US Army Corps
of Engineers
Louisville District

FINAL SAMPLING AND ANALYSIS PLAN ADDENDUM

For the

EXPOSED SOIL SAMPLING AND CHARACTERIZATION

After

SLAB AND FOUNDATION REMOVALS AT LOAD LINES 5, 7, 8, 10

Ravenna Army Ammunition Plant,
Ravenna, Ohio

9 July 2007

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AOC	Area of concern
bgs	Below ground surface
BRACO	Base Realignment and Closure Office
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPC	Contaminant of potential concern
CSM	Conceptual site model
DOT	Department of Transportation
DQO	Data quality objective
EPA	U.S. Environmental Protection Agency
ERA	Ecological risk assessment
FSA	Field Staging Area
HHRC	Human health risk characterization
IDW	Investigation-derived waste
NGB	National Guard Bureau
OAC	Ohio Administrative Code
OE	Ordnance and explosives
OHARNG	Ohio Army National Guard
Ohio EPA	Ohio Environmental Protection Agency
OVA	Organic vapor analyzer
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PID	Photoionization detector
PPE	Personal protective equipment
PRG	Preliminary remediation goal
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
RI	Remedial Investigation
RVAAP	Ravenna Army Ammunition Plant
SAP	Sampling and Analysis Plan
SRC	Site-related contaminant
SSHP	Site Safety and Health Plan
SVOC	Semivolatile organic compound
TAL	Target analyte list
TNT	Trinitrotoluene
USACE	U.S. Army Corps of Engineers
USCS	Unified Soil Classification System
VOC	Volatile organic compound
WBG	Winklepeck Burning Grounds

1.0 PART I – FIELD SAMPLING PLAN

1.1 PROJECT DESCRIPTION

1.1.1 Introduction

Previously under a contract to the Base Realignment and Closure Office (BRACO), demolition and removal of buildings, including removal of slabs and foundations, was done at Load Lines 5, 7, 8, and 10. As per that contract, the BRACO contractor surveyed the corners of the buildings in Ohio State Plane coordinates, and also left green metal (drive) fence posts at the corners of all demolished buildings. A figure along with locations of these corners will be provided as Attachment A. Upon removal of the floor slabs and foundations, the BRACO contractor regraded the surface of the bare earth below the slabs to drain and seeded those areas. There was no fill dirt or materials placed over the areas where the floor slabs were removed. The investigation discussed in this addendum is being conducted to evaluate the nature and extent of potential contamination in the surface soil from previous manufacturing operations in the surface soil under the slabs at these AOCs. Subsurface sampling beneath the former floor slab areas and adjacent to foundations will be conducted in a future study.

This Sampling and Analysis Plan (SAP) Addendum includes the sampling and analysis objectives, rationales, planned activities, and criteria specific to the soil investigations at Load Lines 5, 7, 8, and 10. Where appropriate, the SAP Addendum contains references to the Final Facility-Wide Sampling and Analysis Plan for the Ravenna Army Ammunition Plant (FWSAP), March 2001, for standard procedures and protocols.

Both the FWSAP and this SAP Addendum have been developed following the U.S. Army Corps of Engineers (USACE) guidance document " Requirements for the Preparation of Sampling and Analysis Plans", EM200-1-3, September 1994 (USACE 1994a), to collectively meet the requirements established by the Ohio Environmental Protection Agency (Ohio EPA), Northeast District, and the U.S. Environmental Protection Agency (EPA), Region 5, for conducting Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) investigations.

A project-specific quality assurance project plan (QAPP) is included as part II of this sampling and analysis plan addendum.

A project-specific site safety and health plan will be prepared per the Facility-Wide Safety and Health Plan and provided as Attachment C.

1.1.2 History and Contaminants

The Ravenna Army Ammunition Plant (RVAAP) is located in northeastern Ohio in Portage and Trumbull counties and lies about 4.8 km (3 miles) east northeast of the city Ravenna, Ohio (Figure 1-1). Operations at the facility began in September 1941 and included the storage, handling, and packing of military ammunition and explosives. The facility encompasses 8,775 ha (21,683 acres) and is jointly operated by the Base Realignment and Closure Office (BRACO) of the U.S. Army and National Guard Bureau. The BRACO controls environmental areas of concern (AOCs) and active mission areas. A detailed history of process operations and waste disposal processes for each AOC at RVAAP (Figure 1-2) is presented in the Preliminary Assessment for the Ravenna Army Ammunition Plant, Ravenna, Ohio (USACE 1996).

Load Lines 5, 7, 8, and 10 are located in an area known as Fuze and Booster Hill, which is in the south central part of RVAAP (Figure 1-2).

1.1.3 Summary of Existing Data

The following assessments and evaluations have been conducted at Load Lines 5, 7, 8, & 10:

- Installation Assessment of Ravenna Army Ammunition Plant (USATHMA 1978);

- Preliminary Review and Visual Site Inspection conducted as a part of Resource Conservation and Recovery Act (RCRA) Facility Assessment conducted by the USEPA. (Jacobs 9 Engineering Group, Inc. 1989);

- Preliminary Assessment Screening of the Boundary Load Line Areas (USAEHA 1994);

- Relative Risk Site Evaluation for Newly Added Sites at the Ravenna Army Ammunition Plant (USACHPPM 1998);

- Final Report of the Characterization of 14 RVAAP AOCs, RVAAP, Ohio, March 2007, MKM Engineers, Inc.; and

- Hazardous and Medical Waste Study No. 37-EF-5360-99, Relative Risk Site Evaluation for Newly Added Sites at the Ravenna Army Ammunition Plant, Ravenna, Ohio 10-23 October 1998.

Discussions of the environmental contamination at Load Lines 5, 7, 8, and 10 determined in the 14 RVAAP AOCs Characterization, GSA Contract No. GS-10F-0542N, Order W912QR-04-F-0161, are provided in Volume II-B (LL 5 and 7) and Volume II-C (LL 8 and 10) of the Final report for that investigation.

1.1.4 Specific Sampling and Analysis Problems

Even though the buildings have been removed from each of the load lines, some habitat exists for wildlife that represents potential biological hazards (e.g., snakes, ground spiders, chiggers, etc) during the planned field activities. Also, the high deer population at RVAAP and vegetation overgrowth can result in a high tick population. Per the Final Facility-Wide Safety and Health Plan for Environmental Investigations at RVAAP, March 2001, all sampling personnel will be advised specifically of biological hazards and pertinent preventive measures.

1.2 PROJECT ORGANIZATION AND RESPONSIBILITIES

The project organization and responsibilities are presented in Figure 2-1. The functional responsibilities of all key personnel, except the Field Logistics and Investigation-Derived Waste (IDW) Coordinator, are described in Section 2.0 of the FWSAP and, therefore, are not repeated here. Field sampling is scheduled to occur in early August 2007.

The Site and Sample Managers will coordinate operational logistics such as supplies, rentals, deliveries, sample packaging and shipping, and IDW management.

The sampling technician position will have specific responsibilities for labeling all samples, preparing the Chain of Custody, preparing the samples for shipment, and coordinating the shipping of all samples with the sample manager.

The Site Manager will coordinate disposal of all IDW generated under the project. The Site Manager may designate a sampling team member that will conduct an IDW management quality assurance (QA) and compliance review at the conclusion of each field project to ensure all containers are accounted for and properly labeled and staged pending characterization and disposal. The designated sampling team member or the Site Manager will work, in conjunction with the Project Manager, to prepare IDW characterization reports and to ensure proper disposition of IDW upon receipt of characterization results.

1.3 SCOPE AND OBJECTIVES

1.3.1 Sub-floor Sampling Scope and Objectives

The scope of this investigation is to assess the extent of potential contamination in the exposed surface soil from the removal of the slabs for the razed buildings in Load Lines 5, 7, 8, and 10. The primary objectives of the under the slab investigation are as follows:

- Conduct surface soil sampling using multi-increment field sampling to determine if manufacturing operations at the load lines have impacted the surface soil beneath the building slabs;

- Assess the acquired data to determine if any data gaps exist with respect to sources and extent of surface soil contamination.

- Provide recommendations for any additional investigations and/or actions.

Investigation-specific objectives have been developed using the data quality objectives (DQO) approach presented in the FWSAP. Project-specific sampling objectives are presented for surface soil in this SAP Addendum.

1.3.2 Data Quality Objectives

The project DQO is to provide sufficient high-quality data to address the primary project objectives identified in Section 3.1.

1.3.2.1 Conceptual Site Model (CSM)

The facility-wide CSM for RVAAP, presented in the FWSAP, is applicable to each of the load lines for this investigation, based on current knowledge. The CSM for these lines, although based on the compilation of previously collected data, may be limited due to the nature of the operations conducted at each of these lines.

A summary of each of the load line operations is presented in the Final Report of the Characterization of Load Lines 5, 7, 8, and 10, GSA Contract No. GS-10F-0542N, Order W912QR-04-F-0161, dated March 2007, and has been used in the design of the surface soil investigation to be conducted herein. It is expected that surface soil contamination is limited due to the nature of the operations conducted at each of these lines.

Uncertainties within the CSM for Load Lines 5, 7, 8, and 10 are for the most part minimal. The production activities at each of the lines are documented in the archives.

1.3.2.2 Problem Definition

Surface soil data have not been collected under the slabs or in the proximity of the foundations of buildings at Load Lines 5, 7, 8, and 10 during previous investigations, and collection of sufficient data is required for these AOCs in order to further characterize these areas for presence of manufacturing related contamination.

1.3.2.3 Remedial Action Objectives

Section 3.2.3 of the FWSAP describes the process for identifying remedial action objectives for RVAAP under the CERCLA process.

1.3.2.4 Identify Decisions

The key decisions for all investigations at RVAAP have been identified in Section 3.2.4 in Table 3-1 of the FWSAP.

1.3.2.5 Define the Study Boundaries

The investigation areas for Load Lines 5, 7, 8, and 10 are presented in Figures 4-1 through 4-4. These areas were established by the USACE team during the previous scoping process and encompass all known or suspected historical operations areas and adjacent support areas.

1.3.2.6 Identify Decision Rules

Decision rules used to guide remediation decisions are provided in Section 3.2.6 of the FWSAP. Since no soil data exists to define the nature and extent of contamination in the exposed surface soil, risk of exposure to contaminants if any has not been ascertained. The purpose of the investigation is to determine the presence, type, concentration, and extent of contamination in surface soil. These data will be used to identify areas where additional characterization may be needed.

1.3.2.7 Identify Inputs to the Decisions

Inputs to the decision process are the analytical results and the refined AOC-specific conceptual model developed from field observations and environmental data.

1.3.2.8 Specify Limits on Decision Error

Limits on decision errors are addressed in Section 3.2.8 of the FWSAP.

1.3.2.9 Sample Design

The rationale for sampling of surface soils and the sampling design for the investigation of exposed soils after slab/foundation removal from razed buildings at the specified load lines are described in detail in Chapter 4.0 of this AOC-specific SAP Addendum. Appendix A provides a summary table of the proposed sampling for the potentially contaminated areas.

1.3.3 DATA EVALUATION METHODS

The methods for identifying site related chemicals (SRCs) related to past AOC operations are described in the following sections. The data evaluation methods to be employed for the load line investigations are consistent with those established under previous Phase I and Phase II Remedial Investigations (RIs) at RVAAP.

Analytical results will be screened against the facility-wide surface soil background values for RVAAP developed as part of the Phase II RI for the Winklepeck Burning Grounds (WBG) (USACE 2001c). These facility-wide background criteria and the processes used to generate them have been reviewed and accepted by USACE and Ohio EPA. This screening step will be used to determine if detected metals are SRCs or if they are naturally occurring. Discussion of this process is contained in Paragraphs 3.4 and 3.5 of "RVAAP's Facility Wide Human Health Risk Assessor Manual", 2004.

Alternatively, if the clean-up goals for the proposed future uses of Load Lines 5, 7, 8, and 10 are established prior to finalization of the report discussing the results of the sampling described herein, the measured concentrations of constituents in the surface soils in the former building areas will be compared directly to those clean-up goals for surface soils and dry sediment.

1.3.3.1 Definition of Aggregates

Data collected from Load Lines 5, 7, 8, and 10 will be aggregated by environmental medium (i.e. - surface soil,). Soil data will be aggregated by depth interval [i.e. - surface soil from 0 to 0.3 m (0 to 1 ft) below ground surface (bgs)].

1.3.3.2 Data Screening

Data screening prior to the preliminary evaluation will consist of four steps: (1) data quality assessment, (2) frequency of detection screen, (3) background screening, and (4) screening of essential human nutrients. These screens will be used to identify SRCs.

A detailed assessment of the quality of the investigation analytical results will take place. Data that are rejected as a result of the data quality assessment will not be evaluated further in the screening process.

1.4 FIELD ACTIVITIES

In order to organize and track sampling efforts for Load Lines 5, 7, 8, and 10 for the exposed surface soils after slab removals, a summary of the number of sampling locations, and sampling rationales, was developed for reference during field operations. The selection of these locations for multi-increment surface soil sampling is based on the project DQOs and the CSM. The sampling locations planned for the exposed soil after the slab removal investigations are shown on Figures 4-1 through 4-4. Tables 4-(1, 2, 3, 4) provide detailed listings of the proposed sampling locations of surface soils. Appendix A contains a summary of planned sampling activities of surface soil, inclusive of QA and QC samples.

1.4.1 Geophysics

Not used.

1.4.2 Soil Gas Survey

Not used.

1.4.3 Groundwater

Not used.

1.4.4 Sub-surface Soil

1.4.5 Surface Soil

1.4.5.1 Rationales

Surface soil sampling will employ multi-increment field sampling to provide characterization of the exposed soils after the removal of the slabs and in the proximity of the foundations of each of the razed buildings at Load Lines 5, 7, 8, and 10, except at those buildings thought to have negligible potential for residual contamination. The buildings thought to have negligible potential for residual contamination, and therefore not sampled, include the time clock houses, change houses, inert storage, ice houses, shipping, and boiler buildings. These buildings are outside the main production operations and were utilized in support of the production conducted at the load lines. Surface soil field samples from 0.0 to 0.3 m (0 to 1 ft) will be collected from a minimum of 30 discrete sample locations at each sample area during the investigation to assess contaminant occurrence and distribution, if any, in surface soil within the exposed soil. All samples will be analyzed for explosives and TAL metals. Additionally, approximately 15% of the total number of multi-increment field samples will be analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polychlorinated biphenyl compounds (PCBs), pesticides, and propellants. Also at those locations where historical information indicates a potential, the multi-incremental samples will be analyzed for nitrates and/or chlorates.

For the purposes of multi-increment field sampling, one sample will be taken from a designated area for every 10,000 sq. ft. or less, which ever is the case. One multi-increment field sample that is aggregated from at least 30 aliquots will be collected from each of the designated sample areas.

1.4.5.2 Composite Soil Sampling Requirements - Multi-increment Samples

Surface soil multi-increment field samples are aggregated samples collected from multiple stratified random locations within each of the designated sample areas. The sample aliquots are collected using a small-diameter (7/8" inside diameter) step probe; thus, the corresponding volume for each aliquot is small. As per the surface soil criterion at RVAAP, the individual aliquots will be obtained by pushing the step probe sampler from 0 – 12" in depth. A sufficient number of aliquots are collected to provide a representative, repeatable approximation of the average concentration of a particular constituent within a designated area. For an approximate 0.25-acre area (exposure unit), approximately 10,000 sq. ft., no less than 30 aliquots will be collected.

The entire volume of all aliquots is aggregated into a single field sample. That entire sample is then forwarded to a fixed-base laboratory where laboratory sample preparation, consisting of air-drying, sieving, and grinding will be done to provide a small representative sample suitable for chemical analysis. The standard operating procedure (SOP) for laboratory drying and particle size reduction of the sample is provided in Appendix B and is reference in Section 7.1 of the QAPP. Additionally, procedures for maintaining security of the samples at the analytical laboratory at included as Appendix C. Discrete samples will be collected in sample areas where the subsequent analysis is for VOCs.

1.4.5.3 Sample Collection for Field and Laboratory Analysis

The locations where discrete samples are collected for VOCs analyses will be based on knowledge of the past production procedures. For safety purposes, field screening of surface soil discrete samples for organic vapors will be performed using a photo-ionization detector (PID) per Section 4.3.2.3 of the Facility-wide SAP; samples for headspace analyses will not be collected. Organic vapor screening will not be conducted at multi-increment surface sampling points. For discrete sample locations, organic vapor screening will be performed at the time of sampling. Surface sample aliquots for laboratory will be collected as discussed in Section 4.5.2 of the FWSAP.

1.4.5.4 Quality Control Procedures

1.4.5.4.1 Field QC

At a rate of approximate 1 in 10, duplicate, 30-increment multi-increment field samples, designated MI QA, will be collected to appraise the repeatability of the field collection process.

Evaluation of the field quality control will be performed by comparing the analytical results of the primary MI sample to those of the MI QA sample. The laboratory QC/QA procedures described below will be conducted on the primary MI samples for which a field duplicate MI QA sample is collected.

1.4..5.4.2 Laboratory QC

The 30-increment multi-increment field soil samples will be brought to the sample building, Building 1036, put in a refrigerator, and shipped with ice to the primary off-site laboratory, STL North Canton, OH. At the primary off-site laboratory, the entire sample will be refrigerated until it is air-dried, sieved, and ground. The primary lab will conduct its QC analysis on a representative split of the processed primary sample, and the QA laboratory, one different from the Primary Laboratory, will analyze a representative split of the primary processed sample.

Matrix spike/matrix spike duplicate samples will be collected at a rate of 5% of total samples per media. Duplicate and split samples will be derived from the same sampling station, selected on a random basis, and submitted for the same analyses as the environmental samples. Two rinsate blanks will be collected for surface soil equipment per field cycle. Trip blanks will accompany all shipments containing VOCs, and temperature blanks will be added to all coolers. Chapter 5.0 and the QAPP Addendum (Chapter 8.0) summarize QA/QC sampling requirements.

1.4.5.5 Sampling Methods for Soil

MI surface soil samples will be collected in accordance with the procedures presented in Appendix D. The following procedures will be used:

- The GPS coordinates of corners of razed buildings where soil samples are to taken will be provided by the BRACO contractor who performed the building demolitions.

- The corners of razed buildings where sampling is to occur will be located and staked in the field.

- Within the sampling boundaries, 30 sampling points will be located in a stratified random pattern described in Attachment 2.

- Surface vegetation and roots will be scraped aside or removed.

