NAVWPNSUPPCEN Medical Department will provide a physician who has received specialized training on chemical agent casualties at the U. S. Army Biomedical Laboratory and who has trained hospital corpsmen to support all phases of the operation within the confines of NAVWPNSUPPCEN Crane.

(2) Hospitalization and treatment facilities are available at Ireland Army Hospital, Fort Knox, Kentucky, in the event these facilities are required.

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ANNEX I (Medical) to Operation Plan 2-80 (Chemical Burial Ground Exhumation Plan)

5. SERVICE SUPPORT:

a. Supply: Necessary medical logistical support will be coordinated with the Medical Department, NAVWPNSUPPCEN, Crane, Indiana.

b. Personnel and Training:

(1) The minimum on-site medical support required during any phase of the operation is a team trained in first aid and emergency chemical agent casualty treatment, with an ambulance and two trained aidmen available for quick response to the operations site.

(2) Should a CAI occur, augmentation of medical support will be in accordance with CAIC response guidelines to Annex H.

(3) All phases of the operation will be supported by a physician who has received specialized training for treatment of chemical agent casualties at the U. S. Army Bio-Medical Laboratory, Edgewood Arsenal, Aberdeen Proving Ground, Maryland, or equivalent training.

(4) The trained physician(s) will insure adequate training in treatment and effects of the chemical agents listed in Annex C for all medical personnel assigned responsibility to support this operation.

6. COMMAND AND SIGNAL: Communication will be maintained with the OCC as provided in Appendix D.

ANNEX J - (Public Affairs) to Operation Plan 2-80 (Chemical Burial Ground Exhumation Plan)

1. SITUATION: See basic plan.

2. MISSION: When directed to execute by the NAVWPNSUPPCEN Crane Commanding Officer, the Public Affairs Officer will provide information to the public. Information will basically be general in nature and will be released in the event of a CAI resulting in personnel injury or threatening conditions to off-Center areas.

2. EXECUTION:

a. Concept of Operations. The Public Affairs Office will provide information for officials and news releases/briefings for desingated media representatives as required.

b. Response to Local Queries. Questions from the local media will be answered on a case-by-case basis as dictated by the situation. No statement of specific plans will be provided before the operation is executed.

c. Documentation of Operations. Submit copies of all news/photo releases, response to significant queries, local press clippings, and an evaluation of local press public reaction to the operation to the NAVWPNSUPPCEN Crane OCC Commander for inclusion in the after action report to COMNAVSEASYSCOM.

4. COMMAND AND SIGNAL. News releases will be prepared and distributed only at the direction of the NAVWPNSUPPCEN Crane OCC Commanding Officer.

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ANNEX K (Program, Budget, and Funding Plan) to Operation Plan 2-80 (Chemical Burial Ground Exhumation Plan)

1. SITUATION: See basic plan.

2. MISSION: To provide a cost estimate and cost reporting procedures for execution of the chemical burial ground exhumation effort.

3. EXECUTION:

a. The following estimated costs and audit procedures are applicable in accordance with operation requirements:

(1) Site preparation by Public Works Department	$ 5,000
(2) Fabrication of support equipment	8,000
(3) Support materials	3,000
(4) EOD Group II operational costs	42,000
(5) NAVSURFWPNCEN Dahlgren support	20,000
(6) OESO Indian Head support	5,000
(7) Site clean up and closing	5,000
(8) Security	10,000
(9) EOD Facility	5,000
Basic Estimated Cost	$103,000

The above total is based on full execution of the plan with a minimum of weather delays. Because of weather uncertainties a 20 percent contingency factor for a prolonged execution phase is planned.

20% contingency	20,600
Total Estimated Cost	$123,600

b. Special accounting job orders will be established to define each area of costs related to this plan. Final costs will be submitted within 30 days after the operation has been completed.

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ANNEX L (Environmental Assessment) to Operation Plan 2-80 (Chemical Burial Ground Exhumation Plan)

1. INTRODUCTION. In an effort to protect the environment from possible future damage, restore the site to the original condition, and thereby enhance the environment, several items of ordnance will be excavated from a burial site and transported to a safe storage site.

2. PROPOSED ACTION. This operation is being carried out to prevent a possible release of mustard agent at a future date by placing the munitions in a condition from which it can be safely demilitarized by normal procedures. Excavation will be only that required for ordnance removal and will effect a maximum area of 0.01 hectares. The excavated earth will be checked for pH, adjusted if necessary, returned, and properly graded and seeded. This operation will be performed by military personnel entirely on military property and is considered a minor training exercise and thereby categorically excluded from further environmental scrutiny (federal, state, local NAVWPNSUPPCEN Crane land use policies, pollution abatement programs or natural resources management).

3. PROBABLE IMPACT OF THE PROPOSED ACTION ON THE ENVIRONMENT. The exhumation effort, material preparation and land restoration minimizes any chance of spillage and chemical accident/incident control precludes any potential influence upon the environment.

4. ALTERNATIVES. There are no acceptable alternatives to this action.

5. ANY PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED. Although there are no expected violations to the Clean Air Act or the FWPCA, contingency plans have been made to negate any possible spillage of agent by decontaminating the area and containing it until it has been safely neutralized. Because of the nature of the chemical agent, air emissions during operations will be controlled within the hot line area. Controlled excavation will prevent any possible contamination of run-off water.

6. THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USE OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY. None.

7. ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES THAT WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED. None.

8. CONSIDERATIONS THAT OFFSET THE ADVERSE ENVIRONMENTAL EFFECTS. The site will be monitored through shallow wells for a period of three years. There is no adverse condition expected and the land will be completely restored upon removal of the monitoring sites. Future land use is expected to be as originally intended, separation area for magazines and for military use only.

ANNEX M (Area and Material Clean-up and Certification) to Operations Plan 2-80 (Chemical Burial Ground)

1. SITUATION: See basic plan.

2. MISSION: To insure that the land area and materials utilized during the exhumation operation are decontaminated and properly certified in accordance with the latest criteria available.

3. EXECUTION:

a. General: Because mustard agent is extremely persistent, it is not considered feasible to decontaminate the soil making up the primary burial ground area to the extent considered appropriate for release to private parties. The approach to be taken will involve the following:

(1) Analysis of surface and sub-surface water for agent and/or decontaminant.

(2) Surveillance of soil during the excavation effort for traces of agent.

(3) Treatment of the excavation using decontaminant.

(4) Decontamination of equipment/materials utilized during the operation.

(5) Monitoring of the surface and sub-surface water for a period of time after the primary effort has been completed.

b. Specific action before the exhumation effort:

(1) Surface water monitoring will be accomplished utilizing a perimeter slit trench located down hill from the burial ground.

(2) Sub-surface water that would normally flow through the rock strata will be monitored by sampling at an outcropping below the burial ground.

(3) Three core samples will be taken along the north boundary and analyzed for the presence of agent and/or decontaminant. Soil samples obtained during core boring will be placed in a five-gallon container for each site and the presence or absence of mustard determined by using M15 or M18 kits and MS paper as appropriate. Monitoring will be qualitative only. The need for quantitative analysis is not foreseen.

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c. Detection and decontamination during the exhumation effort:

(1) Land: Potentially Contaminated Area (PCA) soil samples:

(a) Using the five gallon method, collect samples of spoils at the end of each day and test for presence/absence of mustard using appropriate test media--M15/18 or M8 paper. Samples will also be taken of soils at the bottom of each pit.

(b) Agent-contaminated soil will be detoxed and deconned using field procedures. A bleach solution 1-5 percent in volume will be the decon material of choice (M-8 paper will be used as a field detector).

(c) Seventy-two hours after detox/decon procedures, a sample of the soil will be analyzed for both residual contamination and excess decon materials.

(d) The PCA will be properly marked on the "Center Maps" with procedures for future use attached.

(e) If contamination is excessive and field detox/decon is not acceptable, the soil base will be removed and placed in a bleach/soap solution for at least 72 hours and monitored prior to final disposition.