- Using a stainless steel soil step probe or paint-free mattock, an aliquot of soil will be collected at each of the 30 sampling points.

- The thirty aliquots will be placed into a plastic-lined bucket. The 30 aliquots will be combined to make one MI sample.

- The plastic liner will be closed, labeled and delivered to Building 1036 for storage in a refrigerator and subsequently shipped to the primary laboratory where the sample will be processed.

1.4.5.6 Field Measurement Procedures and Criteria

Field determinations of explosives will not be conducted during the investigation. For the selections of discrete sample locations for VOC analysis, organic vapor screening will follow Section 4.5.2.3 of the Facility-wide SAP, with the following exception. Headspace gases will not be collected and screened in the field for organic vapors. All organic vapor analyzer (OVA) readings will be noted in the field boring logs.

Procedures for discrete sampling surface soil for chemical analyses are presented in Section 4.5.2.1 of the Facility-wide SAP.

Multi-increment samples will not be analyzed for VOCs. The following chemical analyses will be conducted for multi-increment surface soil samples:

- Multi-increment samples will be analyzed for explosives including PETN, NG and NC, TAL metals, chlorate, nitrate, SVOCs, Herbicides and Pesticides. The samples to be analyzed for SVOC, Herbicides and Pesticides are defined in Tables 4-1 through 4-4.

The following chemical analyses will be conducted for discrete surface soil samples:

- Discrete samples will be analyzed for VOCs only.

The selection of future sub-surface samples will be guided by, among other factors, the results of the surface soil analytical results. Tables 4-1 through 4-4 in Appendix A contain additional detailed information regarding analytical requirements. Requirements for sample containers and preservation techniques for surface samples are presented in Section 4.4.2.6 of the FWSAP and in the quality assurance project plan (QAPP) Addendum.

1.4.6 Decontamination Procedures

The decontamination procedure for soil sampling activities is presented in Section 4.4.2.8 of the FWSAP. A final decontamination inspection of any equipment leaving RVAAP at the end of field activities will be conducted to ensure proper decontamination.

1.4.7 Sample Container / Preservation Techniques

Sample container and preservation technique requirements will follow those prescribed in Table 4-5 in the exposed soil investigation QAPP Addendum.

1.4.8 Site Survey

Following sampling activities, the horizontal coordinates of all discrete soil sampling locations will be determined to within 0.3 m (1 ft). For discrete soil sampling locations, the surface elevations will be determined at the point of collection to within 0.2 ft. GPS or survey coordinates of the razed building corners established by the decon/demo contractors will be used to establish the MI sample areas.

All locations will be conveyed in Ohio State Plane Coordinates (NAD83). The vertical datum for all elevations will be 1929 National Geodetic Vertical Datum. In addition, electronic results will be provided to USACE and RVAAP in ASCII format.

1.4.9 OE Anomaly Avoidance

The OE (ordnance explosive) Contractor previously assessed the area during the removal of the slabs at each of the four Load Lines. No UXO (unexploded ordnance) was detected at LL 5, LL 7, LL8, and LL 10. Therefore, no UXOs surveys or anomaly avoidance are required for the sampling of surface soils described in the following sections. Details of the initial survey methods may be found in the FWSAP (Section 4).

1.5 SAMPLE CHAIN OF CUSTODY / DOCUMENTATION

1.5.1 Field Book

All field logbook information will follow structures identified in Section 5.1 of the FWSAP.

1.5.2 Photographs

Information regarding the documentation of photographs for the investigation is presented in Section 5.2 of the FWSAP. Representative photographs will be taken of the investigative measures and any significant observations that are made during the field effort.

1.5.3 Sample Numbering System

The sample numbering system that will be used to identify samples collected during the investigation is explained in Section 5.3 of the FWSAP. Samples have previously been collected at each of the load lines; therefore, sample numbering will continue the sequence established in the previous investigation. Tables 5-1 through 5-4 define the baseline sample identification listing for the soil investigation. Samples collected in addition to the baseline set will be identified sequentially by following the numbering system. If a sample in the baseline set is not collected or is reassigned to another location, a specific reason and notation will be given in the project field books.

1.5.4 Sample Documentation

All sample label, logbook, field record, and field form information will follow structures identified in Section 5.4 of the FWSAP.

1.5.5 Documentation Procedures

Documentation and tracking of samples and field information will follow the series of steps identified in Section 5.5 of the FWSAP.

1.5.6 Corrections to Documentation

Any corrections to documentation will follow guidance established in Section 5.6 of the FWSAP.

1.6 SAMPLE PACKAGING AND SHIPPING REQUIREMENTS

Packaging and shipping of primary samples shall follow procedures specified in Chapter 6.0 of the FWSAP. Coolers containing QA samples that are shipped to the USACE contract laboratory for independent analysis will also be prepared and shipped in accordance with the FWSAP.

The addresses and points-of-contact for laboratories used for chemical analyses for this field effort are listed in Chapter 2.0 of the QAPP.

1.7 INVESTIGATION- DERIVED WASTE

All IDW, including auger cuttings, personal protective equipment (PPE), disposable sampling equipment, and decontamination fluids, will be properly handled, labeled, characterized, and managed in accordance with Chapter 7.0 of the FWSAP, federal and state of Ohio large-quantity generator requirements, and RVAAP's Installation Hazardous Waste Management Plan.

Three types of IDW are anticipated, which will be contained separately. The types and estimated quantities for each include:

- Soil from various including residual surface soil, resulting from sample collection using hand sampling equipment. One 55-gal drum of soil IDW is anticipated.

- Decontamination fluids, including those derived from decontamination of sampling equipment. One 55-gal drum of decontamination fluid is anticipated from sampling equipment decontamination.

- Expendables/solid wastes, including PPE and disposable sampling equipment. One 55-gal drum of expendable IDW is anticipated.

1.7.1 Investigation-Derived Waste Collection and Containerization

All solid non-indigenous (expendable sampling equipment and trash) IDW will be segregated as non-contaminated and potentially contaminated material. Potentially contaminated and non-contaminated, solid, non-indigenous IDW will be identified in the field on the basis of visual inspection (e.g., soiled versus non-soiled), usage of the waste material (e.g., outer sampling gloves versus glove liners), and field screening of the material using available field instrumentation (e.g., OVA). All non-contaminated, non-indigenous IDW will be contained in trash bags. Potentially contaminated, non-indigenous IDW will be contained in labeled DOT-approved, open-top, 55-gal drums equipped with plastic drum liners and sealed with bung-top lids.

All liquid non-indigenous IDW (e.g., decontamination rinse water) will be segregated by waste stream (e.g., soap and water/water rinses will be separated from methanol and hydrochloric acid rinses) and the waste stream contained in labeled DOT-approved, 55-gal closed-top drums. All known or potentially hazardous liquid, non-indigenous IDW streams, such as methanol or hydrochloric acid rinses, will be contained separately in labeled DOT-approved, closed-top, 55-gal drums.

1.7.2 Waste Container Labeling

All IDW containers will be labeled prior to placing IDW in them. All IDW containers (drums and roll-off boxes) will be labeled in accordance with Section 7.2 of the FWSAP.

1.7.3 Investigation-Derived Waste Field Staging

A field staging area (FSA) will be designated at each load line at the beginning of field activities and approved by the RVAAP Acting Facility Manager. IDW drums or other specified containers will be located at the designated FSA for each load line. A centralized FSA at Building 1036 will be established for the staging of all drums of IDW. The FSA will be managed according to the requirements of Section 7.3 of the FWSAP.

Daily inventories of IDW will be taken and provided to the RVAAP Acting Facility Manager by the designated IDW coordinator. A final inventory will be conducted prior to demobilization from the site and all IDW staged at the FSA at Building 1036. All liquid waste not transported off of the facility within 30 days following project completion will require secondary containment.

1.7.4 Investigation-Derived Waste Characterization and Classification for Disposal

All indigenous IDW (soil) will be characterized for disposal on the basis of analytical results from environmental samples collected from each sampling station. Non-indigenous IDW (decontamination fluids), except for PPE and expendable sampling equipment, will be characterized for disposal on the basis of composite samples collected from segregated waste stream storage containers. Composite waste samples will be submitted for laboratory analysis of full Toxicity Characteristic Leaching Procedure (TCLP) to characterize each waste stream for disposal. Procedures for composite waste sampling are presented in Sections 7.4.1 and 7.4.2 of the FWSAP. PPE and expendable sampling equipment will be managed in accordance with Section 7.4 of the FWSAP.

1.7.5 Investigation-Derived Waste Disposal

Upon approval of IDW classification reports, all solid and liquid IDW will be removed from the site and disposed of by a licensed waste disposal contractor in accordance with Section 7.5 of the FWSAP and all applicable State and Federal rules, laws, and regulations. All shipments of IDW off-site will be coordinated through the RVAAP Environmental Coordinator.

1.8 REFERENCES FOR FIELD SAMPLING - PART I

USACE (U.S. Army Corps of Engineers) 1994a. Requirements for the Preparation of Sampling and Analysis Plans, EM 200-1-3.

USACE (U.S. Army Corps of Engineers) 1996. Preliminary Assessment for the Ravenna Army Ammunition Plant, Ravenna, Ohio.

USACE (U.S. Army Corps of Engineers) 2001a. Facility-Wide Sampling and Analysis Plan for the Ravenna Army Ammunition Plant, Ravenna, Ohio, DACA62-00-D-0001, D.O. CY02, Final, March 2001.

USACE (U.S. Army Corps of Engineers) 2001b. U.S. Army Corps of Engineers, Louisville District Analytical Chemistry Guidelines, Rev. 1.0, January.

USACE (U.S. Army Corps of Engineers) 2001c. Phase II Remedial Investigation Report for the Winklepeck Burning Grounds at the Ravenna Army Ammunition Plant, Ravenna, Ohio, DACA62-94-D0029, D.O. 0060, Final, April.

USACE (U.S. Army Corps of Engineers). 2004. RVAAP's Facility Wide Human Health Risk Assessor Manual, 2004.

USACE (U.S. Army Corps of Engineers) 2007. Characterization of 14 RVAAP AOCs, GSA Contract No. GS-10F-0542N, Order W919QR-04-F-0161, Final March 2007.

2.0 PART II - QUALITY ASSURANCE PROJECT PLAN (QAPP)

LIST OF ACRONYMS / ABBREVIATIONS FOR QAPP - PART II

COC	chain of custody
CX	Center of Expertise
EPA	U.S. Environmental Protection Agency
FSP	Field Sampling Plan
GPL	GPL Laboratories
HTRW	Hazardous, Toxic, and Radioactive Waste
ICP	inductively coupled plasma
LCS	laboratory control sample
MDL	method detection limit
MRL	method reporting level
MS	matrix spike
MSD	matrix spike duplicate
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RI	Remedial Investigation
SAP	Sampling and Analysis Plan
SOP	standard operating procedure
STL	STL Laboratories
USACE	U.S. Army Corps of Engineers

2.1 PROJECT DESCRIPTION

This Quality Assurance Project Plan (QAPP) addendum addresses supplemental project-specific information in relation to the final Facility-Wide QAPP (FWQAPP) for the Ravenna Army Ammunition Plant (USACE 2001b). Each QAPP section is presented documenting adherence to the FWQAPP or stipulating project-specific addendum requirements.

Primary analytical direction for these projects will be obtained from the identified EPA SW-846 Methods; the USACE Shell for Analytical Chemistry Requirements Appendix I, EM200-1-3, (USACE 2001a); and the Louisville Chemistry Guideline, Rev. 5 (USACE 2002).

2.1.1 Site History / Background Information

This information is contained in Section 1.1 of the Field Sampling Plan (FSP) of the Exposed Soil Investigation from Slab/Foundation Removals at Load Lines 5, 7, 8, and 10 Sampling and Analysis Plan (SAP) Addendum.

2.1.2 Past Data Collection Activity / Current Status

This information is contained in Section 1.2 of the FSP of the Exposed Soil Investigation from Slab/Foundation Removals at Load Lines 5, 7, 8, and 10 SAP Addendum.

2.1.3 Project Objectives and Scope

This information is contained in Chapter 3.0 of the FSP of the Exposed Soil Investigation from Slab Removals at Load Lines 5, 7, 8, and 10 SAP Addendum.

2.1.4 Sample Network Design and Rationale

This information is contained in Paragraph 1.4 of the FSP (Part I above). The analytical suites for each of the areas of interested were selected on the basis of operations conducted in the building, and the potential for significant quantities of VOCs, SVOCs, nitrates, chlorates, propellants, and explosives being processed in the buildings or in their proximity. The number of samples for PCBs, Pesticides and Herbicides is pre-set by the FWSAP. Most of these locations were selected randomly, but with the intent of gaining understanding of the potential location where application may have occurred.

2.1.5 Parameters to Be Tested and Frequency

Sample matrix types, analytical parameters, and analytical methods are discussed in Paragraph 1.4 of the FSP (Part I above). These sampling and analysis requirements are summarized in Appendix of the SAP Addendum, in conjunction with anticipated sample numbers, quality assurance (QA) sample frequencies, and field quality control (QC) sample frequencies.

2.1.6 Project Schedule

The exposed soil investigation from slab removals at Load Lines 5, 7, 8, and 10 Sampling and Analysis Plan project schedule is discussed in Chapter 2.0 of the FSP of the SAP Addendum.

2.2 PROJECT ORGANIZATION AND RESPONSIBILITY

The functional project organization and responsibilities are described in Section 2.0 of the Facility-wide SAP and the Exposed Soil Investigation from Slab/Foundation Removals at Load Lines 5, 7, 8, and 10 SAP Addendum. The laboratory will meet the requirements set forth by the Louisville District. The contract laboratories QAPP will be made available for review upon request. The laboratory's organizational structure, roles, and responsibilities will be identified in the contractor's laboratory specific QAPP.

2.3 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT

2.3.1 Data Quality Objectives

The project team shall adhere to the Data Quality Objectives (DQOs) summarized for this investigation in the FSP addendum and will follow Tables 3-1 and 3-2 in the FWQAPP. All QC parameters stated in the specific U.S. Environmental Protection Agency (EPA) SW-846 methods will be adhered to for each chemical listed. The SW-846 method references found in the FWQAPP have been revised to the Update III methods (i.e., 8260A is now 8260B, 8270B is now 8270C, etc.). The selected laboratories are required to comply with all methods as written; recommendations are considered requirements. Concurrence with the USACE Shell for Analytical Chemistry Requirements, Appendix I EM200-1-3 and Louisville Chemistry Guideline, is expected.

2.3.2 Level of Quality Control Effort

The project team shall ensure that all QC efforts will follow Section 3.2 of the Facility-wide QAPP. Field QC measurements will include field source water blanks (or alternatively written documentation that the water meets project requirements), trip blanks, field duplicates, equipment rinsate blanks, and temperature cooler blanks. Laboratory QC measurements will include method blanks, laboratory control samples (LCSs), laboratory duplicates, and matrix spike/matrix spike duplicate (MS/MSD) samples. LCS measurements will include the standard mid-level analyte concentration, plus a QC/method reporting level (MRL) low-level concentration, per the Louisville Chemistry Guideline. It is recognized that the laboratory will routinely perform and monitor the QC/MRL; however, guidance check limits will be utilized as advisory and corrective action will not be required for individual analyte variances.

2.3.3 Accuracy, Precision, and Sensitivity of Analysis

Program accuracy, precision, and sensitivity goals identified in Section 3.3 and Tables 3-1 through 3-9 of the FWQAPP will be imposed by the contractor for this investigation. In addition, the Louisville Chemistry Guideline identifies analytical method quality objectives related to individual method QC protocol. Current analytical method control limits will be submitted to the USACE, Louisville District Chemistry group by the contractor’s selected laboratory for review. Upon acceptance, these QC limits will be imposed during analytical runs. If these internal QC operational limits are not acceptable to USACE, Louisville District, the laboratory will impose the Louisville Chemistry Guideline control limits.

Program and project reporting levels are identified in Tables 3-1 through 3-9 of the FWQAPP. The contractor selected laboratory will make all reasonable attempts to meet these levels for each individual sample analysis. When samples require dilution, both the minimum dilution and quantified dilution must be reported. The laboratory will screen all samples to determine optimum dilution ranges. Dilution runs will be performed to quantitate high target analyte concentrations within the upper half of the calibration range, thus reducing the degree of dilution as much as possible. In addition, a five times less diluted run will then be performed to report other target analyte reporting levels as low as possible without destroying analytical detectors and instrumentation. If there are matrix interferences, non-target analyte, or high target analyte concentrations that preclude analysis of an undiluted sample, the laboratory project manager will contact USACE, Louisville District; forward analytical and chromatographic information from diluted runs; and obtain direction on how to proceed.

2.3.4 Completeness, Representativeness, and Comparability

Completeness, representativeness, and comparability goals identified in Section 3.4 and Tables 3-1 and 3-2 of the FWQAPP will be imposed for this investigation.

2.4 SAMPLING PROCEDURES

Sampling procedures are discussed in Chapter 4.0 of the FWSAP and SAP Addendum for the Exposed Soil Investigation from Slab Removals at Load Lines 5, 7, 8, and 10.

Table 4-5 of the SAP Addendum summarizes sample container, preservation, and holding time requirements for the soil matrices for this investigation. The number of containers required is estimated in this table.

As noted in the FWQAPP, additional sample volumes will be provided, when necessary, for the express purpose of performing associated laboratory QC (MS/MSD). These laboratory QC samples will be designated by the field and identified for the laboratory on respective chain of custody (COC) documentation.

2.5 SAMPLE CUSTODY

2.5.1 Field Procedures

The project team shall follow all sample handling, packaging, and shipment procedures identified in Section 5.1 of the FWQAPP.

2.5.2 Laboratory Chain-of-Custody Procedures

The laboratory COC will follow handling and custody procedures identified in its specific QAPP.

2.5.3 Final Evidence Files Custody Procedures

Custody of evidence files will follow those criteria defined in Section 5.3 of the FWQAPP.

2.6 CALIBRATION PROCEDURES AND FREQUENCY

2.6.1 Field Instruments / Equipment

The project team will follow the field instruments and equipment calibrations identified in Section 6.1 of the FWQAPP.

2.6.2 Laboratory Instruments

Calibration of laboratory equipment will follow procedures identified in the contractor’s laboratory specific QAPP and laboratory-specific standard operating procedures (SOPs), and corporate and facility-specific operating procedures.

2.7 ANALYTICAL PROCEDURES

2.7.1 Laboratory Analysis

Analytical methods, parameters, and quantitation or detection limits are those listed in Tables 3-3 through 3-9 of the FWQAPP.