(2) Hardware:

(a) The level of agent contamination will be monitored by the use of the M-8 paper and/or vapor tubes.

(b) Liquid/sludge/decomposed agent by-products will be treated as pure material. Adequate detox procedures will be used at all times.

NOTE: Agent detox material will be 1-5 percent volume bleach and .03 percent by weight wetting agent. Decon at water temperature over 50°F will be required during actual operations.

(c) Broken, damaged or unacceptable hardware, either due to corrosion, damaged walls, seal area, or any other major defect which offers no assurances to its integrity, shall be rendered safe by proper detox/decon procedures.

(d) Suspected hardware will be checked for wall thickness and other questionable areas. Final disposition will then be discussed.

(e) Disposition or disposal of parts, equipment and materials will be accomplished only after proper procedures and documentation are completed along with necessary Command approval.

(3) Equipment:

(a) Heavy-duty and auxiliary equipment will be detoxed and deconned at the end of the operation.

NOTE: "Hot Equipment" will be rendered safe each day.

(b) Porous materials will be considered "hot" and expendable if used in or around the contaminated area.

(c) Personal gear and safety equipment will be certified each week and rendered safe each day. Expendable equipment will be disposed of at the end of the operation; replacement costs will be charged to the operation. Daily changes of overalls, long johns, and other clothing, which come in direct contact with the skin, will be required.

(d) No personally-owned safety gear or equipment will be allowed in or around the operational area.

d. Site restoration:

(1) The following actions will be performed once the exhumation effort has been completed:

(a) At each excavation, prior to backfill, a floor of 6" deep crushed rock will be placed over the entire floor and extended up the sides. A section of perforated "Orangeburg" pipe will be placed in the center and allowed to extend 2' above grade.

(b) The excavation will be backfilled completely using the material originally excavated leaving the monitoring tube exposed.

e. After-operation monitoring (water only):

(1) Commencing with backfill date, monitor each well at the following intervals:

(a) 3 months.

(b) 6 months.

(c) 12 months.

(d) 24 months.

(e) 36 months.

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(2) Monitoring will cease at the end of 36 months, unless qualitative analysis indicates the presence of mustard. In that event, the monitoring period commences after decontamination procedures are affected through the appropriate perforated pipe vent.

(3) Samples will be taken from each monitoring well, from the surface water weir box and at the outcropping north of the site. Samples will be taken according to the time schedule above.

f. Certification--the following will apply:

(1) Conditional certification of demilitarization upon site restoration.

(2) Certification of demilitarization after the 36 month mustard-free monitoring period.

(3) Restricted to DOD use only (for uninhabited spaces).

4. SERVICE SUPPORT:

a. Technical services for monitoring and certification will be provided by the Ordnance Environmental Support Office (OESO), Indian Head.

b. Water sampling will be performed by NAVWPNSUPPCEN Crane.

5. COMMAND AND SIGNAL: Not included.

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APPENDIX B

Execution Requests

DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
WASHINGTON, D C 20362

IN REPLY REFER TO
6412/WEC
Ser 88
21 APR 1980

From: Commander, Naval Sea Systems Command
To: Commanding Officer, Naval Weapons Support Center, Crane, In.

Subj: Chemical Burial Ground Exhumation Project

Ref: (a) NAVWPNSUPPCEN ltr 041-DLG:mwm 6460 of 18 April 1980

1. Reference (a) provided a detailed Operation Plan to exhume the chemical burial ground at NAVWPNSUPPCEN Crane in compliance with direction from the Department of Defense Explosive Safety Board (DDESB). The plan includes inspection of any recovered items for safety, preparation for storage or detoxification as appropriate and transfer to the U. S. Army Technical Escort Unit for disposition.

2. The Operation Plan has been reviewed and is approved for execution commencing about 1 September 1980. The necessary funding to accomplish the project will be provided by separate correspondence.

Kleber S. Masterson Jr.

K. S. MASTERSON Jr.
Rear Admiral, USN
Assistant Deputy Commander for
AAW & Surface Warfare Systems

DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
WASHINGTON, D.C. 20362

IN REPLY REFER TO
64121E/WEC
Ser 205

MAY 5 1980

From: Commander, Naval Sea Systems Command
To: Distribution

Subj: Exhumation of Naval Weapons Support Center, Crane Chemical Burial Grounds

Ref: (a) NAVWPNSUPPCEN ltr 041-DLG:jak 6260 of 15 April 1980 (NOTAL)

Encl: (1) Operation Plan 2-80 (Chemical Burial Ground Exhumation Plan)

1. With the assistance of cognizant personnel from each action addressee, Naval Weapons Support Center (NAVWPNSUPPCEN), Crane has completed the Operations Plan (OPLAN) to exhume and demilitarize the old chemical burial grounds at NAVWPNSUPPCEN. The purpose of this letter is to formally request addressees' support during the final preparation stages as well as the actual execution of the project. Assistance is required as follows:

a. For Naval Ordnance Station, Indian Head (Ordnance Environmental Support Office) -

(1) Provide assistance during exhumation effort to insure compliance to certification requirements.

b. For Naval Surface Weapons Center, Dahlgren -

(1) Provide design details to NAVWPNSUPPCEN Crane for processing and support equipment.

(2) Provide personnel in the field to act in Safety Advisory Role for Explosive Ordnance Disposal (EOD) forces.

c. For Navy Explosive Ordnance Disposal Facility, Indian Head -

(1) Develop Standard Operating Procedures (SOP) for EOD forces.
(2) Insure EOD forces are properly trained for effort outlined.
(3) Provide personnel in the field to act as Safety Observer for EOD forces.

2. NAVWPNSUPPCEN Crane will -

(1) Provide all required support for EOD forces including equipment fabrication, material supply, and emergency forces.

(2) Provide Operations Coordination Center (OCC) for exhumation effort.

(3) Coordinate use of all required forces during all project phases.

6412 1E/WEC
Ser 205

Subj: Exhumation of Naval Weapons Support Center, Crane Chemical Burial Grounds

3. Addressees are requested to review enclosure (1) for details of respective responsibilities and utilize the Critical Event/Resource Plan of reference (a) for planning purposes. Funding for the operation will be provided by COMNAVSEA (SEA 642)

4. It is anticipated that the primary effort (Exhumation Phase) will commence about 1 September 1980.

R. A. TURNER, JR.
By direction

Distribution:
NAVORDSTA Indian Head (OE30)
NAVSURFWPNCEN Dahlgren (Mr. F. Sanchez)
NAVEODFAC Indian Head

Copy to:
NAVWPNSUPPCEN Crane (w/o encl)
CHNAVMAT (MAT 046) (w/encl)

DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
WASHINGTON, D.C. 20362

IN REPLY REFER TO
SEA 6412/W
Ser 204
21 APR 1980

From: Commander, Naval Sea Systems Command
To: Commander in Chief, U. S. Atlantic Fleet

Subj: Exhumation of Naval Weapons Support Center (NAVWPNSUPPCEN) Crane Chemical Burial Grounds

Encl: (1) Operation Plan 2-80 (Chemical Burial Ground Exhumation Plan)

1. In response to a Department of Defense Explosive Safety Board (DDESB) request to "Demilitarize" a chemical burial ground located at NAVWPNSUPPCEN Crane, a project for compliance is being actively pursued. An Operations Plan (OPLAN) provided as enclosure (1) covering all phases of the project utilizes Explosive Ordnance Disposal (EOD) personnel for the primary effort. The effort would involve 8 to 10 personnel for a period of approximately 30 days.

2. Current plans call for the exhumation effort to be initiated about 1 September 1980. It is requested that EOD Group Two personnel be made available to support this effort during the planned time frame. Training in support of this effort will be conducted by NAVEODFAC Indian Head personnel.

a. EOD Group Two will be required to:

(1) Provide an On-Scene Commander (OSC) for the project's field effort.

(2) Provide personnel to conduct all "Hands On" operations during the exhumation efforts.