All multi-increment field samples will be air dried and prepared in accordance with the SOP NC-IP-0001, “Particle Size Reduction of Solid Matrices”, Revision No. 3, 05/24/04 (Appendix B).

The laboratory specific-QAPP will be followed during the analysis of these samples. The laboratory will implement the following defined EPA methods.

- Acid Digestion of Soil, Sludge, Sediment, and other Solid Waste Samples for ICP by SW846 Method 3050B.
- Trace ICP Quantitation for HSL Metals According to Method 6010B.
- Trace ICP Quantitation for HSL Metals According to Method 6020A.
- Cold Vapor Analysis for Mercury in Accordance with SW846 Methods 7470A and 7471A.
- Volatile Organics – 8260B.
- Extraction for Semivolatile Organics by Method 3540C (Soxhlet Extraction).
- Soil Extraction for Explosives by Method 3540C (Soxhlet Extraction).
- Method 3520C, Continuous Liquid-Liquid Extraction for Semivolatile Organics.
- Method 3520C, Continuous Liquid-Liquid Extraction for Explosive Organics.
- Method 8270C, GC/MS Analysis of Semivolatile Organics.
- HPLC Analysis of Nitroaromatic and Nitramine Explosive Residues in Water, Soil, and Sediment Samples (8330).
- HPLC Analysis of Nitroglycerine in Water and Soil Samples (8332).
- Nitrocellulose, N from Method 353.2.

The laboratory will at all times maintain a safe and contaminant free environment for the analysis of samples. The laboratories will demonstrate, through instrument blanks, holding blanks, and analytical method blanks, that the laboratory environment and procedures will not and do not impact analytical results.

The laboratory will also implement all reasonable procedures to maintain project reporting levels for all sample analyses. Where contaminant and sample matrix analytical interferences impact the laboratory’s ability to obtain project reporting levels, the laboratory will institute sample clean-up processes, minimize dilutions, adjust instrument operational parameters, or propose alternative analytical methods or procedures. Elevated reporting levels will be kept to a minimum throughout the execution of this work. When samples require dilution, both the minimum dilution and quantified dilution must be reported. The laboratory will screen all samples to determine optimum dilution ranges. Dilution runs will be performed to quantitate high target analyte concentrations within the upper half of the calibration range, thus reducing the degree of dilution as much as possible. In addition, a five times less diluted run will then be performed to report other target analyte reporting levels as low as possible without destroying analytical detectors and instrumentation. If there are matrix interferences, non-target analyte, or high target analyte concentrations that preclude analysis of an undiluted sample, the laboratory project manager will contact the investigation contractor and USACE, Louisville District; forward analytical and chromatographic information from diluted runs; and obtain direction on how to proceed.

2.7.2 Field Screening and Analytical Protocols

Procedures for field analysis are identified in Chapter 6.0 of the FWSAP and in Chapter 4.0 of the FSP of this SAP Addendum. Only screening of samples for organic vapors using a photo-ionization detector will be conducted. Headspace analysis will not be conducted.

2.8 INTERNAL QUALITY CONTROL CHECKS

2.8.1 Field Sample Collection

Field duplicate MI QA sample types, numbers, and frequencies are identified in Chapters 4.0 and 5.0 of the FSP of this SAP Addendum. In general, the project team will collect field duplicates at a frequency of 10%. Field equipment rinsates will be collected at a frequency of 10% for water samples, while one soil equipment rinsate sample will be collected per each load line area investigated. This will constitute a process check for the effectiveness of the decontamination procedure. Two site source water samples (one potable deionized and one ASTM I) will be collected, or written documentation that the water meets the requirements of deionized water and ASTM I water will be provided. Volatile organic trip blanks will accompany all shipments containing volatile organic water samples.

2.8.2 Field Measurement

Refer to Chapter 4.0 of the FSP of this SAP Addendum for details regarding these measurements.

2.8.3 Laboratory Analysis

Analytical QC procedures will follow those identified in the referenced EPA methodologies. These will include method blanks, LCS, MS, MSD, laboratory duplicate analysis, calibration standards, internal standards, surrogate standards, and calibration check standards.

The laboratory will conform to their QAPP and implement their established SOPs to perform the various analytical methods required by the project. QC frequencies will follow those identified in Section 8.3 of the FWQAPP.

Analyses will also be consistent with direction provided by the USACE Shell for Analytical Chemistry Requirements, Appendix I EM200-1-3, 1 February 2001 and the Louisville Chemistry Guideline, Rev. 5 June 2002, Samir Mansy. The following are clarifications to this guidance relative to this project:

- The QC/method detection limit (MDL) check will be performed quarterly, until criteria can be established. After performance criteria are determined, the frequency of this QC check may be reduced to biannually or annually per instrument;

- Analytical method blanks will be considered clean as long as analyte concentrations are below reporting levels. Corrective actions will be performed for any analyte detected above the established MRL. Any analytes detected between the MDL and the MRL will be flagged appropriately;

- LCSs will contain all project target compounds; however, for organic methods, only the SW-846 subset of system monitoring compounds will be used to monitor method performance and initiate analytical method corrective actions;

- For methods that have multi-responders within the same analytical process, the laboratory will not include all analytes within the matrix spiking mixture. A representative analyte will be employed for the MS evaluation;

- Inductively coupled plasma (ICP) initial calibration curves will be confirmed through the analysis of a blank and three standards, and this documentation will be reported as part of the analytical data package; and

- ICP serial dilution will be performed on a per batch basis. If the serial dilution falls outside acceptance criteria, a post-digestion spike analysis will be performed.

2.9 DATA REDUCTION, VALIDATION, AND REPORTING

2.9.1 Data Reduction

Sample collection and field measurements will follow the established protocols defined in the FWQAPP, FWSAP, and this SAP Addendum. Laboratory data reduction will follow the laboratory specific QAPP guidance and conform to general direction provided by the FWQAPP, the USACE Shell for Analytical Chemistry Requirements, Appendix I EM200-1-3, (USACE 2001a), and the Louisville Chemistry Guideline, (USACE 2002).

2.9.2 Data Verification / Validation

Project data verification and validation will follow direction provided in the FWQAPP Section 9.2 and diagramed in Figure 9-1. Protocol for analytical data verification and validation has been updated to the following references:

- USACE Louisville Chemistry Guideline, Rev. 5, June 2002.
- USACE Shell for Analytical Chemistry Requirements, Appendix I EM200-1-3, February 2001.
- Environmental Data Assurance Guideline, USACE Louisville, May 2000.
- EPA National Functional Guidelines for Organic Data Review, EPA-540/R-99/008, October 1999.
- EPA National Functional Guidelines for Inorganic Data Review, EPA-540/R-94/013, February 1994.

All data will be reviewed and verified by the contractor in accordance with the FWQAPP.

A minimum of 10% of the data acquired during this investigation will be validated in accordance with the direction provided in the FWQAPP and the Louisville Chemistry Guideline, Rev.5, June 2002, Samir Mansy. An independent data validation subcontractor qualified by USACE, Louisville District will perform this data validation.

2.9.3 Data Reporting

Analytical data reports will follow the direction provided in the FWQAPP.

2.10 PERFORMANCE AND SYSTEM AUDITS

2.10.1 Field Audits

A minimum of one field surveillance for the investigation will be performed by the QA Officer and/or the Field Team Leader. This audit will encompass the sampling of surface soils.

USACE, EPA Region 5, or Ohio EPA audits may be conducted at the discretion of the respective agency.

2.10.2 Laboratory Audits

Routine USACE- Louisville on-site laboratory audits may be conducted by USACE, while audits by EPA Region 5 or Ohio EPA may be conducted at the discretion of the respective agencies.

Internal performance and systems audits will be conducted by laboratories QA staff, as defined in the laboratory specific-QAPP.

2.11 PREVENTIVE MAINTENANCE PROCEDURES

2.11.1 Field Instruments and Equipment

Maintenance of all field analytical and sampling equipment will follow direction provided in Section 11.1 of the FWQAPP.

2.11.2 Laboratory Instruments

Routine and preventive maintenance for all laboratory instruments and equipment will follow the direction of appropriate sections of the contract laboratory specific-QAPP.

2.12 SPECIFIC ROUTINE PROCEDURES TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

2.12.1 Field Measurement Data

Field data will be assessed as outlined in Section 12.1 of the FWQAPP.

2.12.2 Laboratory Data

Laboratory data will be assessed as outlined in Section 12.2 of the FWQAPP.

2.13 CORRECTIVE ACTIONS

2.13.1 Sample Collection / Field Measurements

Field activity corrective action protocol will follow directions provided in Section 13.1 of the FWQAPP.

2.13.2 Laboratory Analyses

Laboratory activity corrective action protocol will follow directions provided in Section 13.2 of the FWQAPP and the appropriate sections of the contract laboratory specific-QAPP.

2.14 QA REPORTS TO MANAGEMENT

Procedures and reports will follow the protocol identified in Section 14.0 of the FWQAPP and those directed by appropriate sections of the contract laboratory specific-QAPP.

2.15 REFERENCES FOR THE QAPP - PART II

USACE 2001a. Requirements for the Preparation of Sampling and Analysis Plans, EM200-1-3, Appendix I, Shell for Analytical Chemistry Requirements, February.

USACE 2001b. Facility-wide Sampling and Analysis Plan for Environmental Investigations at the Ravenna Army Ammunition Plant, Ravenna, Ohio, DACA62-00-D-0001, Delivery Order CY02, Final, March 2001.

USACE 2002. Louisville Chemistry Guideline (LCG), Environmental Chemistry Branch, Rev. 5, June.

FIGURES

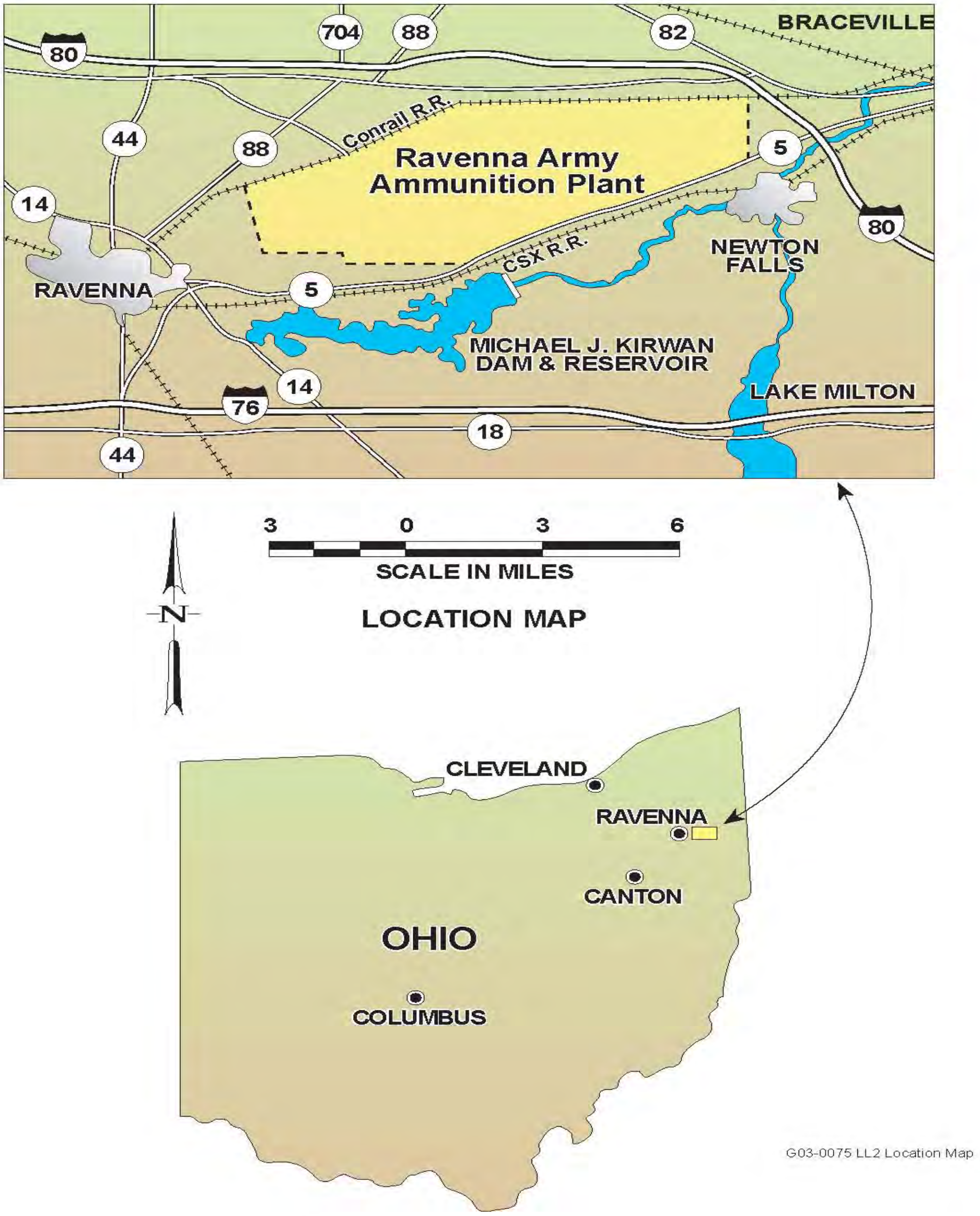

Figure 1-1. General Location and Orientation of RVAAP

FIGURE 1-1. General Location of Ravenna Army Ammunition Plant, Ravenna, Ohio.

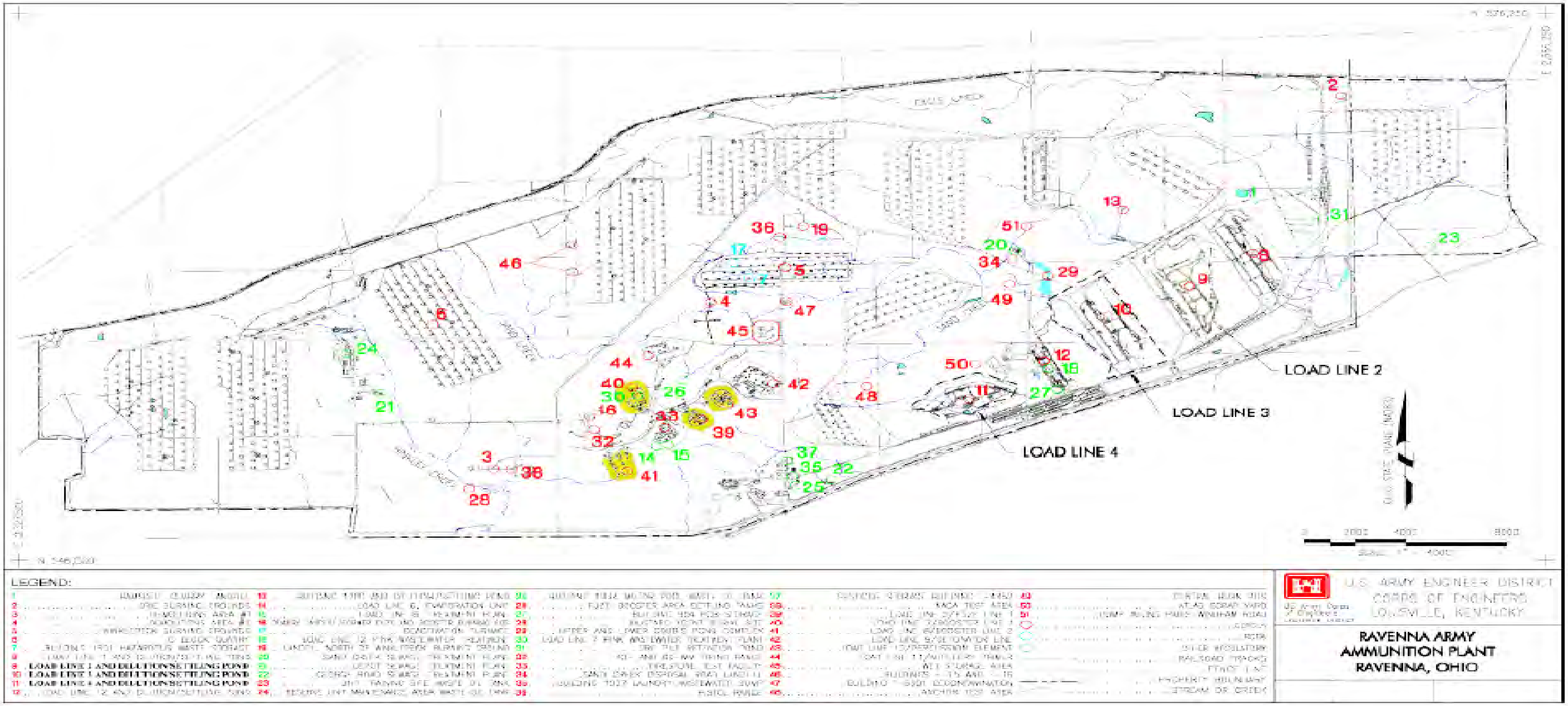

Figure 1-2. Ravenna Army Ammunition Plant Facility Map

FIGURE 1-2. Facility Map for Ravenna Army Ammunition Plan, Ravenna, Ohio.

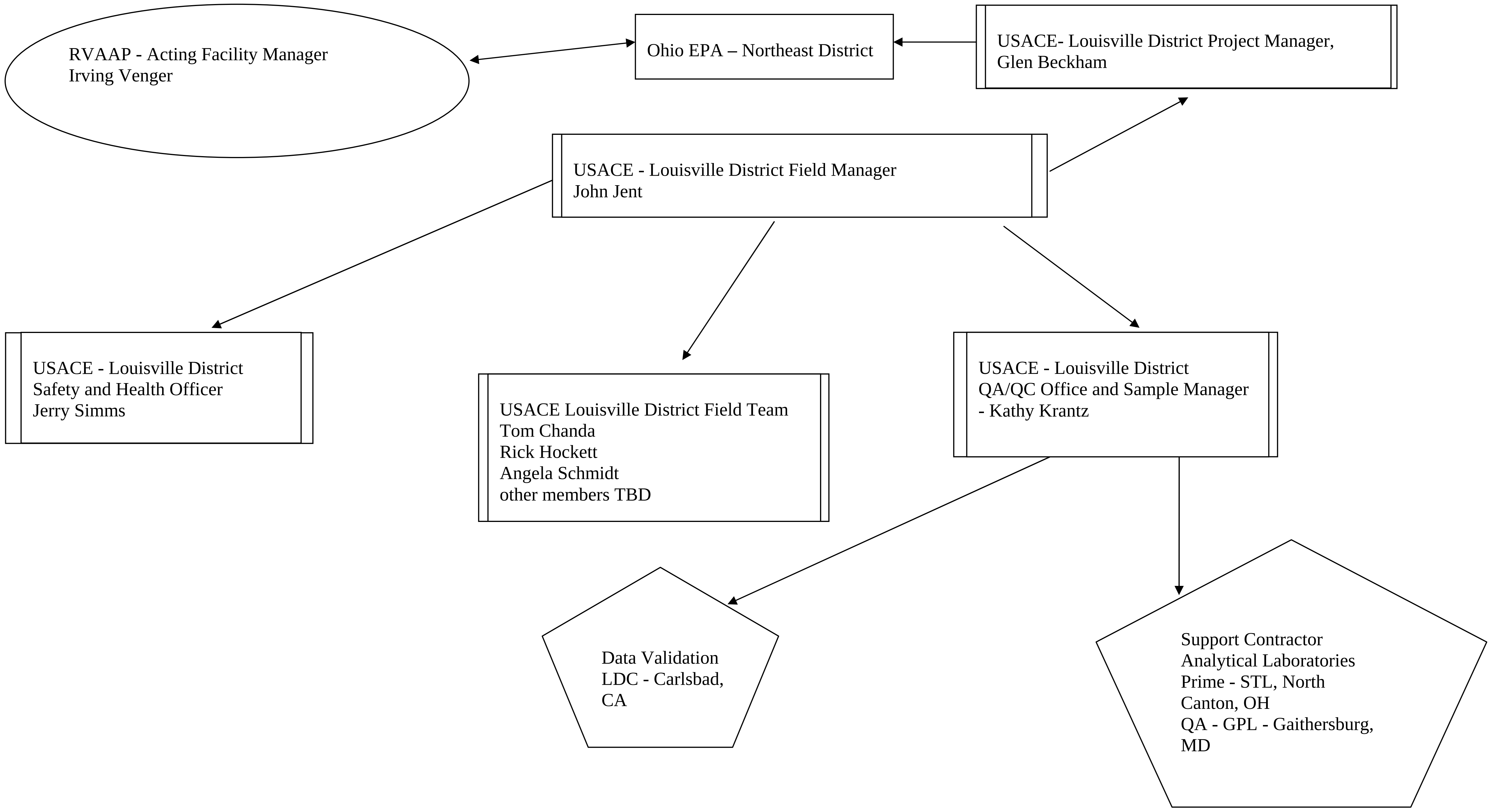

FIGURE 2-1. Tentative Project Organization Chart for the exposed soil sampling and characterization for Load Lines 5, 7, 8, and 10.

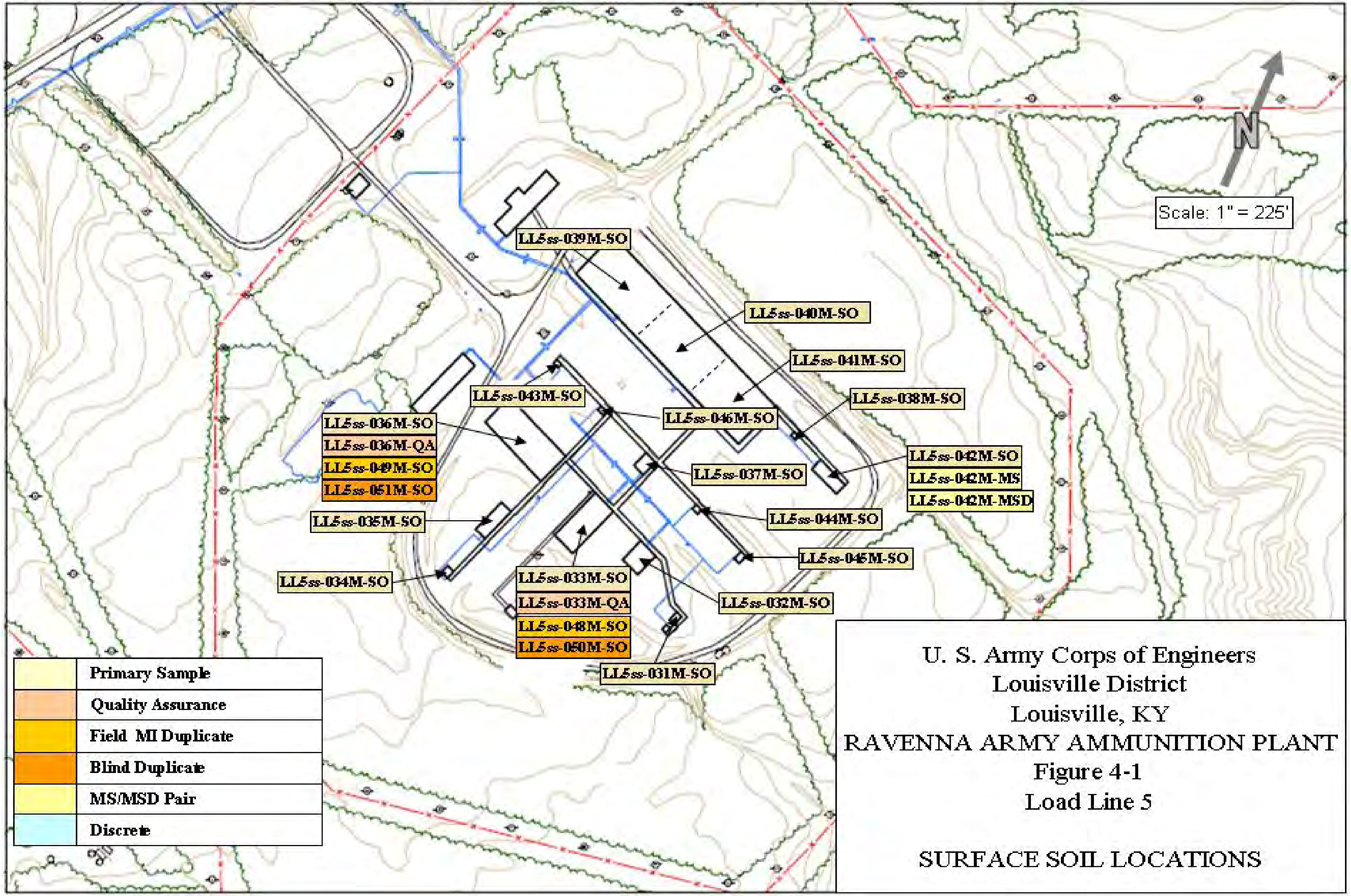

FIGURE 4-1. Surface soil sample locations for Load Line 5 at Ravenna Army Ammunition Plant, Ravenna, Ohio.

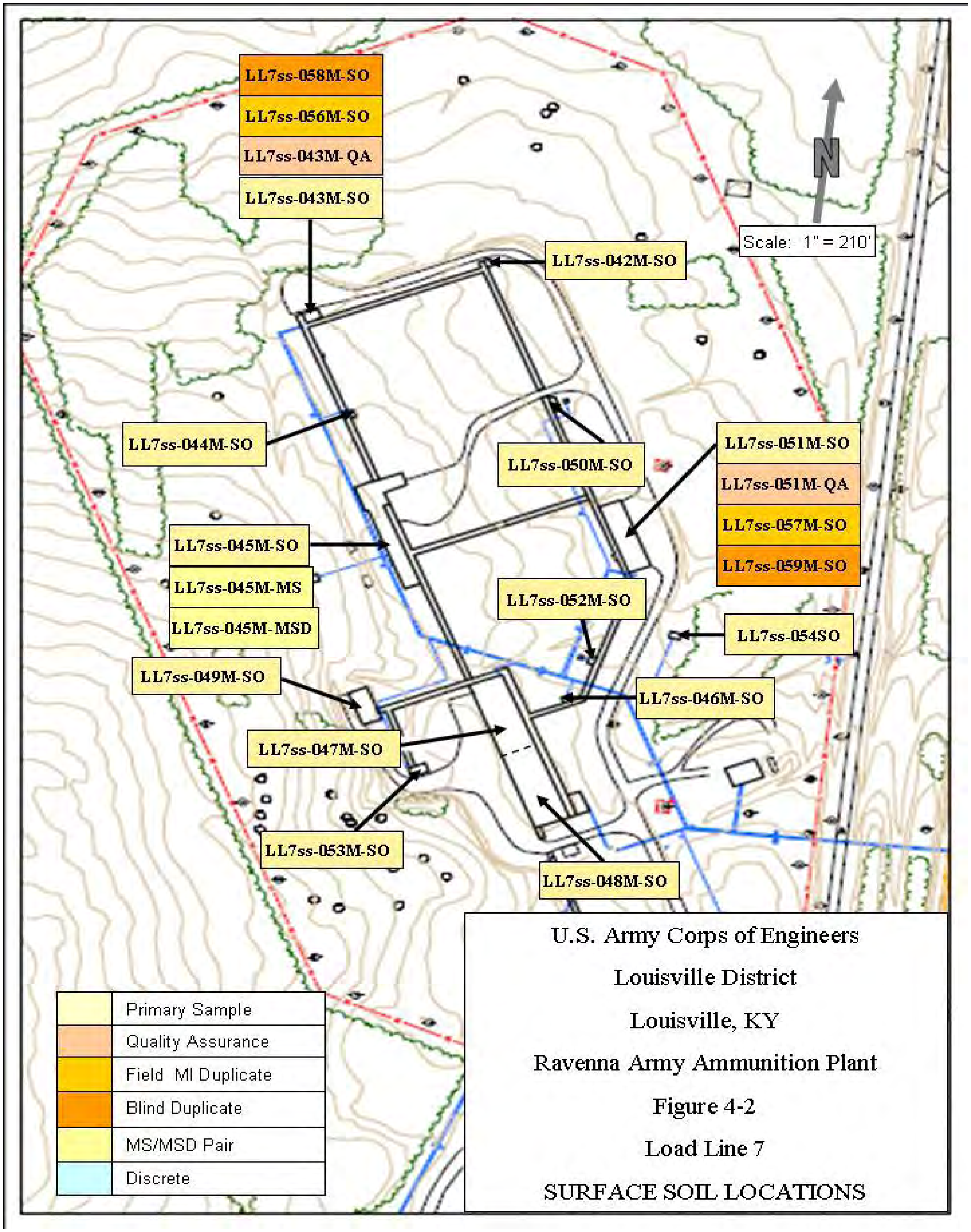

FIGURE 4-2. Surface soil sample locations for Load Line 7 at Ravenna Army Ammunition Plant, Ravenna, Ohio.

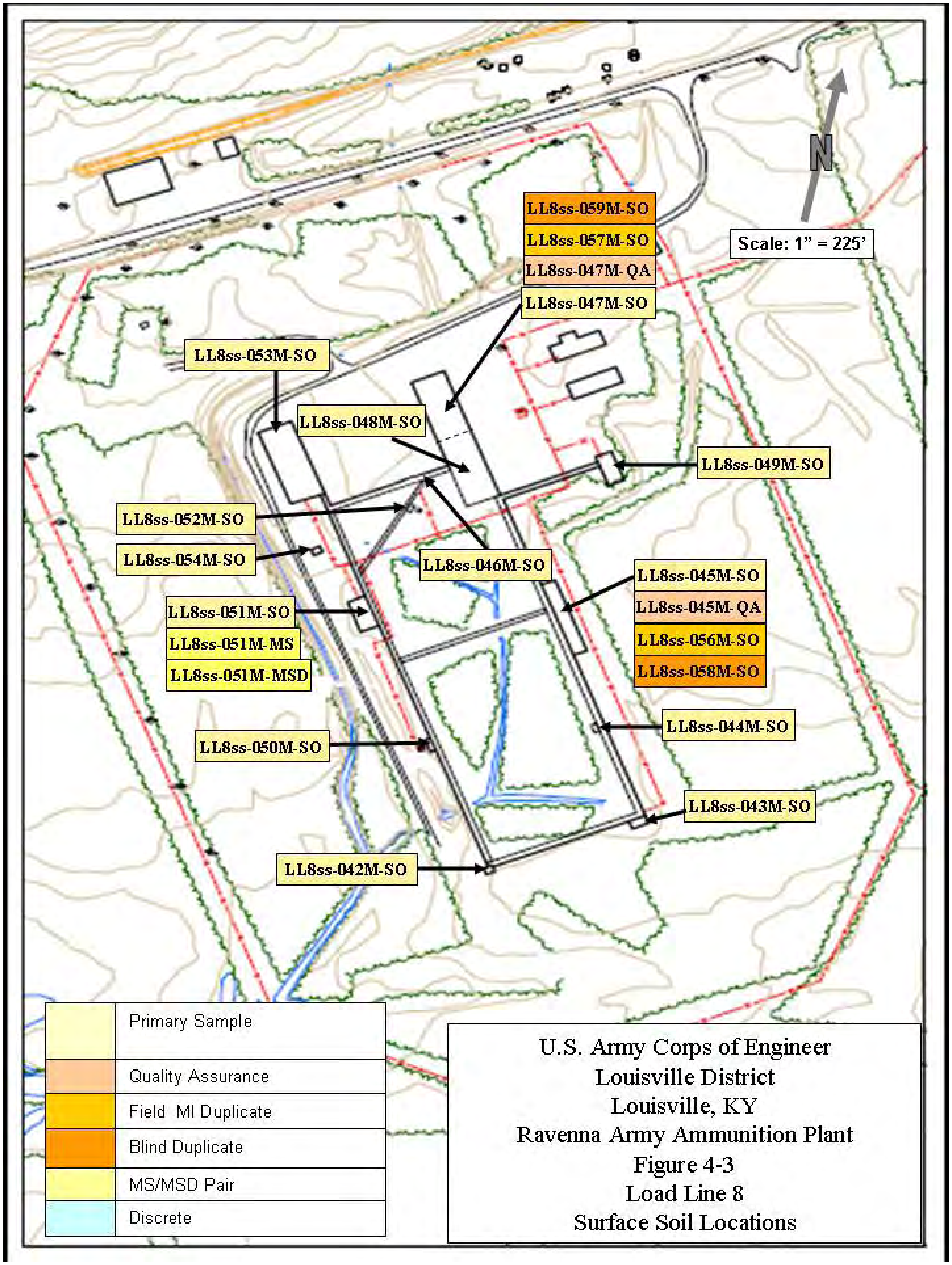

FIGURE 4-3. Surface soil sample locations for Load Line 8 at Ravenna Army Ammunition Plant, Ravenna, Ohio.

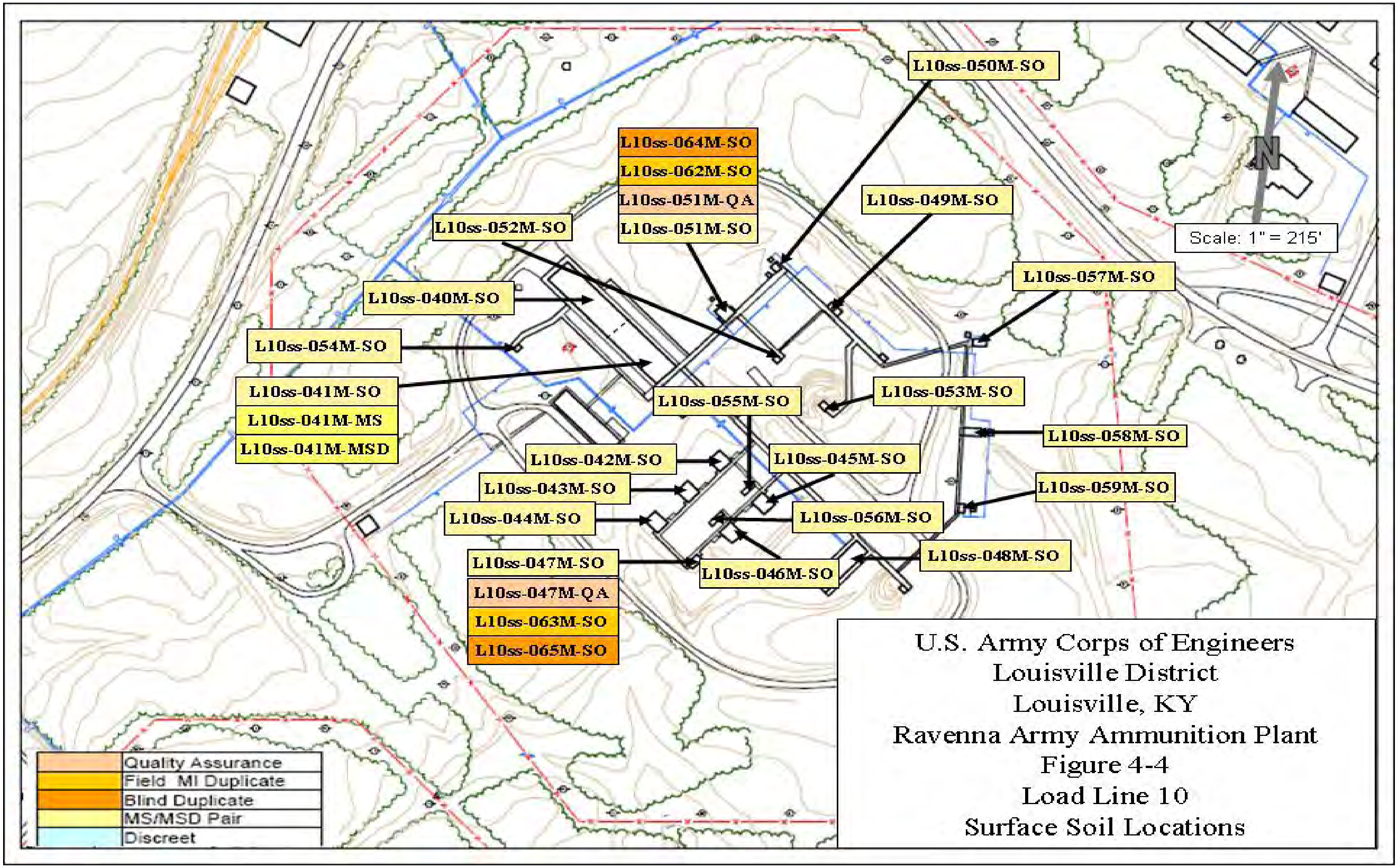

FIGURE 4-4. Surface soil sample locations for Load Line 10 at Ravenna Army Ammunition Plant, Ravenna, Ohio.