(3) Provide primary chemical accident/incident control.

3. Funding for the Group Two effort will be provided by NAVSEA. Informal liaison has been effected regarding this effort with COMEODGRU TWO who concurs with his Command's participation in the project.

Kleber S. Masterson Jr.

K. S. [illegible]
Rear Admiral, [illegible]
Assistant Commander for
AAW & Surface Warfare Systems

Copy to:
COMEDOGRU TWO Ft. Story, VA
NAVWPNSUPPCEN Crane, IN
CINCLANTFLT (Code N332), Norfolk, VA

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DEPARTMENT OF THE NAVY
COMMANDER NAVAL SURFACE FORCE
UNITED STATES ATLANTIC FLEET
NORFOLK, VIRGINIA 23511

6412
Ser N325/ 4913
23 MAY 1980

From: Commander Naval Surface Force, U. S. Atlantic Fleet
To: Commander Explosive Ordnance Group TWO

Subj: Exhumation of Naval Weapons Support Center (NAVWPNSUPPCEN) Crane Chemical Burial Grounds

Ref: (a) CINCLANTFLT ltr 6412/FF1-2/N332C ser 2891 of 5 May 1980
(b) FONECON between LCDR Kochey/Staff COMNAVSURFLANT and LCDR Duignan/Staff COMEODGRU TWO of 14 May 1980

1. In accordance with reference (a) and as discussed in reference (b), request you take enclosure (1) of reference (a) for action.

2. Direct liaison is authorized for coordination.

R. B. ROGERS
Assistant Chief of Staff
(Operations and Plans)

Copy to:
CINCLANTFLT (N332)
COMNAVSEASYSCOM
CO NAVWPNSUPPCEN

APPENDIX C

Field Commander's Operation Log Synopsis

EOD-MAM:jam
6412-4835A/230
24 September 1980

From: LCDR M. A. MURRAY, USN, 420-64-4041/1140
To: Commanding Officer, Naval Weapons Support Center, Crane, Indiana 47522

Subj: Chemical Burial Ground Exhumation

Ref: (a) Operation Plan 2-80 (Chemical Burial Ground Exhumation Plan)

Encl: (1) Chemical Burial Ground Exhumation Daily Log Summary
(2) Chemical Burial Ground Exhumation Detachment Personnel

1. In accordance with reference (a), enclosures (1) and (2) are forwarded.

M. A. Murray
M. A. MURRAY

PERSONAL DATA

This document contains identifiable personal data which is to be safeguarded pursuant to the Privacy Act of 1974. This information is to be released only to authorized personnel having a need to know for official uses. When not in use, this document should be stored in a locked cabinet or secured area.

CHEMICAL BURIAL GROUND EXHUMATION DAILY LOG SUMMARY

Monday, 8 September 1980 - Advance team of LCDR Murray, LT Moxie, CWO-3 Bartleson and TM1 Williams arrived NAVWPNSUPPCEN Crane. Made messing and berthing arrangements. Assessed geographical layout of burial site and prepared site for the Forester 4022 Ferrus Locator Survey and buried object verification. Site prepared with area grids consisting of three foot center to center search lanes crossing the narrow.

Tuesday, 9 September 1980 - LCDR Murray and LTJG Barlow met with CAPT Hughes, Commanding Officer NAVWPNSUPPCEN Crane and Safety Department personnel to discuss Public Works support requirements for executing the Burial Ground Exhumation. Commenced verification search of burial site using a reference sketch completed by J. Hersey, NAVEODFAC, of 8 March 1977 with the following results:

Site "A" - 2 ft. of barbed wire, cleared, no further contacts.

Site "B" - Several small pieces of barbed wire, cleared, no other contacts.

Site "C" - One Thorium Canister, cleared, no other contacts.

Site 5 - Good strong contact at 2.5 ft. Labeled as dig site.

Site 6 - Good strong contact at 2.4 ft. Labeled as dig site.

Remainder of Detachment arrived from EOD Group Two, Ft. Story, VA.

Wednesday, 10 September 1980 - All personnel received I.D. Badges from Security. Continued final site preparation. Completed verification survey with Forester Locator 4022 with the following results:

Site 7 - 8 ft. diameter site cluttered with Thorium Canisters. New positions labeled as B1 and B2 will be dug at the same time. Average depth of contacts 20 inches.

Site 9 - Entire area cluttered with barbed wire. Unable to completely clear all the wire. No significant contacts.

Site 10 - Good contact at 2.4 ft. Dig site.

Site 11 - Good contact at 2.4 ft. Dig site.

Site B3 - New contact at 4 ft. Dig site.

Site 13 - Good contact at 3.2 ft. Dig site.

Site 14 - Good contact at 4.8 ft. Dig site.

Site 15 - Good contact at 4.0 ft. Dig site.

Site 16 - No significant contacts.

Submitted a new Burial Ground verification sketch to the Safety Department.

Thursday, 11 September 1980 - Continued final site preparations. Cryogenerators arrived. Number 1 Cryogenerator tested and on line. Modtemp suits cleared and transferred to burial site. All personnel were briefed by a NAVWPNSUPPCEN Crane doctor and Industrial Hygienist on Mustard HD Agent.

Friday, 12 September 1980 - Number 2 Cryogenerator on line. Final blueprint of burial plots submitted to Safety for the record. Final modifications to Decon Vat and "A" frame completed. Hotline completed. All communications checked O.K.

Saturday, 13 September 1980 - All Modtemp back packs charged. Final staging of all support equipment completed. Full dress rehearsal in minimum protective clothing and Modtemp from removal site through munition cutting, decon, steaming and hotline procedures.

Sunday, 14 September 1980 - Weighed all back packs. Mixed HTH Solutions in all vats as follows:

Decon Vat - 150 lbs HTH (2%)
Bomb soak tank - 240 lbs HTH (5%)
Hotline Vat for Modtemp - 20 lbs HTH (1%)
Foot Bath at Hotline - 25 lbs HTH (2.5%)

Final equipment checked completed. Final walk through on decon vat and hotline procedures. Briefed initial entry team on removing 10 bombs from Magazine 1403. Policed entire area and removed all debris and nonessential material. Site ready for exhumation.

Monday, 15 September 1980 - LCDR Murray briefed Commanding Officer and Executive Officer of NAVWPNSUPPCEN Crane on entire operational sequence. 0915 Hotline manned, PH levels checked in all vats. 0930 entered Magazine 1403 and transferred 10 bombs to decon vat. Neutralized eight bombs and returned two to Magazine 1403. One of the "Bears" contained approximately three gallons of HD. Site #15 is excavated. Two metal ammunition cans with lab metal debris found at 47 inches. 1935 Hotline secured.

Tuesday, 16 September 1980 - 1150 Hotline manned and PH levels checked in all vats. Two bombs removed from Magazine 1403 and neutralized. One bomb contained approximately one and one-half gallons HD. Started digging on sites #13 and #14. Three buckets of scrap metal removed at 22 inches and transferred to bomb soak tank. 1735 Hotline secured.

Wednesday, 17 September 1980 - Hotline manned at 0900 and PH levels checked in all vats and tanks. Three bombs removed from sites #13 and #14. Deconned, steamed, cut and transferred to soak tank. Two bombs removed from site B-3. Deconned, steamed, cut and transferred to soak tank. No HD present in any bombs recovered today. Sites #13, 14, and B-3 cleared and verified with locator. Hotline secured at 1640.

Thursday, 18 September 1980 - Hotline manned at 0855 and PH levels checked in all vats and tanks. Started digging on sites 10 and 11. One bomb recovered, deconned, steamed, cut and transferred to soak tank. Sites #10 and #11 cleared

and verified with locator. Started digging site #6. Scrap metal removed from site #6 and transferred to soak tank. Site #6 cleared and verified with locator. Started digging site #8. Site #8 full of Thorium containers. 1643 Hotline secured.