TABLES

Table 4-1. Baseline Surface Soil Sample Identification for Load Line 5 (RVAAP-39)

Description			Sq. Ft				Number of Samples						
Facility/Area	Building	Building Utilization	Slab Area	MI Area	Sample ID	Depth (ft)	Explosives	Propellants	Metals	SVOCs	VOCs	Pesticides/Herbicides/PCBs	Other
Multi-increment Surface Soil Locations	1F-WP-1	1941-45 - Fulminate Dry House	160	160	LL5ss-031M-SO	0 to 1	1	-	1	-	-	-	-
	1F-WP-3	1941-45 - Fulminate Mix House	1250	1250	LL5ss-032M-SO	0 to 1	1	-	1	-	-	-	-
	1F-WP-4	1941-45 - Primer Loading Bldg.	3750	3750	LL5ss-033M-SO	0 to 1	1	1	1	1	-	1	-
QA	1F-WP-4	"	"	"	LL5ss-033M-QA	0 to 1	1	1	1	1	-	1	-
Field MI Duplicate to LL5ss-033SO MI-QA	1F-WP-4	"	"	"	LL5ss-048M-SO	0 to 1	1	1	1	1	-	1	-
QC Duplicate to LL5ss-033SO	1F-WP-4	"	"	"	LL5ss-050M-SO	0 to 1	1	1	1	1	-	1	-
	1F-WP-6	1941-45 - Black Powder Dry House	160	160	LL5ss-034M-SO	0 to 1	1	-	1	-	-	-	1-Nitrate Only
	1F-WP-7	1941-45 - Black Powder Pelleting House	780	780	LL5ss-035M-SO	0 to 1	1	-	1	-	-	-	1-Nitrate Only
	1F-WP-8	1941-45 - Delay Loading House	3875	3875	LL5ss-036M-SO	0 to 1	1	1	1	1	-	1	1-Nitrate Only
QA	1F-WP-8	"	3875	3875	LL5ss-036M-QA	0 to 1	1	1	1	1	-	1	1-Nitrate Only
Field MI Duplicate to LL5ss-036SO MI-QA	1F-WP-8	"	"	"	LL5ss-049M-SO	0 to 1	1	1	1	1	-	1	1-Nitrate Only
QC Duplicate to LL5ss-036SO	1F-WP-8	"	"	"	LL5ss-051M-SO	0 to 1	1	1	1	1	-	1	1-Nitrate Only
	1F-WP-9	1941-45 - Primer Dry House	710	710	LL5ss-037M-SO	0 to 1	1	-	1	-	-	-	-
	1F-WP-10	1941-45 - Detonator Service Magazine	160	160	LL5ss-038M-SO	0 to 1	1	-	1	-	-	-	-
	1F-WP-11	1941-45 - Fuze Assembly Bldg.	30000	10000	LL5ss-039M-SO	0 to 1	1	-	1	-	-	-	-
	1F-WP-11	"	30000	10000	LL5ss-040M-SO	0 to 1	1	-	1	-	-	-	-
	1F-WP-11	"	30000	10000	LL5ss-041M-SO	0 to 1	1	-	1	-	-	-	-
	1F-WP-12	1941-45 - Fuze Testing Bldg.	1250	1250	LL5ss-042M-SO	0 to 1	1	-	1	1	-	1	1-Nitrate Only
	1F-WP-12	"	1250	1250	LL5ss-042M-MS	0 to 1	1	-	1	1	-	1	1-Nitrate Only
	1F-WP-12	"	"	"	LL5ss-042M-MSD	0 to 1	1	-	1	1	-	1	1-Nitrate Only
	1F-WP-18	1941-45 - Primer House	160	160	LL5ss-044M-SO	0 to 1	1	-	1	-	-	-	-
	1F-WP-19	1941-45 - Pellet Storage Bldg.	160	160	LL5ss-045M-SO	0 to 1	1	-	1	-	-	-	-
	1F-WP-20	1941-45 - Delay Storage Bldg.	160	160	LL5ss-046M-SO	0 to 1	1	-	1	-	-	-	-
Discrete Surface Soil Locations	1F-WP-15	1941-45 - Paint Storage Bldg.	160	160	LL5ss-047D-SO	0 to 1		-	1	-	1	-	-
QA	1F-WP-15	"	160	160	LL5ss-047D-QA	0 to 1			1		1		
	1F-WP-15	"	160	160	LL5ss-047D-MS	0 to 1					1		
	1F-WP-15	"	160	160	LL5ss-047D-MSD	0 to 1					1		
QC Duplicate to LL5ss-047D-SO	1F-WP-15	"	160	160	LL5ss-052D-SO	0 to 1			1		1		
	1F-WP-4	1941-45 - Primer Loading Bldg.	3750	3750	LL5ss-033D-SO	0 to 1	-	-	-	-	1	-	-
	1F-WP-8	1941-45 - Delay Loading House	3875	3875	LL5ss-036D-SO	0 to 1	-	-	-	-	1	-	-
		Primary Sample				Primary Lab	21	6	24	9	6	9	8-Nitrate Only
		Quality Assurance				QA LAB	2	2	3	2	1	2	1-Nitrate Only

☐	Primary Sample
🟧	Quality Assurance
🟨	Field MI Duplicate
🟧	Blind Duplicate
🟨	MS/MSD Pair
🟦	Discrete

Table 4-2. Baseline Surface Soil Sample Identification for Load Line 7 (RVAAP-40)

Description			Sq. Ft.				Number of Samples						
Facility/Area	**Building**	**Building Utilization**	**Slab Area**	**MI Area**	**Sample ID**	**Depth (ft)**	**Explosives**	**Propellants**	**Metals**	**SVOCs**	**VOCs**	**Pesticides/Herbicides/PCBs**	**Other**
Multi-increment Surface Soil Locations	1B-WP-1	1941-45 - Tetryl Magazine; 1968-70 - Booster Storage (A-5), Pellet Magazine	160	160	LL7ss-042M-SO	0 to 1	1	-	1	-	-	-	-
	1B-WP-2	1941-45 - Tetryl Screening & Blending Bldg.; 1969-70 - Main Charge Storage, Melt Pour	470	470	LL7ss-043M-SO	0 to 1	1	1	1	1	-	1	-
QA	1B-WP-2	1941-45 - Tetryl Screening & Blending Bldg.; 1969-70 - Main Charge Storage, Melt Pour	"	"	LL7ss-043M-QA	0 to 1	1	1	1	1	-	1	-
Field MI Duplicate to LL7ss043SO MI-QA	1B-WP-2	1941-45 - Tetryl Screening & Blending Bldg.; 1969-70 - Main Charge Storage, Melt Pour	"	"	LL5ss-056M-SO	0 to 1	1	1	1	1	-	1	-
QC Duplicate to LL7ss043SO	1B-WP-2	1941-45 - Tetryl Screening & Blending Bldg.; 1969-70 - Main Charge Storage, Melt Pour	"	"	LL5ss-058M-SO	0 to 1	1	1	1	1	-	1	-
	1B-WP-3	1941-45 - Tetry Rest House; 1969-70 - Not in Use	160	160	LL7ss-044M-SO	0 to 1	1	-	1	-	-	-	-
	1B-WP-4	1941-45 - Tetryl Pelleting Bldg.; 1969-70 - Main Charge Storage, Melt Pour and Curing	5625	5625	LL7ss-045M-SO	0 to 1	1	-	1	-	-	-	-
	1B-WP-4	"	5625	5625	LL7ss-045M-MS	0 to 1	1	-	1	-	-	-	-
	1B-WP-4	"	"	"	LL7ss-045M-MSD	0 to 1	1	-	1	-	-	-	-
	1B-WP-5	1941-45 - Detonator Magazine; 1969-70 - Detonator Magazine	160	160	LL7ss-046M-SO	0 to 1	1	-	1	-	-	-	-
	1B-WP-6	1941-45 - Booster Assembly and Shipping; 1969-70 - Assembly and Shipping	13125	6263	LL7ss-047M-SO	0 to 1	1	-	1		-		-
	1B-WP-6	"	"	"	LL7ss-048M-SO	0 to 1	1	-	1	-	-	-	-
	1B-WP-7	1941-45 - Testing Bldg.; 1969-70 - Testing Bldg.	940	940	LL7ss-049M-SO	0 to 1	1	1	1	-	-	-	-
	1B-WP-12	1941-45 - Tetryl Pellet Storage Bldg.; 1969-70 - M42 Primer Storage & Case Assembly	160	160	LL7ss-050M-SO	0 to 1	1	-	1	-	-	-	-
	1B-WP-13	1941-45 - Tetryl Cupping Bldg. 1969-70 - M42 Primer Storage and Case Assembly	3125	3125	LL7ss-051M-SO	0 to 1	1	-	1	-	-	-	-
QA	1B-WP-13	1941-45 - Tetryl Cupping Bldg. 1969-70 - M42 Primer Storage and Case Assembly	"	"	LL7ss-051M-QA	0 to 1	1	-	1	-	-	-	-
Field MI Duplicate to LL7ss051SO MI-QA	1B-WP-13	1941-45 - Tetryl Cupping Bldg. 1969-70 - M42 Primer Storage and Case Assembly	"	"	LL5ss-057M-SO	0 to 1	1	-	1	-	-	-	-
QC Duplicate to LL7ss051SO	1B-WP-13	1941-45 - Tetryl Cupping Bldg. 1969-70 - M42 Primer Storage and Case Assembly	"	"	LL5ss-059M-SO	0 to 1	1	-	1	-	-	-	-
	1B-WP-17	1941-45 - Cupped Pellet Rest House; 1969-70 - M551 Fuze Storage	160	160	LL7ss-052M-SO	0 to 1	1	-	1	-	-	-	-
	1B-WP-18	1941-45 - Primer House; 1969-70 - Not In Use	160	160	LL7ss-053M-SO	0 to 1	1	-	1	-	-	-	-
	1B-WP-22	1941-45 - Solvent Storage Bldg.; 1969-70 - M9 Propellant Storage	160	160	LL7ss-054M-SO	0 to 1	1	1	1	1	-	1	-
Discrete Surface Soil Locations	1B-WP-22	1941-45 - Solvent Storage Bldg.; 1969-70 - M9 Propellant Storage	160	160	LL7ss-055D-SO	0 to 1	-	-	-	-	1	-	-
QA	1B-WP-22	"	"	"	LL7ss-055D-QA	0 to 1					1		
QC Duplicate to LL7ss055D-SO	1B-WP-22	"	"	"	LL7ss-060D-SO	0 to 1					1		
	1B-WP-2	1941-45 - Tetryl Screening & Blending Bldg.; 1969-70 - Main Charge Storage, Melt Pour	470	470	LL7ss-043D-SO	0 to 1	-	-	-	-	1	-	-
	1B-WP-13	1941-45 - Tetryl Cupping Bldg. 1969-70 - M42 Primer Storage and Case Assembly	3125	3125	LL7ss-051D-SO	0 to 1	-	-	-	-	1	-	-
		Primary Sample				PRIMARY LAB	19	5	19	4	4	4	
	🟧	Quality Assurance				QA LAB	2	1	2	1	1	1	
	🟨	Field MI Duplicate											
	🟧	Blind Duplicate											
	🟨	MS/MSD Pair											
	🟦	Discrete											

Table 4-3. Baseline Surface Soil Sample Identification for Load Line 8 (RVAAP-41)

Description			Sq. Ft.				Number of Samples						
Facility/Area	Building	Building Utilization	Slab Area	MI Area	Sample ID	Depth (ft)	Explosives	Propellants	Metals	SVOCs	VOCs	Pesticides Herbicides PCBs	Other
Multi-increment Surface Soil Locations	2B-WP-1	1941-45 - Tetryl Magazine; 1970 Era - Not In Use	160	160	LL8ss-042M-SO	0 to 1	1	-	1	-	-	-	-
	2B-WP-2	1941-45 - Tetryl Screening & Blending Bldg.; 1970 Era - Octol Storage Magazine	470	470	LL8ss-043M-SO	0 to 1	1	1	1	-	-	-	-
	2B-WP-3	1941-45 - Tetry Rest House; 1970 Era - Not in Use	160	160	LL8ss-044M-SO	0 to 1	1	-	1	-	-	-	-
	2B-WP-4	1941-45 - Tetryl Pelleting Bldg.; 1970 Era - Melt Pour Operation	5625	5625	LL8ss-045M-SO	0 to 1	1	1	1	1	-	1	-
QA	2B-WP-4	1941-45 - Tetryl Pelleting Bldg.; 1970 Era - Melt Pour Operation	"	"	LL8ss-045M-QA	0 to 1	1	1	1	1	-	1	-
Field MI Duplicate to LL8ss-045SO MI-QA	2B-WP-4	1941-45 - Tetryl Pelleting Bldg.; 1970 Era - Melt Pour Operation	"	"	LL5ss-056M-SO	0 to 1	1	1	1	1	-	1	-
QC Duplicate to LL8ss-045SO	2B-WP-4	1941-45 - Tetryl Pelleting Bldg.; 1970 Era - Melt Pour Operation	"	"	LL5ss-058M-SO	0 to 1	1	1	1	1	-	1	-
	2B-WP-5	1941-45 - Detonator Magazine; 1970 Era - Not In Use	160	160	LL8ss-046M-SO	0 to 1	1	-	1	-	-	-	-
	2B-WP-6	1941-45 - Booster Assembly and Shipping; 1970 Era - Assembly and Shipping	13125	6563	LL8ss-047M-SO	0 to 1	1		1	-	-	-	-
QA	2B-WP-6	1941-45 - Booster Assembly and Shipping; 1970 Era - Assembly and Shipping	13125	6563	LL8ss-047M-QA	0 to 1	1		1	-	-	-	-
Field MI Duplicate to LL8ss-047SO MI-QA	2B-WP-6	1941-45 - Booster Assembly and Shipping; 1970 Era - Assembly and Shipping	"	"	LL5ss-057M-SO	0 to 1	1		1	-	-	-	-
QC Duplicate to LL8ss-047SO	2B-WP-6	1941-45 - Booster Assembly and Shipping; 1970 Era - Assembly and Shipping	"	"	LL5ss-059M-SO	0 to 1	1		1	-	-	-	-
	2B-WP-6	"	"	"	LL8ss-048M-SO	0 to 1	1	-	1		-		-
	2B-WP-7	1941-45 - Testing Bldg.; 1970 Era - Curing	940	940	LL8ss-049M-SO	0 to 1	1	-	1	-	-	-	-
	2B-WP-12	1941-45 - Tetryl Pellet Storage Bldg.; 1970 Era - S & A Device With Detonator Storage	160	160	LL8ss-050M-SO	0 to 1	1	-	1	-	-	-	-
	2B-WP-13	1941-45 - Tetryl Cupping Bldg. 1970 Era - Not In Use	3125	3125	LL8ss-051M-SO	0 to 1	1	-	1	-	-	-	-
	2B-WP-13	"	3125	3125	LL8ss-051M-MS	0 to 1	1	-	1	-	-	-	-
	2B-WP-13	"	"	"	LL8ss-051M-MSD	0 to 1	1	-	1	-	-	-	-
	2B-WP-17	1941-45 - Cupped Pellet Rest House; 1970 Era - Not In Use	160	160	LL8ss-052M-SO	0 to 1	1	-	1	-	-	-	-
	2B-WP-21	1941-45 - Booster Assembly and Shipping; 1970 Era - Not In Use			LL8ss-053M-SO	0 to 1	1	-	1	1	-	1	-
	2B-WP-22	1941-45 - Solvent Storage Bldg.; 1970 Era - Not In Use	160	160	LL8ss-054M-SO	0 to 1	1	-	1	1	-	1	-
Discrete Surface Soil Locations	2B-WP-22	1941-45 - Solvent Storage Bldg.; 1970 Era - Not In Use	160	160	LL8ss-055M-SO	0 to 1	-	-	-	-	1	-	-
QA	2B-WP-22	"	160	160	LL8ss-055M-QA	0 to 1					1		
QC Duplicate to LL8ss-055M-SO	2B-WP-22	"	160	160	LL8ss-060D-SO	0 to 1					1		
	2B-WP-4	1941-45 - Tetryl Pelleting Bldg.; 1970 Era - Melt Pour Operation	5625	5625	LL8ss-045M-SO	0 to 1	-	-	-	-	1	-	-
	2B-WP-6	1941-45 - Booster Assembly and Shipping; 1970 Era - Assembly and Shipping	13125	6263	LL8ss-047M-SO	0 to 1	-	-	-	-	1	-	-
		Primary Sample				PRIMARY LAB	19	4	19	5	4	5	
	🟧	Quality Assurance				QA LAB	2	1	2	1	1	1	
	🟨	Field MI Duplicate											
	🟧	Blind Duplicate											
	🟨	MS/MSD Pair											
	🟦	Discrete											

Table 4-4. Baseline Surface Soil Sample Identification for Load Line 10 (RVAAP-43)