Friday, 19 September 1980 - Hotline manned 0840 and PH levels checked in all vats and tanks. Continued digging sites #8, B1 and B2. Sites #8, B1 and B2 cleared and verified by locator. One hundred eighty-five Thorium cannisters removed from sites #8, B1 and B2. Started digging Site #5. Removed a chemical gas I.D. kit container from site #5 which contained six ounces of HD in a laboratory glass flask with a glass stopper. Deconned HD and cleared and verified site #5. Chemical Gas I.D. kit container transferred to soak tank. All sites cleared and verified. All hand tools deconned and all combustible material removed from sites and burned. 1538 Hotline secured.

Saturday, 20 September, and Sunday, 21 September 1980 - Holiday routine.

Monday, 22 September 1980 - 0840 Hotline manned and PH level checked in all vats and tanks. One hundred eighty-five Thorium cannisters separated and placed in two DOT approved 55 gallon drums, processed through Hotline and placed in Magazine 1407. Deconned ten powder cans and transferred to Magazine 1403. Holes from sites #10, #11, B3, #13, and #14 prepared for residue from decon and soak vats. Decon and soak vats drained into holes. Holes checked with M8 paper with negative results. Bomb halves removed from soak tank and thermite burned. Bomb bodies and scrap metal were checked and put into ten DOT 55 gallon drums, processed through Hotline and transferred to magazine 1403. Hotline vat for modtemps drained. Cryogenerators and modtemps packaged and loaded for shipment. Decon vat steamed and PH level increased to 10. Hotline secured 1535.

Tuesday, 23 September 1980 - 0800 Hotline manned. PH level checked in decon vat. Decon vat drained. All equipment deconned and verified. The M12A1 Decon Apparatus is being used to decon burial site.

Wednesday, 24 September 1980 - 0830 Hotline manned. Decon vat and "A" frame removed from site. Used the M12A1 Decon Apparatus for second decon of burial site. Hotline secured and burial site turned over to the NAVWPNSUPPCEN Crane Safety Department. The following ~~thermite~~ items were deconned, steamed, cut and thermite burned:

a. Ten M70A1 bombs removed from Magazine 1403.

b. Six M70A1 bombs excavated from Burial Ground.

c. One M1 Gas Identification Detonation Set.

The total amount of HD blister agent~~s~~ deconned was approximately four and one-half gallons.

CHEMICAL BURIAL GROUND EXHUMATION DETACHMENT PERSONNEL

EXPLOSIVE ORDNANCE DISPOSAL GROUP TWO PERSONNEL

LCDR M. A. MURRAY, USN, 420-64-4041/1140 (EODMUTWO)
LT D. MOXIE, USN, 194-40-3904/1140 (EODMUTWO)
CWO-3 J. D. BARTLESON, USN, 265-50-0487/7481 (EODTEUTWO)
AOCS L. K. SCHUCKER, USN, 538-36-6570 (EODTEUTWO)
CMCS M. L. CLARK, USN, 395-40-0876 (EODMUTWO)
AOC G. E. MOCK, USN, 513-42-9886 (EODMUTWO)
AS1 F. H. JENSEN, USN, 048-46-3187 (EODMUTWO)
TM1 M. E. WILLIAMS, USN, 567-88-6605 (EODMUTWO)
GMG2 M. U. FAHRENHORST, USN, 494-64-1427 (EODMUTWO)
GMG2 G. D. COWAN, USN, 207-38-5916, (EODMUTWO)
EOCN C. J. McCOLLUM, USN, 498-68-9816 (EODMUTWO)

EXPLOSIVE ORDNANCE DISPOSAL DETACHMENT NWSC CRANE PERSONNEL

LTJG C. E. BARLOW, USN, 264-74-1829/6482
GMCM R. L. FOSTER, USN, 234-60-1936
MN1 G. W. ZAHNISER, USN, 227-64-8135
EM1 M. B. McSHERRY, USN, 474-52-7877
AO1 S. K. LARMON, USN, 249-90-5868

EXPLOSIVE ORDNANCE DISPOSAL FACILITY PERSONNEL

MAJOR J. W. SCHMID, USA, 139-36-4129
PH1 H. W. MATHIS, USN, 083-46-8905

NAVAL SURFACE WEAPONS CENTER, DAHLGREN PERSONNEL

MR. FILIPE SANCHEZ
MR. AUBREY TRIGGER

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APPENDIX D

Standing Operating Procedures for the Exhumation Effort

Standing Operating Procedure (SOP) for Protective Clothing During Exhumation Project at Crane NWSC

1. Purpose: This SOP delineates what protective clothing will be worn, when it will be worn, and where it will be worn during the exhumation project.

2. Applicability. The SOP is applicable to all personnel working on the Crane exhumation operation.

3. Procedures. These will be broken down by area.

a. Area C: Outside Area B and encompasses everything not in A or B.

(1) There are no special clothing requirements for anyone in Area C.

b. Area B: Everything outside the hotline and inside of Area C. This area will extend just past the trailer and magazine #1409.

(1) All personnel operating in Area B will have a M17 mask (with M13A2 green filter elements) on their hip available for use if an accident occurs. The M9 mask is substitutable for the M17.

(2) Once the hotline is established, those personnel working the hotline will wear:

(a) Long underwear including socks

(b) Rubber boots

(c) Booties

(d) Coveralls

(e) Toxicological Agent Protective (TAP) Aprons

(f) Inner cloth gloves

(g) TAP gloves

(h) TAP hood

(i) M9 protective mask

(3) A backup team located outside the hotline will wear the same as 3b(2) above. They will be used for emergencies only. That team will consist of four men.

c. Area A: Area within the present fence and once hotline is established, anything inside of the hotline.

(1) Prior to the establishment of a hotline, designated personnel will survey the area with forresters to more accurately identify those places where metal contacts were previously found. These personnel should wear field clothing only.

(2) Personnel positioning equipment within this area need only wear field clothing also since nothing has been unearthed to this point.

(3) During all operations the backhoe operator should have on coveralls with an M9 mask at his hip available when and if needed. He should also wear work gloves.

(4) Once the hotline is established and actual exhumation begins, two team members will be required to have on protective clothing IAW para 3b(2) above. This will allow ease of digging to recover a munition. Once the munition is found, however, the MODTEPS will be worn since actually handling the munition might cause contamination. Therefore, two members should be standing by in MODTEPS to take over the exhumation chores. Those in minimum protective clothing should step into the shaded area and be available for assistance if needed.

(5) The MODTEPS suit will be worn by those persons actually handling the items and by those operating the detoxification vat. During all operations in the suit, the buddy system will be followed. This will insure that the back packs are changed on time and operations continue smoothly.

d. The Safety Officer will wear minimum protective clothing as in para 3b(2).

4. Undressing Procedures.

a. Those personnel in MODTEPS will submerge in a small tub of

remove the decontamination solution from the suit.

b. Next they will be monitored using blue band tubes and M8 paper to insure completeness of decontamination.

c. They will be assisted in undressing by two personnel on the hotline. The undressing procedure will be:

(1) Remove helmet

(2) Remove gloves

(3) Remove top portion of MODTEPS

(4) Remove boots

(5) Remove bottom of MODTEPS

d. All components of each suit will be placed in a separate plastic bag.

e. The communication equipment will be double wrapped in plastic before entering the hotline area and will neither be deconned nor removed from the helmet.

f. The individual will then walk to the trailer, remove his underclothes, take a hot shower, dress and be checked by a medic.

g. The entire suit will be placed in a large plastic bag and the bag will be sealed for 4 hours at a temperature of at least 70°F. Then a blue band tube check will be made of the bag's contents. If negative, the suit will be removed and hung up in the trailer. If positive, the suit will be deconned again and the procedure repeated until results are negative.

h. Those personnel dressed in minimum protective clothing will use the standard undressing procedure such as:

(1) Decon booties in shuffle pit and STB slurry (HTH weak solution will do)

(2) Remove booties

(3) Decon hood, rinse and remove

(4) Decon gloves, rinse and remove (together)

(5) Remove apron

(6) Walk to shower, remove boots and underclothes

(7) Take deep breath, hold it, remove mask and shower

(8) Release breath after washing head and upper torso.

(9) Dress and medical check

i. All clothing will be placed in plastic bags, kept at least at 70°F and then tested with the blue band tube. If results are negative, then clothing will be hung up for next day's operation. If positive readings are discovered, they will be deconned again until checks are negative.

STEP-BY-STEP STANDING OPERATING PROCEDURES FOR ACTUAL EXHUMATION PROJECT

1. The exhumation project in Crane NWSC will be done entirely by Naval EOD personnel with technical advice and assistance from the EOD Facility (Army representative) and NSWC Dahlgren. The actual personnel within the "hot" area will be military EOD only unless some extraordinary circumstances arise to warrant others entering the area. The persons doing the project will be controlled by COMEODMUTWO.

2. After the area is more clearly marked, that portion which appears to contain the largest amount of contacts will be excavated first. This will follow the decon/detox of the items presently stored above ground.

3. Procedures:

a. Use of personnel in the area will be decided by COMEODMUTWO and, therefore, not discussed at all in the SOP.

b. Those items removed from magazine 1403 will be deconned/detoxed first in the following manner:

(1) Each round will be removed from the present containers and then removed from the plastic bag and inspected. This will include a check with the blue band tubes of the M18 kit.

(2) After inspection to insure neither fuze nor burster are present, the rounds will be placed one at a time in the decon vat and the nose plug removed by wrench or hand. If this is not possible, the nose plug will be cut off with a hydraulic cutter and the contents allowed to mix with the decon. After the bomb is empty, it will be cut in half crosswise between the two lugs and the two halves will be placed cut end down over steam nozzles in another vat. They will be steamed for at least 30 minutes then placed in a 55 gallon drum of 2 1/2 percent HTH solution. After submersion for 24 hours, the decon solution will be poured from the drums back into the holes from which the rounds were exhumed. When all items have been similarly treated, sand will be placed in the bottom of the drums and the cut items placed back in the drums with the cut side up. Into each half will be placed a thermite grenade to detoxify any residual contamination. Once the detoxification is completed, the rounds will be disposed of IAW current doctrine. They will then be uncontaminated scrap metal.

4. General:

a. All items recovered by digging will be handled in a similar manner.

b. As each item is uncovered, however, the two-man team in MODTEPS will remove it from the hole with the assistance of the backhoe and the item will be placed near the detox vat. Therefore, the two men will not have to leave the hole until all items are removed from the hole.

c. Plastic bags will be available if the round is leaking so that any possible contamination can be contained in the hole.

d. When each item is recovered, it will be checked with the M18 kit (blue band tube) to determine whether or not it is leaking. If leaking, it will immediately be placed in plastic bags then be removed from the hole.

e. When all rounds have been detoxified, Crane Safety Office will determi. final disposition. When no further assistance is required from MUTWO, those individuals can return to home station. Personnel in supervisory positions who will be required to provide input to the After-Action report will remain at Crane until the After-Action Report is completed.

APPENDIX E

Certification Documents

DEPARTMENT OF THE NAVY
NAVAL SURFACE WEAPONS CENTER
DAHLGREN, VIRGINIA 22448

WHITE OAK LABORATORY
SILVER SPRING, MD. 20910
(202) 394-

DAHLGREN LABORATORY
DAHLGREN, VA. 22448
(703) 663- 8535

IN REPLY REFER TO:
G502:FBS:saw
3403

OCT 20 1980

From: Commanding Officer, Naval Surface Weapons Center
To: Commanding Officer, Naval Weapons Support Center
Crane, Indiana 47522

Subj: Certification of Decontaminated/Detoxified Chemical Warfare Hardware

Ref: (a) DARCOM Regulation 385-31
(b) DARCOM Regulation 385-102 (Draft)
(c) Operation Plan 2-80

1. As per references (a) and (b) the U. S. Army has established safety guidelines for the treatment of hardware exposed to chemical warfare agents. The treatment known as decontamination/detoxification is one of pyrolysis of residual chemical contamination utilizing heat for a given duration (ie 1000°F for 15 min., 2000°F for 1-2 min., etc.)

2. Because of the advanced state of corrosion exhibited by all of the material exhumed, the provisions of reference (c) were utilized along with more detailed procedures of the field SOP. Those procedures were as follows:

a. Steam and drain in decontaminant for 30 minutes.

b. Steamout in decontaminant for 45 minutes.

c. Soak in 5% bleach tank for 48 hours.

d. Burn out with 2 each M-14 grenades (3000°F for over 30 seconds).

e. Inspect with M-8 tubes.

3. The resultant scrap metal exhibited no traces of HD Mustard Agent and were subsequently packed in DOT approved 55 gallon drums along with a quantity of vermiculite.

4. Because of the "security type" sensitivity associated with chemical warfare material, it is advised that the drums be crushed to prevent identification and then land filled at NAVWPNSUPPCEN Crane. The material will not now or in the future be a toxic waste problem in the NAVWPNSUPPCEN Crane landfill.

NAVAL ORDNANCE STATION
INDIAN HEAD, MD. 20640

IN REPLY REFER TO
PM5-ILT:jak
6240
23 October 1980

From: Commanding Officer, Naval Ordnance Station, Indian Head, MD
To: Commanding Officer, Naval Weapons Support Center, Crane, IN 47522

Subj: Chemical Burial Ground Environmental Condition, Interim Certification of

Ref: (a) Operation Plan 2-80 Appendix
(b) NWSC memo 3032-DB:lmw of 7 August 1980

1. The purpose of the letter is to certify that the environmental considerations of reference (a) have been satisfied to date.

2. The Director Ordnance Environmental Support Office (OESO) has inspected the site and found conditions in strict accordance with the requirements of reference (a). The base data as presented in reference (b) has been reviewed and found to confirm the absence of contamination both in surface and ground waters. However it is recommended that the retained samples be tested for presence of chemical agent with M-8 field test paper.

3. In addition to the sample sites described in reference (a), the effluent end of the sand and gravel filter must be sampled in the same manner. Results from each sampling in accordance with reference (a) should be forwarded to the OESO to serve as a basis for final certification when the samples show no increase in any key parameter (PH, Residual Chlorine, Negative M-8) for three years.

4. In accordance with reference (a) and the additional conditions cited above, this document provides interim certification that no environmental insult presently accrues the subject site.

IVAN TOMINACK
By direction

Copy to:
SEA-6412

OFFICER IN CHARGE
NAVAL ENERGY AND ENVIRONMENTAL SUPPORT ACTIVITY
PORT HUENEME, CALIFORNIA 93043

IN REPLY REFER TO:
42:JM:lm
3256.4A
Ser: 1482

07 NOV 1980

From: Officer in Charge
To: Commanding Officer (Code 04), Naval Weapons Support Center, Crane, IN 47522

Subj: Naval Weapons Support Center, Crane Thorium Nitrate Disposal Sites; certification of cleanliness

Encl: (1) Report of Clean Up Operations for Thorium Nitrate Disposal Sites Located at Naval Weapons Support Center, Crane, Indiana; 18 October 1980

1. Based on the information contained in enclosure (1), the thorium nitrate disposal sites located at the Naval Weapons Support Center, Crane, Indiana are considered decontaminated and may be released for radiologically unrestricted use.