Description			Sq. Ft.				Number of Samples						
Facility/Area	Building	Building Utilization	Slab Area	MI Area	Sample ID	Depth (ft)	Explosives	Propellants	Metals	SVOCs	VOCs	Pesticides Herbicides PCBs	Other
Multi-increment Surface Soil Locations	PE-1	1941 - 1945; 1951 - 1956; 1969-70 - PE Manufacturing Bldg	13125	6563	L10ss-040M-SO	0 to 1	1	-	1		-		-
	PE-1	"	"	"	L10ss-041M-SO	0 to 1	1	-	1	-	-	-	-
	PE-1	"	"	"	L10ss-041M-MS	0 to 1	1	-	1	-	-	-	-
	PE-1	"	"	"	L10ss-041M-MSD	0 to 1	1	-	1	-	-	-	-
	PE-4	1941 - 1945; 1951 - 1956; 1969-70 - Preliminary Dry House	625	625	L10ss-042M-SO	0 to 1	1	-	1	-	-	-	-
	PE-5	1941 - 1945; 1951 - 1956; 1969-70 - Preliminary Dry House	625	625	L10ss-043M-SO	0 to 1	1	-	1	-	-	-	-
	PE-6	1941 - 1945; 1951 - 1956; 1969-70 - Preliminary Dry House	625	625	L10ss-044M-SO	0 to 1	1	-	1	-	-	-	-
	PE-7	1941 - 1945; 1951 - 1956 - Canned Primer Storage Bldg; 1969-70 - Not In Use	625	625	L10ss-045M-SO	0 to 1	1	-	1	-	-	-	-
	PE-8	1941 - 1945; 1951 - 1956 - Canned Primer Storage Bldg; 1969-70 - Not In Use	625	625	L10ss-046M-SO	0 to 1	1	-	1	-	-	-	-
	PE-9	1941 - 1945; 1951 - 1956; 1969-70 - Final Dry House	625	625	L10ss-047M-SO	0 to 1	1	-	1	-	-	-	1-Chlorate Only
QA	PE-9	1941 - 1945; 1951 - 1956; 1969-70 - Final Dry House	"	"	L10ss-047M-QA	0 to 1	1	-	1	-	-	-	1-Chlorate Only
Field MI Duplicate to LL10ss-047SO MI-QA	PE-9	1941 - 1945; 1951 - 1956; 1969-70 - Final Dry House	"	"	LL5ss-063M-SO	0 to 1	1	-	1	-	-	-	1-Chlorate Only
QC Duplicate to LL10ss-047SO	PE-9	1941 - 1945; 1951 - 1956; 1969-70 - Final Dry House	"	"	LL5ss-065M-SO	0 to 1	1		1	-	-	-	1-Chlorate Only
	PE-10	1941 - 1945; 1951 - 1956; 1969-70 - Testing, Packaging and Shipping	2500	2500	L10ss-048M-SO	0 to 1	1	-	1	-	-	-	-
	PE-12 & 13	1941 - 1945; 1951 - 1956; 1969-70 - Potassium Chlorate Bldg.	470	470	L10ss-049M-SO	0 to 1	1	-	1	-	-	-	1-Chlorate Only
	PE-12 & 13	1941 - 1945; 1951 - 1956; 1969-70 - Potassium Chlorate Bldg.	470	470	L10ss-049M-MS	0 to 1							1-Chlorate Only
	PE-12 & 13	1941 - 1945; 1951 - 1956; 1969-70 - Potassium Chlorate Bldg.	470	470	L10ss-049M-MSD	0 to 1							1-Chlorate Only
	PE-14	1941 - 1945; 1951 - 1956; 1969-70 - Fuel Mixing Bldg.	470	470	L10ss-050M-SO	0 to 1	1 + PETN		1	-	-	-	-
	PE-15	1941 - 1945; 1951 - 1956; 1969-70 - Wet Mix B	315	315	L10ss-051M-SO	0 to 1	1 + PETN	1	1	1	-	1	-
QA	PE-15	1941 - 1945; 1951 - 1956; 1969-70 - Wet Mix B	"	"	L10ss-051M-QA	0 to 1	1 + PETN	1	1	1	-	1	-
Field MI Duplicate to LL10ss-051SO MI-QA	PE-15	1941 - 1945; 1951 - 1956; 1969-70 - Wet Mix B	"	"	LL5ss-062M-SO	0 to 1	1 + PETN	1	1	1		1	-
QC Duplicate to LL10ss-051SO	PE-15	1941 - 1945; 1951 - 1956; 1969-70 - Wet Mix B	"	"	LL5ss-064M-SO	0 to 1	1 + PETN	1	1	1		1	-
	PE-16	1941 - 1945; 1951 - 1956; 1969-70 - Dry House	240	240	L10ss-060M-SO	0 to 1	1	-	1	-	-	-	-
	PE-18	1941 - 1945; 1951 - 1956; 1969-70 - Mixture Inspection Bldg.	625	625	L10ss-052M-SO	0 to 1	1	1	1	-	-	-	1-Chlorate Only
	PE-19	1941 - 1945; 1951 - 1956;19 69-70 - Gum Solution Bldg.	470	470	L10ss-053M-SO	0 to 1	1	-	1	1	-	1	-
	PE-20	1941 - 1945; 1951 - 1956; 1969-70 - Potassium Chlorate Magazine	160	160	L10ss-054M-SO	0 to 1	1	-	1	-	-	-	-
	PE-21	1941 - 1945; 1951 - 1956; 1969-70 - TNT Magazine	160	160	L10ss-055M-SO	0 to 1	1	-	1	-	-	-	-
	PE-22	1941 - 1945; 1951 - 1956; 1969-70 - Solvent Storage Bldg	39	39	L10ss-056M-SO	0 to 1	1	-	1	1	-	1	-
	PE-28	1941 - 1945; 1951 - 1956 - Primer Canning Bldg.; 1969-70 - Not In Use	117	117	L10ss-057M-SO	0 to 1	1	-	1	-	-	-	-
	PE-29	1941 - 1945; 1951 - 1956 - Primer Canning Bldg.; 1969-70 - Not In Use	117	117	L10ss-058M-SO	0 to 1	1	-	1	-	-	-	-
	PE-30	1941 - 1945; 1951 - 1956; 1969-70 - PETN Screen House	240	240	L10ss-059M-SO	0 to 1	1 + PETN	-	1	-	-	-	1-Chlorate Only
Discrete Surface Soil Locations	PE-19	1941 - 1945; 1951 - 1956;19 69-70 - Gum Solution Bldg.	470	470	L10ss-060D-SO	0 to 1		-	-	-	1	-	-
QA	PE-19	1941 - 1945; 1951 - 1956;19 69-70 - Gum Solution Bldg.	470	470	L10ss-060D-QA	0 to 1					1		
QC Duplicate to LL10ss-060D-SO	PE-19	1941 - 1945; 1951 - 1956;19 69-70 - Gum Solution Bldg.	470	470	L10ss-066D-SO	0 to 1					1		
"	PE-22	1941 - 1945; 1951 - 1956; 1969-70 - Solvent Storage Bldg	39	39	L10ss-061D-SO	0 to 1		-	-	-	1	-	-
						PRIMARY LAB	27*	4	27	5	3	5	8-Chlorate Only
						QA LAB	2**	1	2	1	1	1	1-Chlorate Only

Primary Sample
Quality Assurance
Field MI Duplicate
Blind Duplicate
MS/MSD Pair
Discrete

*22 + 5 W/PETN
** 1 + 1W/PETN

TABLE 4-5 Laboratory Container and preservation requirements for analyses of soil samples to be collected at slab and foundation removal at LLs 5, 7, 8, and 10.

Analyte Group	Approx. No. of Containers incl. Field QC	Laboratory Container	Minimum Sample Size	Preservative	Holding Time
VOCs		One 2-oz. glass jar with Teflon®-lined cap (no headspace)	20 grams	Cool, 4°C	14 d
Explosive Compounds		One 4-oz. glass jar with Teflon®-lined cap	100 grams	Cool, 4°C	14 days (extraction) 40 days (analysis)
Propellants		One 4-oz. glass jar with Teflon®-lined cap	100 grams	Cool, 4°C	14 days (extraction) 40 days (analysis)
Metals		One 8-oz. wide-mouth glass jar with Teflon®-lined cap	50 grams	Cool, 4°C	180 d
SVOCs		One 8-oz. wide-mouth glass jar with Teflon®-lined cap	100 grams	Cool, 4°C	14 days (extraction) 40 days (analysis)
Pesticides/Herbicides/PCBs		One 8-oz. wide-mouth glass jar with Teflon®-lined cap or use same container as SVOC, where possible	100 grams	Cool, 4°C	14 days (extraction) 40 days (analysis)
Nitrates, Chorates		One 4-oz. glass jar with Teflon®-lined cap	100 grams	Cool, 4°C	14 days (extraction) 40 days (analysis)

a One sample will be tripled in volume for the laboratory to perform appropriate laboratory QC analysis.
QC = quality control. VOC = volatile organic compound.
b The field multi-incremental sample will collect a volume of about 0.125 cubic feet = 216 cubic inches ; weighs about 12.5 pounds = 5670 grams
c Only the VOC samples will be collected in the field in glass jars.

APPENDIX A

SAMPLING SUMMARY FOR THE SURFACE SOIL

AFTER SLAB REMOVAL

APPENDIX A - SAMPLING SUMMARY FOR THE SURFACE SOIL AFTER SLAB REMOVAL

Appendix A   Sampling Summary for the Surface Soil After Slab Removal

PRIMARY LAB	MI PREP	EXPLOSIVES	EXPLOSIVES & PETN	METALS	PROPELLANTS	SVOCS	VOCS	PCBS	PESTICIDES	HERBICIDES	NITRATES	CHLORATES
LOAD LINE 5	15	15		16	2	3	3	3	3	3	4	
MS/MSD		2		2		2	2	2	2	2	2	
FIELD MI DUP	2	2		2	2	2		2	2	2	1	
QC DUP		2		3	2	2	1	2	2	2	1	
LOAD LINE 7	13	13		13	3	2	3	2	2	2		
MS/MSD		2		2								
FIELD MI DUP	2	2		2	1	1		1	1	1		
QC DUP		2		2	1	1	1	1	1	1		
LOAD LINE 8	13	13		13	2	3	3	3	3	3		
MS/MSD		2		2								
FIELD MI DUP	2	2		2	1	1		1	1	1		
QC DUP		2		2	1	1	1	1	1	1		
LOAD LINE 10	21	18	3	21	2	3	2	3	3	3		4
MS/MSD		2	1	2								2
FIELD MI DUP	2	1	1	2	1	1		1	1	1		1
QC DUP		1	1	2	1	1	1	1	1	1		1
CONTINGENCY	3	3		3	1	1	1	1	1	1		1
PRIMARY LAB TOTAL	**73**	**84**	**6**	**91**	**20**	**24**	**18**	**24**	**24**	**24**	**8**	**9**

QA LAB

LOAD LINE 5		2		3	2	2	1	2	2	2	1	
LOAD LINE 7		2		2	1	1	1	1	1	1		
LOAD LINE 8		2		2	1	1	1	1	1	1		
LOAD LINE 10		1	1	2	1	1	1	1	1	1		1
CONTINGENCY		1		1	1	1	1		1	1	1	1
QA LAB TOTAL		**8**	**1**	**10**	**6**	**6**	**5**	**5**	**6**	**6**	**2**	**2**

CRREL MI SAMPLE PREPARATION (PULVERIZATION) FOR EXPLOSIVES ONLY = (13 + 11 + 12 + 20 + 2) = 58 GROUND MI SAMPLES

CRREL MI SAMPLE PREPARATION (PULVERIZATON) FOR EXPLOSIVE & PROPELLANTS = (4 + 4 + 3 + 3 + 1) = 15 GROUND MI SAMPLES

LABORATORY PROCESSING / ANALYZING OF MI FIELD SAMPLES

BULK MI FIELD SAMPLE SENT TO PRIMARY LAB IN COOLER WITH ICE

PRIMARY LAB PROCESSES ENTIRE SAMPLE (AIR DRY, PASS #10 SIEVE, GRIND WITH KITCHENAID COFFEE GRINDER)

PRIMARY LAB PREPARES REPRESENTATIVE PRIMARY JAR SAMPLE(S) FOR ITS OWN ANALYZES OF METALS AND (SVOCS, PCBS, PESTICIDES, HERBICIDES, NITRATES, AND CHLORATES) AS LISTED ON THE SAMPLING TABLES

PRIMARY LAB ANALZES PRIMARY JAR SAMPLE(S) FOR METALS AND (SVOCS, PCBS, PESTICIDES, HERBICIDES, NITRATES, AND CHLORATES) AS LISTED ON THE SAMPLING TABLES

WHERE INDICATED FOR QC DUPLICATE, THE PRIMARY LAB PREPARES REPRESENTATIVE JAR SAMPLE(S) FROM THE ENTIRE GROUND SAMPLE AND RELABELS THAT JAR SAMPLE(S) AS PER THE SAMPLING TABLES

PRIMARY LAB ANALYZES THE QC DUPLICATE FOR METALS AND (SVOCS, PCBS, PESTICIDES, HERBICIDES, NITRATES, AND

CHLORATES) AS LISTED ON THE SAMPLING TABLES

WHERE INDICATED FOR MS/MSD, THE PRIMARY LAB PREPARES REPRESENTATIVE JAR SAMPLE(S) FROM THE ENTIRE GROUND SAMPLE AND RELABELS THAT JAR SAMPLE(S) AS PER THE SAMPLING TABLES

PRIMARY LAB ANALYZES THE MS/MSD JAR SAMPLES FOR (METALS, SVOCS, PCBS, PESTICIDES, HERBICIDES, NITRATES, AND CHLORATES) AS LISTED ON THE SAMPLING TABLES

WHERE INDICATED FOR QA DUPLICATE, THE PRIMARY LAB PREPARES REPRESENTATIVE JAR SAMPLE(S) FROM THE ENTIRE GROUND SAMPLE, LABELS THE JAR SAMPLE(S) AS LISTED ON THE SAMPLING TABLES, AND FORWARDS THE SAMPLE JAR(S) ON ICE TO THE QA LAB

QA LAB ANALYZES THE SAMPLE JAR(S) AS LISTED ON THE SAMPLING TABLES

PRIMARY LAB SENDS THE REMAINDER OF THE BULK MI GROUND SAMPLE TO CRREL (ICE NOT REQUIRED)

CRREL PULVERIZES THE REMAINDER OF THE BULK MI GROUND SAMPLE, PER REQUIREMENTS FOR (EXPLOSIVES ONLY) OR (EXPLOSIVES AND PROPELLANTS)

CRREL PREPARES, LABELS, AND SHIPS A REPRESENTATIVE PRIMARY JAR SAMPLE TO THE PRIMARY LAB, AND A SECOND REPRESENTATIVE JAR SAMPLE (QC) TO THE PRIMARY LAB, AS LISTED ON THE SAMPLING TABLES (ICE NOT REQUIRED DURING SHIPMENT OF JAR SAMPLE(S))

PRIMARY LAB ANALYZES THE SAMPLE JAR(S) AS LISTED ON THE SAMPLING TABLES

CRREL PREPARES, LABELS, AND SHIPS A REPRESENTATIVE QA JAR SAMPLE TO THE QA LAB, AS INDICATED ON THE SAMPLING TABLES - (ICE NOT REQUIRED DURING SHIPMENT OF JAR SAMPLE(S))

QA LAB ANALYZES THE SAMPLE JAR AS LISTED ON THE SAMPLING TABLES

PROCEDURES FOR DISCRETE SAMPLES FOR VOC ANALYSES - CONVENTIONAL

FIELD CREW PREPARES AND LABELS SEPARATE 2 OZ JAR SAMPLES FOR PRIMARY, QA, MS, MSD, AND QC DUPLICATE, AS LISTED ON THE SAMPLNG TABLES - ALL SAMPLES SHIPPED ON ICE AND WITH TRIP BLANKS

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APPENDIX B –

STANDARD OPERATING PROCEDURE FOR PARTICLE SIZE REDUCTION OF SOLID MATRICES

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Implementation Date 10-18-06

STL North Canton
STANDARD OPERATING PROCEDURE

TITLE: PARTICLE SIZE REDUCTION OF SOLID MATRICES

(SUPERSEDES: Revision 3, dated 05/24/04)

Approved by: Mark L. Bruce 10/17/06
Technology Specialist Date

Approved by: Dorothy J. Leeson 10/18/06
Quality Assurance Manager Date

Approved by: William J. Geibel 10-17-06
Environmental Health and Safety Coordinator Date

Approved by: 10/18/06
Laboratory Director Date

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TABLE OF CONTENTS

1. SCOPE AND APPLICATION

1.1. These particle size reduction and homogenization procedures are applicable to soil and sediment matrices (1.5 kg maximum) to be analyzed for inorganic and semivolatile analytes with low vapor pressures.

1.2. This document accurately reflects current laboratory standard operating procedures (SOP) as of the date above. All facility SOPs are maintained and updated as necessary.

2. SUMMARY OF METHOD

2.1. Air-Dried Soil Homogenization Process--the sample is air dried at room temperature and chopped or ground to a fine powder to facilitate obtaining a representative sub-sample and improving analyte extraction efficiency.

2.2. Soil Fractionation for Lead--applicable to lead impacted soil and is designed to distinguish the lead in the fine soil fraction from the coarse soil fraction.

2.3. Multi-Increment Sample Wet Homogenization Process--applicable to mixing multi-increment samples into a single composite. These samples are NOT air dried, but rather water is added to facilitate homogenization in a heavy-duty mixer.

3. DEFINITIONS

3.1. Refer to the glossary in the Laboratory Quality Manual (LQM), latest version.

3.2. Homogenize--To thoroughly mix the sample and reduce the analyte concentration differences between different parts of the overall sample.

4. INTERFERENCES

4.1. Method interferences may be caused by contaminants in solvents, reagents, glassware, and other processing apparatus that lead to discrete artifacts. All of these materials must be routinely demonstrated to be free from interferences under conditions of the analysis by running laboratory method blanks as described in the Quality Control section. Specific selection of reagents may be required to avoid introduction of contaminants.

5. SAFETY

5.1. Employees must abide by the policies and procedures in the Corporate Safety Manual and this document.

5.2. Eye protection that protects against splash, laboratory coat, and appropriate gloves must be worn while samples, standards, solvents, and reagents are being handled. Cut resistant gloves must be worn doing any other task that presents a strong possibility of getting cut. Disposable gloves that have been contaminated will be removed and discarded; other gloves will be cleaned immediately.

5.3. Exposure to chemicals must be maintained **as low as reasonably achievable**; therefore, unless they are known to be non-hazardous, all samples must be opened, transferred and prepared in a fume hood, or under other means of mechanical ventilation where possible. All samples with stickers that read "Caution/Use Hood!" **must** be opened in the hood. Contact the EH&S Coordinator if this is not possible. Solvent and waste containers will be kept closed unless transfers are being made.

5.4. All work must be stopped in the event of a known or potential compromise to the health and safety of a STL associate. The situation must be reported **immediately** to the EH&S Coordinator and the Laboratory Supervisor.

5.5. When operating the electric chopper or grinder, be sure to keep all liquids clear to prevent the risk of electrical shock from any spills.

5.6. Avoid inhalation of sample dust. Work in a ventilation hood when necessary to avoid accidental dust inhalation.

5.6.1. Construct by fastening the bottom half of a fluorpolymer bottle to a wooden handle with stainless steel screws.

6. EQUIPMENT AND SUPPLIES

6.1. DI water – Reagent water must be produced by a Millipore DI system or equivalent. Reagent water must be free of the analytes of interest as demonstrated through the analysis of preparation blanks.