R. H. SMITH
By direction

Copy to:
NAVFACENGCOM (111N)

REPORT OF CLEAN UP OPERATIONS FOR THORIUM NITRATE DISPOSAL SITES LOCATED AT NAVAL WEAPONS SUPPORT CENTER CRANE, INDIANA

Prepared By

JOHN P. McDONALD
Safety Director/Radiation
Safety Officer

Naval Weapons Support Center, Crane, Indiana

NEIL M. JORDAN
Health Physicist
Radiological Affairs Support Office

Naval Energy and Environmental Support Activity
Port Hueneme, California

18 OCTOBER 1980

Enclosure (1)

I. Background

On 15 September 1980, the Naval Sea Systems Command (NAVSEA) approved operations plan to exhume the Chemical Burial Ground at Naval Weapons Support Center (NAVWPNSUPPCEN) Crane, Indiana, was executed. Operations continued through 24 September 1980. During the course of the operations, two locations containing Thorium Nitrate containers were uncovered. These locations are identified as B1-B2 and 8. (Numbers correspond to exhumation plan locations and are illustrated in Figure 1.) The containers were removed and placed in Department of Transportation (D.O.T.) 17H 55 gallon drums. The material associated with the containers was examined for radioactivity using an Eberline E-500B G.M. Survey instrument. This material did indeed exhibit a low level of radioactivity ranging from 2 mr/hr to 7 mr/hr on the survey meter.

The holes, and their attendant dirt piles, from whence the Thorium Nitrate containers came were then surveyed for radioactive contamination. Instruments used for this survey included an Eberline RM-3-C3 survey meter with an Amperex electronics counter tube type 75NB3; and the aforementioned Eberline E-500B G.M. survey instrument. Both these instruments were currently in calibration with the next calibration due dates, both falling in November 1980. The holes and the dirt piles exhibited a few places of radioactive material contamination along with significant areas in which no contamination was detected.

Approximately 10 gram samples of material were extracted from several random locations in the dirt piles and from random locations on the floors and side walls of the two holes. These samples were placed in glass sample vials and taken to the Industrial Hygiene Laboratory at NAVWPNSUPPCEN Crane for analysis on a scintillation counter to determine the relative level of radioactivity. Five of the samples, as expected, exhibited radioactivity. The laboratory instrument used for this analysis was a Tracer Lab - Manu/Matic, Model SC-505 scintillation counter, with a shielded, radiac detector, Federal Stock Number H6665-663-8073.

II. NAVWPNSUPPCEN Crane Soil Sample Assay by RASO

The 10 gram soil samples were taken to the laboratories of the Radiological Affairs Support Office (RASO), Naval Energy and Environmental Support Activity (NEESA), Port Hueneme, California, for assay and verification of NAVWPNSUPPCEN Crane results. The Health Physicist at RASO verified the NAVWPNSUPPCEN Crane results. His laboratory protocol and results are as follows:

A. Samples counted on NMC G.M., in glass scintillation vials. Primary standard in glass scintillation vial:

B. EPA Intercomparison Standard No. 0072B diluted monazite ore 1500 $\pm$ 120 picocuries, 4-1-77, 10 grams

C. Used NAVWPNSUPPCEN Crane sample "No. 8 loose dirt edge 0^{0}" for intermediate to convert NAVWPNSUPPCEN Crane sample CPM to picocuries.

D. Counting Data

60 min BKG	1240 cts
60 min EPA STD	1413 cts
60 min NAVWPNSUPPCEN	1397 cts

E. Assay of NAVWPNSUPPCEN sample showed 1.37×10^{-3} microcuries. NAVWPNSUPPCEN counting data indicated 125 net CPM for this sample. Conversion factor (preliminary) is 1.10×10^{-5} uci/NCPM

F. Detection limit for NAVWPNSUPPCEN counting system was based on mean of two one-minute background counts (9 CPM and 17 CPM). A 99% confidence level was used.

$$\text{Detection limit } (L_D) = 2 \times K \times \sqrt{\frac{\text{BKG CPM}}{\text{BKG TIME}} + \frac{\text{SAMPLE CPM*}}{\text{SAMPLE TIME}}}$$

*= BKG CPM for zero activity

K = 2.33 sigma for 99% single tail

$$(L_D) = 2 \times 2.33 \times \sqrt{\frac{13}{1} \times \frac{13}{1}} = 24 \text{ CPM above BKG}$$

Radioactivity is significantly above background if net CPM is 24 CPM or greater. These points circled on data summary.

G. Data Summary

LOCATION	SAMPLE DESIGNATION	1ST CPM	2ND CPM	$\overline{X}$ CPM	NET CPM	Th-232 MICROCURIES
Pit 8	0° TOP	12	13	13	0	$\leq 2.6 \times 10^{-4}$
Pit 8	0° MID	16		16	4	$\leq 2.6 \times 10^{-4}$
Pit 8	0° BOT	11	17	14	1	$\leq 2.6 \times 10^{-4}$
Pit 8	90° TOP	11	30	21	8	$\leq 2.6 \times 10^{-4}$
Pit 8	90° MID	9	10	10	0	$\leq 2.6 \times 10^{-4}$
Pit 8	90° BOT	13	11	12	0	$\leq 2.6 \times 10^{-4}$
Pit 8	180° TOP	8	12	10	0	$\leq 2.6 \times 10^{-4}$
Pit 8	180° MID	13	15	14	1	$\leq 2.6 \times 10^{-4}$
Pit 8	180° BOT	7	11	9	0	$\leq 2.6 \times 10^{-4}$
Pit 8	270° TOP	6	15	11	0	$\leq 2.6 \times 10^{-4}$
Pit 8	270° MID	13	8	11	0	$\leq 2.6 \times 10^{-4}$
Pit 8	270° BOT	11	7	9	0	$\leq 2.6 \times 10^{-4}$
Pit 8	Center of Floor	9	12	11	0	$\leq 2.6 \times 10^{-4}$

Continued.

LOCATION	SAMPLE DESIGNATION	1ST CPM	2ND CPM	$\bar{X}$ CPM	NET CPM	Th-232 MICROCURIES
Pile	Loose Dirt (LD) Edge 0°	137	138	138	125	1.4×10^{-3}
Pile	Loose Dirt Edge 60°	34	30	32	19	$\leq 2.6 \times 10^{-4}$
Pile	Loose Dirt Edge 120°	51	59	55	42	4.6×10^{-4}
Pile	Loose Dirt Edge 180°	22	15	19	6	$\leq 2.6 \times 10^{-4}$
Pile	Loose Dirt Edge 240°	46	28	37	24	2.6×10^{-4}
Pile	Loose Dirt Edge 360°	10	10	10	0	$\leq 2.6 \times 10^{-4}$
Pile	LD Center Top	20	24	22	9	2.6×10^{-4}
Pile	LD Center Middle	38	40	39	26	2.8×10^{-4}
Pile	LD Center Bottom	26	19	23	10	$\leq 2.6 \times 10^{-4}$
Pile	B1-2 90° BOT	13	13	13	0	$\leq 2.6 \times 10^{-4}$
Pile	B1-2 90° MID	11	12	12	0	$\leq 2.6 \times 10^{-4}$
Pile	B1-2 90° TOP	12	11	12	0	$\leq 2.6 \times 10^{-4}$
Pile	B1-2 90° BOT	13	16	15	2	$\leq 2.6 \times 10^{-4}$
Pile	B1-2 90° MID	9	11	10	0	$\leq 2.6 \times 10^{-4}$
Pile	B1-2 0° TOP	11	18	15	2	$\leq 2.6 \times 10^{-4}$
Pile	B1-2 180° TOP	12	6	9	0	$\leq 2.6 \times 10^{-4}$
Pile	B1-2 180° MID	6	19	13	0	$\leq 2.6 \times 10^{-4}$
Pile	B1-2 180° BOT	9	16	13	0	$\leq 2.6 \times 10^{-4}$
Pile	B1-2 270° TOP	10	17	14	1	$\leq 2.6 \times 10^{-4}$
Pile	B1-2 270° MID	13	11	12	0	$\leq 2.6 \times 10^{-4}$
Pile	B1-2 270° BOT	13	10	12	0	$\leq 2.6 \times 10^{-4}$
Pit	B1-2 Residue from Hole	51	67	59	46	5.0×10^{-4}
Pile	B1-2 Loose Dirt Edge 0°	7	12	10	0	$\leq 2.6 \times 10^{-4}$
Pile	B1-2 Loose Dirt Edge 60°	9	10	10	0	$\leq 2.6 \times 10^{-4}$
Pile	B1-2 Loose Dirt Edge 120°	12	18	15	2	$\leq 2.6 \times 10^{-4}$
Pile	B1-2 Loose Dirt Edge 180°	9	5	7	0	$\leq 2.6 \times 10^{-4}$
Pile	B1-2 Loose Dirt Edge 240°	12	12	12	0	$\leq 2.6 \times 10^{-4}$
Pile	B1-2 Loose Dirt Edge 360°	11	8	10	0	$\leq 2.6 \times 10^{-4}$
Pile	B1-2 Loose Dirt Ctr TOP	16	12	14	1	$\leq 2.6 \times 10^{-4}$
Pile	B1-2 Loose Dirt Ctr MID	11	20	16	3	$\leq 2.6 \times 10^{-4}$
Pile	B1-2 Loose Dirt Ctr BOT	8	20	14	1	$\leq 2.6 \times 10^{-4}$

III. Disposal Site Release Sequence

Based on the assay of the 10 gram soil samples, the Health Physicist of RASO and the Radiation Safety Officer of NAVWPNSUPPCEN Crane agreed on a sequence of events that would enable the disposal site to be released for unrestricted use with regard to radioactive contamination considerations. The disposal site release sequence is outlined as follows:

A. Remove all contaminated soil from side walls and floors of holes B1-B2 and 8 and place in D.O.T. 17H shipping barrels for disposal at a licensed burial ground for low level, radioactive materials.

B. Sample periodically during soil removal and evaluate samples locally at NAVWPNSUPPCEN Crane using Thorium Nitrate counting standard traceable to EPA intercomparison standard No. 00728 used in RASO's initial assay procedure to insure completeness of contamination removal.

C. Provide representative 100 gram soil samples to RASO for verification of soil cleanliness along the hole walls and floors of holes B1-B2 and 8.

D. Remove all visible contamination from dirt piles excavated from holes B1-B2 and 8 and place in D.O.T. 17H shipping barrels for disposal at a licensed burial ground for low level radioactive materials.

E. Gradually shovel dirt from piles back into the holes. Inspect for and remove all visible contamination uncovered as in Step D.

F. Periodically sample and evaluate dirt from piles as in Step B. to insure cleanliness of replaced dirt.

G. Provide representative 100 gram samples of the dirt piles to RASO for verification of replaced soil cleaniness.

H. Provide RASO with a 100 gram background reference soil sample taken from the near vicinity, but outside of the disposal site.

I. Provide RASO with a 100 gram reference sample of the material still contained within the Thorium Nitrate containers removed from the disposal sites.

J. Prepare a survey report for permanent retention files of RASO and NAVWPNSUPPCEN Crane that will provide release certification so the disposal site can be released for radiologically unrestricted use.

IV. Disposal Site Radioactive Material Contamination Clean Up Operations

On 6 October 1980, clean up of the Thorium Nitrate disposal site was commenced under the direction of the NAVWPNSUPPCEN Crane Radiation Safety Officer, and the personal supervision of the NAVWPNSUPPCEN Crane Deputy Radiation

Safety Officer. The NAVWPNSUPPCEN Crane mobile disaster preparedness van with 110 volt generation capability was moved to the disposal site. The van was equipped with the Industrial Hygiene Laboratory's scintillation counter and detector as described in Section 1 along with a laboratory balance. The scintillation counter was activated and stabilized at the start of each day's operation and after each break. Operations were completed on 8 October 1980. Background readings, with an empty sample bottle in the lead shield, were taken at the start of each day and several times during the day to insure proper operation of the scintillation counter. Background readings of 10-15 counts per minute were consistantly obtained using a 2-minute counting cycle. The clean up operation including sample analysis data is summarized as follows:

A. A 100 gram reference background soil sample was taken from outside the disposal area adjacent to the fence that delineated the outer perimeter of the Chemical Burial Ground. Sample readings from this sample taken on side, with a 2-minute counting cycle showed the following counts: 16 CPM, 25 CPM and 16 CPM respectively. This sample was forwarded to RASO for verification.

B. A 100 gram sample of the material still in the canisters removed from the disposal site was taken and analyzed on site using a 2-minute counting cycle. One reading obtained from this material was 210 CPM. This sample was forwarded to RASO for verification.

C. Several clean up/sample cycles were performed in order to remove the contamination from the walls and floor of hole B1-B2, after the hole was thoroughly cleaned of any contamination as determined by the aforementioned Eberline RM-3-C3 survey meter and its attendant probe. One hundred gram soil samples were taken and analyzed on site using a 2-minute counting cycle. These samples read as follows:

North Wall (0°)	- 25 CPM
East Wall (90°)	- 18 CPM
South Wall (180°)	- 24 CPM
West Wall (270°)	- 9 CPM
Floor where Residue was Found	- 15 CPM

All samples were submitted to RASO for verification. All sweeps of the survey meter and samples were randomly taken in gridded areas of less than 1 square meter.

D. The dirt pile from hole B1-B2 was marked off in 14 1-foot increments using stakes and rope. Each increment was examined visually and by survey

meter and sampled before it was returned to the hole. Some contamination was found in Increment No. 13. This contamination was removed and placed in shipping barrels. Analysis of these samples using 2-minute counting cycle are listed as follows. Samples retained for submission to RASO are indicated.

INCREMENT NO.	SAMPLE	COUNTS PER MINUTE
1 (west end of pile)	1	17
	2	21
	3	15
2	1	15 (retained)
	2	17
3	1	16
	2	20
4	1	20
	2	14
5	1	22
	2	15
6	1	14 (retained)
	2	17
7	1	23
	2	12
8	1	14
	2	14
9	1	13
	2	16
10	1	12 (retained)
	2	12
11	1	12
	2	12
12	1	11
13	1	30 (indicated need for clean up)
	1	11 (retained)
14 (East End of Pile)	1	17 (retained)

E. Hole No. 8 was cleaned and sampled using the same procedures as described for hole B1-B2. The following Samples taken after the hole was determined clean were analyzed on site using a 2-minute counting cycle. The results of this analysis are listed below:

North Wall	(0°)	- 16 CPM
East Wall	(90°)	- 12 CPM
South Wall	(180°)	- 11 CPM
West Wall	(270°)	- 13 CPM
Floor		- 14 CPM

All these samples were submitted to RASO for verification.

F. The dirt pile associated with hole 8 had the contamination so evenly dispersed throughout that the whole pile was placed in shipping barrels for disposal. No samples were retained or submitted to RASO.

G. At the conclusion of the clean up operations, 14 barrels containing Thorium Nitrate canisters and/or contaminated soil remained for disposal. A 100 gram contaminated soil sample, believed by NAVWPNSUPPCEN Crane personnel to be representative of the material removed from the disposal site, was taken from barrel 6. On-site analysis of this sample using 2-minute counting cycles, revealed 63 CPM and 71 CPM respectively. This sample was submitted to RASO for comparison.