6.2. Drying tray, plastic or aluminum

6.2.1. Half cake sheet pan, Pactiv #614255, or equivalent

6.2.2. Quarter sheet cake pan, Pactiv #604245, or equivalent

6.3. Aluminum foil

6.4. Butcher Paper

6.5. Plastic wrap

6.6. Mortar and pestle

6.7. Food chopper, Black and Decker Handi Chopper or DeLonghi Mini Food Processor or equivalent

6.8. Coffee grinder, Kitchen Aid BCG100 or equivalent

6.9. Wooden spatula, 6 in.

6.10. Stainless steel sieves, 1 mm, #10, #20, #60, ¼ inch

6.11. Electrolux Assistant 8 qt mixer, with dough hook

6.12. Large cookie scoop, with hand actuated ejector blade

6.13. Small cookie scoop, with hand actuated ejector blade

6.14. Fluoropolymer scoop, not commercially available

    6.14.1. Construct by fastening the bottom half of a fluorpolymer bottle to a wooden handle with stainless steel screws.

6.15. Stainless steel pot with cover, Bain-Marie 6 qt.

6.16. Wooden spoon, 12" long

Picture of labware for Multi-increment sample wet homogenization process (Section **Error! Reference source not found.**): Large scoop, small scoop, wooden spoon, fluoropolymer scoop, stainless steel pot/cover

7. REAGENTS AND STANDARDS

7.1. Not applicable to this procedure.

8. SAMPLE COLLECTION, PRESERVATION AND STORAGE

8.1. Not applicable to this procedure. Sample collection, preservation, and storage is dependent on the requested test method.

9. QUALITY CONTROL

9.1. Not applicable to this procedure.

10. CALIBRATION AND STANDARDIZATION

10.1. Not applicable to this procedure.

11. PROCEDURE

11.1. One time procedural variations are allowed only if deemed necessary in the professional judgment of supervision to accommodate variation in sample matrix, radioactivity, chemistry, sample size, or other parameters. Any variation in procedure shall be completely documented using a Nonconformance Memo, and is approved by a Technical Specialist and the Quality Assurance Manager. If contractually required, the client shall be notified. The Nonconformance Memo shall be filed in the project file.

11.2. Any unauthorized deviations from this procedure must also be documented as a nonconformance, with a cause and corrective action described.

11.3. Sample Preparation

11.3.1. Air-Dried Soil Homogenization Process

11.3.1.1. Line a tray (~10 in. by 20 in.) with aluminum foil, or use a disposable aluminum tray.

11.3.1.2. Remove large rocks and vegetation. Do not decant the free water. Mix the sample and remove approximately 10g for total solids analysis. Spread all remaining sample in a thin layer in the tray.

11.3.1.3. Place the tray in the ventilated drying rack for one to five days at room temperature.

11.3.1.4. Periodically, stir the sample to expose moist sample to the air.

11.3.1.5. Allow sediment samples to dry to less than 30% moisture content. Soil samples should be less than 5% moisture content. The dried sample must be crushable, and not prone to sticking together.

11.3.1.6. Pulverize the dried sample to break up the dried sample clumps, but do not grind the small pebbles into powder. Depending on sample size and level of mechanization needed, this may be accomplished by using: 1) a mortar and pestle, 2) food chopper, 3) blender, and/or 4) pestle and sieve (1mm openings). For dried soil samples the food chopper is generally the preferred means of breaking of the soil agglomerates without grinding up the small pebbles and stones.

11.3.1.7.If the volume capacity of the pulverizing equipment is large enough, transfer the whole sample to the pulverizer. If sample volume is too large, pulverize the sample in sub-aliquots. Combine all pulverized sub-aliquots, and mix thoroughly by stirring or shaking/tumbling.

11.3.1.8.Pass the sample through a sieve to remove small pebbles and organic materials. Project specific guidelines will determine the sieve opening size. Typically, a #10 sieve is used for soils and a #20 sieve for sediments.

11.3.2. Soil Fractionation for Lead Analysis

11.3.2.1.Add sample ID label to outside of an aluminum tray (~8 in. X 12 in.) Line with butcher paper if aluminum is an analyte of interest.

11.3.2.2.Transfer the entire soil sample to a tray. Remove large rocks and vegetation. Mix the sample, and remove approximately 10g for total solids analysis. Spread all remaining sample in the tray. Spreading the sample in a thin layer speeds drying and reduces the formation of hard clay chunks.

11.3.2.3. Place the tray in the ventilated drying rack for 1 to 5 days.

11.3.2.4.Periodically, stir the sample if needed to expose moist sample to the air.

11.3.2.5.Wet samples with high clay content tend to form large hard clay chunks. To reduce the formation of these hard "bricks", use the bottom of a clean disposable beaker to gently crush the semi-dried sample before drying is complete.

11.3.2.6.Allow the sample to dry until crumbly.

11.3.2.7.Assemble 8-inch sieve stack. The order from the bottom of the stack is collection pan, #60 sieve, and #10 sieve. Transfer sample ID label from drying pan to sieve stack.

11.3.2.8.Transfer dried soil to the #10 sieve at the top of the sieve stack. If fine particulates are present, use sufficient ventilation to prevent the analyst from inhaling the dust. Install sieve cover.

11.3.2.9. Some wet clay samples will dry into a hard "brick" or "pancake". Break by hand until the chunks are small enough to fit into the top sieve and proceed.

11.3.2.10. Place the sieve stack on the shaker table and secure. Run the shaker on high until most of the sample has passed through the #10 sieve (10 minutes to 2 hours depending on sample volume and size of soil agglomerates). The high shaker setting produces ~180 cycles/min with 4 cm travel on the back and forth shaking.

11.3.2.11. Note: Some hard clay samples may have a large percentage of soil agglomerates that do not crumble and pass through the #10 sieve. Do not extend shaking beyond two hours without conferring with the client.

11.3.2.12. Record the weights of the three fractions--large (did not pass through the #10 sieve), coarse (passed through #10 sieve, but not the #60 sieve), and fine (passed through both #10 and #60 sieves).

11.3.2.13. To weigh each fraction, place the corresponding sieve or pan on the balance, press "Tare", transfer the fraction, and place sieve or pan back on the balance. The weight of the fraction will read as a negative value.

11.3.2.14. Discard the large fraction. Mix the fine fraction. Remove approximately 10g for total solids analysis.

11.3.2.15. If the coarse fraction is to be analyzed separately, mix the coarse fraction and remove approximately 10g for total solids analysis. The coarse fraction should be ground in a mortar and pestle (or other grinding device) prior to removing the aliquot for metals digestion.

11.3.2.16. The combination of coarse and fine fractions is defined as the "total". If the "total" is to be measured, weigh 1/10 of the coarse fraction and 1/10 of the fine fraction. Combine, mix, and remove approximately 10g for total solids analysis.

11.3.2.17. Bottle coarse, fine, and "total"(if needed) fractions for metals analysis.

11.3.2.18. For Michigan samples, the "total" result is calculated from a weighted average of the results from the fine and coarse fractions.

Total Lead = [(A x Wf) + (B x Wc)] / (Wf + Wc)

Where:
A = Concentration of Lead (mg/Kg dry) in fine fraction
B = Concentration of Lead (mg/Kg dry) in coarse fraction
Wf = Total weight of fine fraction
Wc = Total weight of coarse fraction

11.3.2.19. Wash the sieves with soap, tap water, and deionized water. Dislodge objects from the screen with a green scratch pad, wooden tongue blade or small screwdriver, as necessary. Dry sieves in a heated oven or air-dry at ambient temperature over night, depending how soon they will be needed.

11.3.3. Multi-increment sample wet homogenization process

11.3.3.1. Weigh 100.0 +/- 0.2 g of each ¼ acre sub-sample. Stir the sample prior to and during the transfer from the original container to the weighing container. Record the weight to 2 decimal places.

11.3.3.2. If there are fewer than 40 sub-samples, increase the weight of sample proportionally. Calculate the new target weight as follows: target weight = 4000g/# sub-samples.

11.3.3.3. Exclude rocks, organic matter, and other debris from the weighed sub-sample by sieving through a ¼ inch sieve prior to weighing when such material is present.

11.3.3.4. The sieve may also be used to break up clay chunks. Sieving may be done either before or after weighing for this purpose. Use only when needed.

11.3.3.5. If a sub-sample is over ½ gravel, expand the maximum particle size from ¼ inch to 1.8 inches.

11.3.3.6. Transfer the weighed (and sieved as needed) sub-sample aliquot to a stainless steel pot used to collect all weighed aliquots for that composite sample. The total mass of the composite sample will be at least 4 kg.

11.3.3.7. Repeat Section 11.3.3.1 until all sub-samples have been weighed and transferred to the compositing pot.

11.3.3.8. Assemble the heavy-duty mixer with mixing hook. The mixing hook must be inserted high in the mounting bracket to avoid dragging on the bottom of the bowl and allow small stones to pass under the hook. Transfer the entire composite sample from the covered stainless steel pot to the stainless mixing bowl.

11.3.3.9. Turn on mixer. Add reagent water to ensure complete mixing of the sample. The mixed sample will have uniformly distributed water, look visually homogeneous, and have the consistency of a thick paste. Do not add so much water as to form runny slurry. Use a wooden spoon to assist the mixing process by scraping mud from the sides and directing it to the center. The picture below shows the proper consistency. Mix for three minutes after the proper consistency has been achieved.

completely mixed composite sample.mpg

11.3.3.10. Record the volume of reagent water added and the total mixing time.

11.3.3.11. Scrape the mud from the wooden spoon and mixing hook.

11.3.3.12. Split the composite sample between nine 250 mL jars and one 2.5 L jar.

11.3.3.12.1. Use the large scoop to dispense 15 equal aliquots of the composite sample. One aliquot into each of nine 8 oz. jars and six aliquots into a 2.5 L jar. Repeat the process if there is sufficient sample for 15 large scoop aliquots.

large scoop use.mpg

11.3.3.12.2. Once the volume of wet composite sample in the bowl is less than 15 large scoops, switch to aliquoting with the small scoop. Dispense 15 small scoops. One into each 8 oz jar and six into the 2.5 L jar.

11.3.3.12.3. Use the fluoropolymer scoop to scrape inside the bowl, and dispense this part of the sample with the small scoop. If there is insufficient sample to use full scoops, the use of replicate partial scoops is acceptable.

fluoropolymer scoop use.mpg

11.3.3.12.4. When aliquoting is complete, the composite sample has been evenly distributed among the 8 oz. jars, and the 2.5 L jar has six times more sample than an 8 oz. jar. Note: Multiple jars are used for various analyses, quality control, and archive purposes.

11.3.3.13. Mix the contents of each 250 mL jar, and remove about 10 grams from the each of the first three jars for three total solids (percent moisture) analyses. The relative percent difference (RPD) between the first two must not exceed 8%.

11.3.3.13.1. If the RPD exceeds 8%, repeat the total solids analysis on two fresh aliquots from the first two jars.

11.3.3.13.2. If the RPD still exceeds 8%, repeat the homogenization process in Sections 11.3.3.1 to 11.3.3.12.

11.3.3.14. Wipe the top of the jar to remove excess sample and install the cap. Transport all sample containers to Sample Receiving.

11.3.3.15. Discard the wooden spoon and spatulas. Wash the mixer bowl, hook and scoops using soap and water. Rinse with tap and reagent water.

11.4. Sample Analysis

11.4.1. Not applicable to this procedure.

11.5. Analytical Documentation

11.5.1. Record all analytical information in the analytical logbook/logsheet which may be in an electronic format, including the analytical data from standards, blanks, LCSs, MS/MSDs, and any corrective actions or modifications to the method.

12. DATA ANALYSIS AND CALCULATIONS

12.1. Not applicable to this procedure.

13. METHOD PERFORMANCE

13.1. The Group/Team Leader has the responsibility to ensure this procedure is performed by an associate who has been properly trained in its use and has the required experience.

14. POLLUTION PREVENTION

14.1. This method does not contain any specific modifications that serve to minimize or prevent pollution.

15. WASTE MANAGEMENT

15.1. All waste will be disposed of in accordance with Federal, State and Local regulations. Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this method and the policies in section 13 of the Corporate Safety Manual for "Waste Management and Pollution Prevention."

15.2. Waste Streams Produced by the Method

15.2.1. Used wood spatulas, aluminum sheets, butcher paper; discard in solid waste.

15.3. Laboratory personnel assigned to perform hazardous waste disposal procedures must have a working knowledge of the established procedures and practices of STL. They must have training on the hazardous waste disposal practices upon initial assignment to these tasks, followed by an annual refresher training.

16. REFERENCES

16.1. References

16.1.1. U.S. EPA, 2000. TRW Recommendations for Sampling and Analysis of Soil at Lead (Pb) Sites. EPA-540-F-00-010. OSWER 9285.7-38. April. Available on-line at: http://www.epa.gov/superfund/programs/lead/products/sssiev.pdf

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16.1.4. Michigan DEQ SOP #213 Revision #1, Nov. 9, 2004, Soil Fractions Preparation for Lead Analysis (Creating Total, Fine and Coarse Soil Samples). Available on-line at: http://www.deq.state.mi.us/documents/deq-rrd-OpMemo_2_SoilFractionsPrepForLead.pdf

16.1.5. Corporate Quality Management Plan (QMP), current version.

16.1.6. STL Laboratory Quality Manual (LQM), current version.

16.1.7. STL Corporate Safety Manual, M-E-0001 and STL North Canton Facility Addendum and Contingency Plan, current version.

16.2. Associated SOPs and Policies, latest version

16.2.1. QA Policy, QA-003

16.2.2. Glassware Washing, NC-QA-0014

17. MISCELLANEOUS (TABLES, APPENDICES, ETC...)

17.1. Reporting Limits--Not applicable to this procedure.

17.2. Method Deviations--None

APPENDIX C

STANDARD OPERATING PROCEDURE FOR LABORATORY AND SAMPLE SECURITY

Controlled Copy
Copy No. ____________

Implementation Date: 12/3/04

SOP No. NC-QA-0009
Revision No. 2.1
Revision Date: 11/28/04
Page 1 of 4

STL NORTH CANTON

STANDARD OPERATING PROCEDURE

TITLE: LABORATORY AND SAMPLE SECURITY

(SUPERSEDES: REVISION 2, 02/13/01)

Approved by: ____________ Quality Assurance Manager 12/2/04 Date

Approved by: ____________ Laboratory Director 12/2/04 Date

Approved by: ____________ Technical Director 12/14/04 Date

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1. PURPOSE

1.1. The laboratory is a secure area. Only laboratory personnel are to have free access to the laboratory work areas. All other people are treated as visitors and must wear visitor badges.

1.2. This document accurately reflects current standard operating procedures (SOP) as of the date above. All facility SOPs are maintained and updated as necessary by the laboratory QA department.

2. RESPONSIBILITIES

2.1. It is the responsibility of the employee to perform the procedure described herein in full compliance with this SOP.

2.2. It is the responsibility of the Laboratory Director, QA Manager, and departmental Supervisor of this facility to assure that the procedure described is performed in full compliance with this SOP. It is also their responsibility to supply adequate training, materials, and equipment to enable the employee to perform this SOP correctly.

3. SAFETY

3.1. Normal office dependent safety precautions must be taken in performing this SOP. If personnel are required to perform any portion of the procedure in laboratory areas, appropriate personal protective equipment and precautions must be utilized.

4. PROCEDURES

4.1. Any deviations from this procedure must be documented as a nonconformance, with a cause and corrective action described.

4.2. In order to assure laboratory security, the following actions have been taken. All exterior doors of the building are locked and are accessible only with an electronic key. The front door is unlocked during the day shift, but, the front office personnel are responsible for screening all people entering the front door during the day shift. The front office personnel must have all other people sign the visitor logbook, issue them a visitor badge, and call an employee to escort the person through the facility.

4.3. Electronic keys are assigned to all employees and are maintained and issued by the safety coordinator. Electronic keys are not to be shared among employees.

4.4. The Chain-of-Custody and Sample Receiving SOPs protect sample security. Under these SOPs, samples are either inside an official sample storage area or they are in the analyst's possession. Analysts are responsible for a sample's security while it is in their possession. The sample is to remain in view of the analyst at all times when it is not in a secure storage area.

5. DEFINITIONS

5.1. Refer to the glossary in the Laboratory Quality Manual (LQM), latest version

6. APPENDICES

6.1. Not applicable

APPENDIX D

DRAFT GUIDANCE FOR MULTI-INCREMENT SAMPLING

DRAFT GUIDANCE FOR MULTI-INCREMENT SAMPLING

1. Purposes & Basic Requirements of Taking Multi-Increment Samples

a. The purpose of collecting, preparing, and analyzing a multi-incremental sample is to provide a repeatable and accurate measure of the average concentrations of constituents of interest within a sample area. Specific data quality objectives (DQOs) will be required for each project that will determine the types and numbers of samples required.

b. Sufficient amount of sample material must be collected from the sample area to account for compositional heterogeneity and additionally, a sufficient number of sub samples utilizing a stratified random methodology must be taken to account for distributional heterogeneity.

c. Typical uses of accurate, average values are as, exposure point concentrations in sample areas, delineation of nature and extent of contamination, characterization sampling of a potential waste material, and closure sampling of a remediated area to provide legally defensible, scientifically based evidence that satisfactory remediation has been accomplished.

d. The likelihood of determining small scale hot spots of contamination by conventional discrete sampling is extremely low, and unrepeatable. Multi-increment sampling provides a much greater probability of determining representative and repeatable contamination within a reasonably sized area,see Reference 8.

2. Determination of Multi-Increment Sample Areas

The determination of appropriate sample areas depends on many factors including, the ultimate use of the average value, the constituent’s toxicity and mobility, physical/chemical characteristics of a given site, and the reasonably anticipated future land use. For instance, in the ecological realm, if a fish population study is to be conducted over a specified reach of a creek or river, then the appropriate multi-increment sample area is the entire same specified reach of that creek or river. If a vegetation analysis is to be made at a burning pad at a burning grounds, then the appropriate sample area is the pad area.

In the human health realm, if the future land use is known, then the appropriate sample area is the smallest exposure area associated with that land use. For instance, if a given site is to be industrial, then the appropriate sample area would be the smallest exposure area associated with industrial usage. If an unrestricted land use, residential, is used, then the smallest exposure area is ¼ acre, and thus sample areas would be no larger than ¼ acre.

In many instances, the physical/chemical/operational characteristics at the site will direct appropriate sample areas.

The determination of multi-increment sample areas would generally be done on a site by site basis for any given investigation in coordination with risk assessment guidelines and risk assessor recommendations. Similar site by site selection is required when discrete biased sampling is performed, so there is nothing new or additional in determining appropriate multi-increment sample areas.