V. <u>RASO Soil Analysis Summary of 100 Gram Soil Samples Submitted by NAVWPNSUPPCEN Crane on 14 October</u>

The Radiation Safety Officer submitted 20 soil samples to RASO for analysis and verification of disposal site cleanliness so the site could be released radiologically for unrestricted use. The RASO assay procedure and data are summarized as follows:

A. Counting Equipment

NMC Model DS-2 decade scaler
Technical associates lead shield with TGM type N1005 GM
Tube 127; 1.4 - 2.0 mg/cm^2 window
System calibrated 25 September 1980
Special calibration 14 October 1980

B. Special Calibration

The calibration standard was an EPA intercomparison standard (S.N. 0072B) containing 10.0 grams of diluted monazite ore. The stated radioactivity

concentration was 150 + 12 picocuries per gram on 14 May 1976. The standard was supplied in a glass scintillation vial. (natural Thorium)

A 10 gram aliquot of NAVWPNSUPPCEN Crane sample "B1-B2 pure mix" soil (RASO No. X02) was placed in a glass scintillation vial. Both the EPA standard and reference soil were counted with the same geometry, with the following results:

EPA #00728	636 counts/15 minutes	St. Dev. = 2.8 CPM
NAVWPNSUPPCEN mix	1149 counts/15 minutes	St. Dev. = 5.1 CPM
Background	190 counts/10 minutes	St. Dev. = 1.9 CPM

Net count rates were:

EPA #00728	23.4 + 3.4 CPM	RSD = 0.145
NAVWPNSUPPCEN mix	57.6 + 5.4 CPM	RSD = 0.0938

The radioactivity concentration of Thorium (equivalent) in NAVWPNSUPPCEN Crane pure mix soil was calculated as follows:

$$\text{EPA STD PCi/G} \times \frac{\text{NAVWPNSUPPCEN pure mix}}{\text{EPA STD NCPM}}$$

$$150 + 12 \text{ PCi/G} \times \frac{57.6 + 5.3 \text{ NCPM}}{23.4 + 3.4 \text{ NCPM}} = \underline{369 + 70 \text{ PCi/G}} \qquad \text{RSD} = 0.190$$

C. Soil Analysis

Each of 20 soil samples was counted in the plastic containers supplied by NAVWPNSUPPCEN Crane. Each container contained 100 grams of soil at ambient moisture content. The pure mix soil was counted before removing the aliquot.

The background count rate subtracted from soil sample count rates and used for critical level calculations was that obtained from a 60-minute count of NAVWPNSUPPCEN Crane reference soil. This was collected from an adjacent uncontaminated area and was the same soil type as those in the disposal area.

A confidence level of 99% (single tail) was used to calculate the critical level. Based on a 60-minute background count and 30-minute sample counts, the critical level was:

$$L_C = (2.33)\sqrt{\frac{21.3 \text{ CPM}}{60} + \frac{21.3 \text{ CPM}}{30}} = 2.4 \text{ CPM}$$

This count rate was equivalent to 5.1 picocuries per gram, Thorium equivalent.

D. Data Summary

SAMPLE DESCRIPTION	GROSS COUNTS	GROSS CPM	NET CPM	RADIOACTIVITY CONCENTRATION pCi/g
Background reference soil	1279	21		
Pure mix from cannisters B1-B2	5879	196	175	369
Hole 8 pile south 180 (in drum)	1290	43	22	46
Sample from BBL 6	4273	142	121	256
Dirt Pile B1-B2 Face Increment 2	623	21	0	≤5
Dirt Pile B1-B2 Face Increment 6	627	21	0	≤5
Dirt Pile B1-B2 Face Increment 10	593	20	0	≤5
Dirt Pile B1-B2 Face Increment 12	649	22	0	≤5
Dirt Pile B1-B2 Face Increment 13	620	21	0	≤5
Dirt Pile B1-B2 Face Increment 14	694	23	2	≤5
Hole 8 bottom	622	21	0	≤5
Hole 8 wall 0°	641	21	0	≤5
Hole 8 wall 90°	673	22	1	≤5
Hole 8 wall 180°	615	21	0	≤5
Hole 8 wall 270°	602	20	0	≤5
Hole B1-B2 north wall 0°	622	21	0	≤5
Hole B1-B2 east wall 90°	648	22	0	≤5
Hole B1-B2 south wall 180°	638	21	0	≤5
Hole B1-B2 west wall 270°	648	22	0	≤5
Hole B1-B2 bottom after cleaning	689	23	2	≤5

IV. Final Criteria for Release to Unrestricted Use

The goal of the clean-up effort was to demonstrate that no detectable radioactivity above the ambient (background) soil level, at a 99% confidence level, remains at the disposal sites. Based on the analysis of the soil samples performed at NAVWPNSUPPCEN Crane, and verified by RASO, it is the consideration of the authors of this report that the clean-up goal was achieved; and that the Thorium Nitrate disposal sites located at NAVWPNSUPPCEN Crane can be released for radiologically unrestricted use.

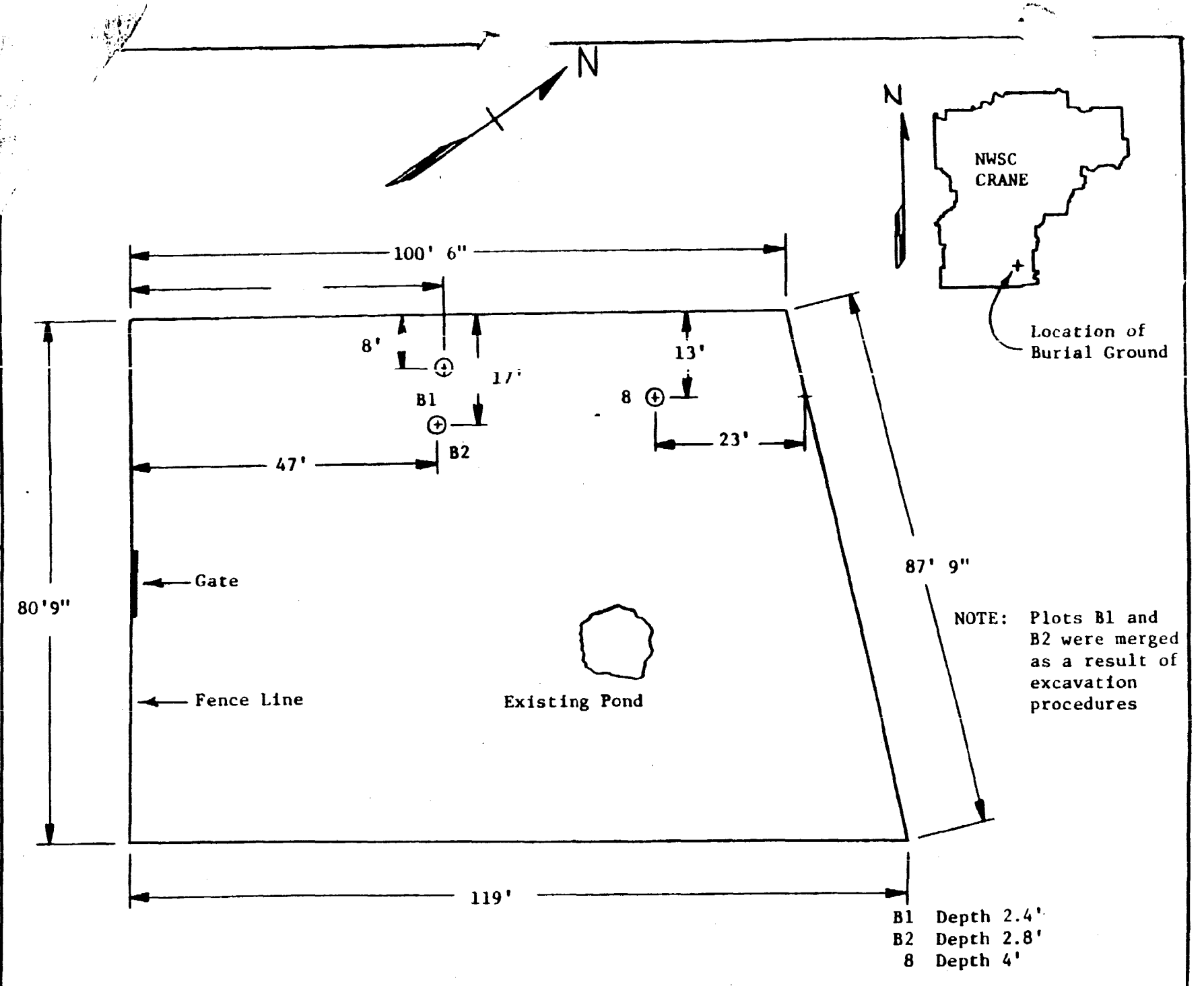

FIGURE 1. Thorium Nitrate Disposal Sites with Respect to Chemical Burial Ground Located at NWSC Crane

DATE

SKETCH NO.