3 Determination of Sub-Sample Locations within a Multi-Increment Sample Area

Obviously, the best and surest measure of determining the average value within a sample area would be to collect portions over the entire sample area. But because that is cost prohibitive in most cases, sampling of only portions within the sample area must be done. As in many other disciplines where heterogeneity is a major concern, sub-sample locations should be selected on a stratified-random basis. The stratification assures coverage over the entire sample area and the randomness provides repeatability and accuracy. Varying degrees of sophistication may be utilized to achieve stratified random sampling locations, as subdividing a sample area into say 30 sub-sample areas and then using a random number generator to select a location within the 30 sub-sample areas. This method requires minor surveying, but the major disadvantage is that sometimes the random locations are not accessible, as for instance if a large tree is present at the specified location. **Alternatively, the sub-sample locations may be located by a “drunken-sailor” approach wherein a sample locator merely wanders over the entire**

sample area throwing out sampling location stakes randomly as he/she walks over the entire sample area.

Generally about 30 sub-samples should be taken within a given sample area. If replicates yield a variability that is too great, then the number of sub-samples would have to be increased, possibly as high as 100 and potentially more sample mass would be required.

4 Collection of a Multi-Increment Sample

Because of the use of multi-increment sampling in other disciplines, tools already exist to collect sub samples of environmental media, as soil and sediment. Reference to the Forest Suppliers, Inc Catalog 54, pages 223 – 229 and the AMS 2003 Soil and Groundwater 2003 Catalog, pages 20 – 39 shows many types of tools are already available that can be used to easily collect the necessary sub-samples. Generally, the samplers should be stainless steel if metals analyses are to be made and a small volume should be collected to facilitate subsequent sample processing. For sediment sampling recently performed something as simple as a plastic scope was utilized. Recent examples of sampling tools utilized have included:

RVAAP Facility-Wide Surface Water Sediment Study,

Eckman dredges for sediment in the large ponds with soft mud, silt or sand bottoms (not appropriate for gravel, rock bottoms, or detritus),

Plastic scoops for silt, sand, clay creek sediment along the rock bottom creeks,

A 7/8”-diameter step probe for small pond sediment sampling

If feasible, disposable tools may be utilized; otherwise decontamination can be made of tools between sample areas, but obviously not during collection of the sub-samples within a sample area. Selection of sampling tools and equipment will also be dependent upon the DQOs and will be identified in the Project Specific Sampling Plan Addendum.

As in all field sampling, sufficient prefield work should be done to select an array of possible tools. Then selection and use of the tools should be customized to the actual field conditions. For instance, one type of surface soil sampler may be more effective with sandy soils than with clayey soils.

The sub-samples collected from a sample area should be all placed in a container, as a large baggie or bowl, large enough to transport them back to the sample processing location.

Because of volatilization issues, multi-increment sampling cannot be utilized for collection of samples for VOC analysis unless collected samples are stored in a solution of methanol.

Additionally, if SVOCs are of concern, further consideration of the use of plastic sampling materials should be done prior to sampling.

5 Processing of a Multi-Increment Sample

The overall goal of the field collection is to collect sufficient material over the sample area to account for both compositional and distributional heterogeneity. In all probability much more sample material will be collected in the field than will be tested in the laboratory. If facilities are available in the field, field sample processing can be done prior to shipment of a sample to the laboratory. If no facilities are available in the field, the total collected field sample can be forwarded to the laboratory where sample processing can be performed. Sample processing must be done of the field collected sample to again provide a representative, but smaller sample of appropriate quantity for laboratory analyses.

The type of material collected will determine the type of processing required. For the thoroughly saturated clayey sediments (muck) collected from the ponds in the RVAAP Surface Water/ Sediment Study, the entire saturated sample was laid out and 30 small spoon samples taken randomly across the mix to fill each of the analytical sample jars.

For less saturated materials, the total sample of a sample area should initially be air dried overnight. Subsequently, the entire air-dried multi-increment sample should be sieved according to the needs of the DQOs, but for soil the most typical size is a #10 sieve. Any materials larger than #10 discarded should be discarded. The remaining air-dried, sieved material should then be ground to better homogenize the sample. As before, the ground material should be laid out and 30 small spoon samples were taken randomly across the mix to fill each of the analytical sample jars.

The sample processing provides a much more representative, uniform, repeatable set of jar samples that analytical labs can analyze.

6 Quality Control/Assurance

A Field

To measure repeatability of field collection techniques, two separate field samples can be collected using the same field collection techniques from any given sample areas to measure their repeatability. **Collection of duplicative samples should be done as a minimum for each type of environmental media and on a pre-selected basis of 1 in 10 where there are more than 15 samples of a given media.** The results of these duplicative samples can then be used to measure repeatability. If such samples are indeed very repeatable, their accuracy can be inferred. If the variability of the replicates is too great, either the number of increments or the mass must be increased (and in some cases both).

B Laboratory

The current practice of preparing duplicates or splits from a single discrete sample is extremely flawed because of no sample processing prior to sending the jar samples to the laboratory. The measures specified for sample processing in 5 above will provide samples to the laboratories that are much more similar than the current practice. With more uniform samples received from the field, the comparison of analytical results from different labs and QC samples from the same laboratory will be much more valid. Significantly improved agreement between original, QC, and QA samples has been observed at both the RVAAP Facility-Wide Surface Water/Sediment Project and the Joliet Army Reserve Project.

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2 Soil Sampling, Handling and Testing, Ohio State University Extension, AGF-206-95, ohioline.osu.edu/agf-fact.0206.html

3 Taking Soil Samples, University of Kentucky Extension, AGR 16, ca.uky.edu/agc/pubs/agr/agr16/agr16.htm

4 Guidelines for Soil Sampling, University of Nebraska,

ianr.unl.edu/pubs/Soil/g1000.htm

5 Soil Sampling, University of Montana,

Montana.edu/wwwpb/pubs/mt8602.html

6 Soil Sampling Fields with Four Types of Probes, University of Missouri, plantmanagementnetwork.org/pub/cm/research/soilprobe

7 Soil Sampling, Colorado State, ext.colostate.edu/pubs/crops/00500.html

8 Composite and Discrete Sampling to Attain Risk Based Site Characterization Objectives- A Case History, Mark Gemperline, 15th Annual International Conference on Contaminated Soils and Water, Oct 1999.

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10 The Effect of Particle Size Reduction by Grinding on Subsample Variance for Explosives Residues in Soil, Marianne E. Walsh, Charles A. Ramsey, Thomas F. Jenkins, Chemoshpere, 49 (2002) 1267-1273.

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US Army Corps
of Engineers
Louisville District

Site Safety and Health Plan for Field Activities Associated with Soil Sampling and Characterization of Soils Exposed Following Slab and Foundation Removals at Load Lines 5,7,8,10

Ravenna Army Depot
Ravenna, Ohio

August 2007

APPROVALS

PREPARED BY:

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REVIEWED BY:

7-31-07

Shelton Poole, CHMM, RPIH

HEALTH AND SAFETY PLAN ACKNOWLEDGEMENT FORM

I have read this Health and Safety Plan and am familiar with the provisions contained in these plans.

Signature **Date**

Project Team Leader ______________________________ __________

On-Site SSHO ____________________________________ ___________

Project Personnel

____ _____________

____ _____________

____ _____________

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Acronyms

AOC – Area of Concern

CPR – Cardiopulmonary Resuscitation

DQOs – Data Quality Objectives

EM – (U.S. Army Corps of Engineers) Engineering Manual 385-1-1 (current version)

EPA – Environmental Protection Agency (U.S.)

MSDS – Material Safety Data Sheet

OEPA – Ohio Environmental Protection Agency

OSHA – Occupational Safety and Health Office

PPE – Personal Protective Equipment

RVAAP – Ravenna Army Ammunition Plant

SSHO – Site Safety and Health Officer

SSHP – Health and Safety Plan

USACE – U.S. Army Corps of Engineers

1.0 OBJECTIVES

This Project Site Safety and Health Plan (SSHP) addendum serves to fulfill the requirements for a Site Specific Health and Safety / Accident Prevention Plan delineated in Appendix A of the U.S. Army Corps of Engineers, Engineering Manual (EM) 385-1-1, November 2003. This addendum must be used in conjunction with the **Facility-Wide Safety and Health Plan for Environmental Investigations at the Ravenna Army Ammunition Plant, Ravenna, Ohio, dated March 2001.** This SSHP was developed and designed to protect onsite personnel from physical, chemical and biological hazards, as well as any other potential hazards which may be encountered during surface soil investigations at Load Lines 5, 7, 8, and 10.

This site is governed under requirements of 29 CFR 1910.120 / 1926.65. The work under this SSHP involves conducting surface soil sampling by the USACE. Work under this project will be in accordance with USACE, 385-1-1 (Health and Safety Requirements Manual), as well as applicable OSHA standards.

All necessary safety equipment shall be provided by the USACE, and documentation of training, medical monitoring and health and safety plan specifications as presented herein will be verified for persons involved in the field sampling effort.

Employees involved in the surface soil sampling will be informed of the anticipated hazards of the site, oriented with the required health and safety procedures, and provided access to a copy of this document.

This is a living document and may be changed as the hazards change or new hazards become apparent. Any changes to this health and safety plan must be reviewed and approved by the Safety and Health Manager, Jerry Simms.

2.0 PROJECT DESCRIPTION

The scope of this investigation is to assess the extent of potential contamination in the exposed surface soil from the removal of the slabs for the razed buildings in Load Lines 5, 7, 8, and 10. The primary objectives of the under the slab investigation are as follows:

- Conduct surface soil sampling using multi-increment field sampling to determine if manufacturing operations at the load lines have impacted the surface soil beneath the building slabs;

- Assess the acquired data to determine if any data gaps exist with respect to sources and extent of surface soil contamination.

- Provide recommendations for any additional investigations and/or actions.

In addition, Facility Wide Descriptions, Environmental Settings and Surface Water utilization can be found in the Facility-Wide Sampling and Analysis Plan.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The project team shall consist of members from the Ohio Environmental Protection Agency and the U.S. Army Corps of Engineers, Louisville District and Kansas City District.

The project team consists of:

Project Team Lead – John P. Jent ph. 502-315-6343 – Louisville, KY

Team Members:
    Tom Chanda, On-Site Site Safety and Health Manager
    Glen Beckham
    Craig Combs
    Richard Cruz
    Rick Hockett
    Kathy Krantz
    Mike Peveler
    Angela Schmidt

Project Industrial Hygienist / H&S Manager – Shelton M. Poole, CHMM, RPIH
    ph. 502-315-6290

4.0 FIELD ACTIVITIES

Field activity is described in Paragraph 1.4.5 of the Sampling and Analysis Plan Addendum. Principal activities will include:
    Field marking of the sampling areas within the footprints of former buildings,
    Laying out 30 sub-sample locations in a stratified, random manner within each sampling area,
    Collecting the sub-samples to a depth of 12-inches at each of the 30 sub-sample locations,
    Collecting the sub-samples into a plastic liner, labeling the liner, maintaining the liner sample in a refrigerator until sample shipment,
    By use of a photoionization detector, select locations for VOC samples, and
    Collecting a limited number of discrete samples in jars for VOC analyses.

5.0 HAZARD ASSESSMENT

(X) Heat Stress
( ) Cold Stress
( ) Explosion/Flammable
(X) Biological
( ) Volatile materials
( ) Utilities
( ) Noise
(X) Inorganic Chemicals
(X) Other; Water hazards, falls, cuts/scrapes
Electrical Hazards, cut hazards

(X) Organic Chemicals
( ) Truck
(X) Walking Surfaces
( ) Falling Objects
(X) Vegetation
(X) Insect Bites
( ) Excavations
( ) Asbestos

Pathways

(X) Air

(X) Dust/Soil

( ) Surface Water

( ) Sediment

( ) Groundwater

(X) Other (Ingestion)

Overall Hazard Evaluation

( )High (X) Medium ( ) Low ( ) Unknown.

- Animals and/or vermin (snakes, rodents). Exposure is possible depending on conditions at the time of work. Areas requiring access are wetlands areas and as such, areas should be observed for any presence of snakes, rodents, etc. prior to field work.

- Insects (spiders, ticks, chiggers, etc.). Exposure is possible.

- Exposure to chemicals during the sampling and decontamination processes. Skin contact, ingestion and inhalation hazards of chemicals are possible. Materials will be handled only to the extent necessary. To minimize the risk of skin contact, site workers will be equipped with rubber gloves, and boots, and exercise proper hygiene protocols to wash hands and faces thoroughly, to minimize the risk of exposure. Workers will be required to wear the appropriate personal protective equipment outlined in this plan. Material Safety Data Sheets (MSDS are provided in Appendix F.

- Weather extremes/hazards. When work is performed outside, there exists the possibility for exposure to adverse weather conditions brought about by thunderstorms or extreme heat or cold. These conditions will be monitored by the SSHO and all work will cease in the event of impending adverse weather conditions (i.e. lightning). Due to the time of year planned for this effort (i.e. summer), cold stress (i.e. hypothermia) would not be a likely concern. If in the future, this work is performed in the fall or winter months, this SSHP will have to be edited and all employees will be educated on early recognition of cold-related injuries or illnesses. The buddy system will be employed and be essential to minimize the risk of injury or adverse health effects.

6.0 TRAINING

USACE maintains a strong corporate commitment to employee safety and health. Employee safety is critical. Safety awareness will be maintained through an initial safety briefing prior to onsite activities. All employees involved in this work will be deemed medically qualified for the work involved and trained according to this plan and the Ohio EPA Guidance for this type of activity. All employees performing on-site activities involving direct contact with possibly contaminated soil will meet the requirements of 29 CFR 1910.120 (f), and 1910.134.

7.0 MEDICAL MONITORING

USACE Louisville District Full-time employees performing work in exclusion or restricted areas are currently included under the District's Medical Surveillance Program for their normal work activities. Personnel assisting from the Ohio Environmental Protection Agency are included in appropriate medical surveillance for their activities with their respective agency.

8.0 FIRST AID AND CPR

At least two (2) of the USACE personnel are First Aid trained and trained in Cardiovascular Pulmonary Resuscitation (CPR).

9.0 PERS0NAL PROTECTIVE EQUIPMENT

Personal protective equipment will be utilized as follows;

Level D will be modified to include gloves (nitrile) for surface soil sampling as well as rubber-soled shoes. Due to the low anticipated exposures to chemical contaminants, the need for respiratory protection is unlikely, therefore not a requirement of the SSHP at this time.

The site location is within reasonable proximity to hospitals and the work team will have a 16-unit first aid kit and phone access readily available. No environmental or chemical hazards have been identified or are anticipated while performing this work. Normal work attire, long pants and work or heavy work shoes during the surface soil sampling will be effective for the hazards present. If site conditions dictate, the SSHO may elect to alter or modify the PPE requirements.

10.0 GENERAL SAFE WORK PRACTICES AND SITE HAZARDS

Buddy System. The buddy system will be employed to assist in early recognition of worker stress during the scope of this job.

Decontamination Procedures. No significant decontamination is anticipated as a result of chemical contamination, however, decontamination of equipment, materials and supplies will consist of cleaning exposed equipment with a detergent solution, soft bristled brushes, and rinsed with de-ionized water. Minimal equipment and clothing decontamination is anticipated. Any disposable equipment or supplies will be properly disposed of in plastic bags and disposed of properly.

Heat Stress/Heat Stroke/Heat Exhaustion. As all the activities for this action will occur outdoors, temperature variations from morning to evening can vary greatly. Due to the time of year this sampling is taking place, heat stress effects are a definite possibility. Employees will watch for signs of symptoms of heat stress in each other. Some symptoms normally affected by heat associated bodily malfunctions:

- profuse sweating, nausea, fainting, dizziness, moist skin, headaches, pale skin color, disorientation, changes in behavior, etc.,

and follow standard precautions for dealing with recognition of these conditions. This will entail, depending on the stage of heat stress, rest in cool place with plenty of fluids replacing water and electrolytes lost in sweat. If the person/worker is unconscious due to heat exhaustion or heat-stroke implement emergency action getting immediate medical attention AND DO NOT give liquids to the unconscious person. In hot weather, employees should refrain from drinking excessive amounts of caffeinated drinks, coffee, etc. The Team Leader/Workers will maintain plenty of potable water on hand and encourage frequent breaks in hot and/or humid conditions to minimize this potential hazard.

Cold Stress. Due to the anticipated timeframe for the work cold stress is not anticipated.

Permit-Required Confined Space Entry. There is no anticipated need for entry into confined spaces on this project.

Trenching and Excavation. No excavation or trenching operations will be performed in the scope of work for this project.

Ticks/Insects. Although the areas where sampling is to take place have recently been cleared, insects are still likely. The following preventive measures will be undertaken. Workers will wear light-weight, light colored, clothing so that ticks may be more readily identified and areas of exposed skin may be minimized. Employees will maintain insect repellent containing Deet. ™ Extreme care should be taken in application of repellent to exposed skin to minimize overspray concerns (i.e. eye injuries, etc.).

Ladder Use. No ladders are to be used in the scope of work for this project.

Radiation Hazards. Not anticipated on this site.

Noise. Not anticipated on this site.

Unexploded Ordnance (UXO). Not anticipated on this site.

Water Hazards. Not anticipated on this site.

Adverse Weather. In the event of a thunderstorm, lightning or other adverse weather arising during field operations, site work will be discontinued, and safe cover taken, until which time the weather condition is safe to continue the work effort. A long billed cap is recommended along with sunscreen to minimize the impacts from direct sunlight during outside work.

Slips, Trips and Falls. In nearly all field operations, slips, trips and fall hazards are present. Specifically the work areas for the subject project have had recent building demolition and therefore some minor amounts of debris may remain. Work boots will thus be required.

Cuts, Punctures, Pinch Hazards. During sampling employees may be working with soil samplers and bolts and other small devices to remove soil from the samplers. During these activities care will be taken to prevent pinching or bruising of the hands. A first aid kit will be readily available for use.

Insects, Vermin and other Vectors. Ohio has been identified with potential occurrences of West Nile Virus as well as other insect (i.e. tick-borne) communicable diseases. The field team will keep on hand for use, insect repellents containing Deet. ™ Field conditions also exist for snakes and other vermin. Workers will avoid work in or around debris or other obstructions, which could harbor nesting areas for these animals.

Chemicals. Sampling of surface soils with possibly trace amounts of chemicals are probable, albeit the risk to human health may be low due to the relative low levels of contaminants likely. PPE will be maintained and utilized when sampling.

11. EMERGENCY PREPAREDNESS

The following is a list of emergency response numbers in case of emergency:

FIRST CALL:

RVAAP Security, Post 1		330 358-2017
	Radio Channel 1, Call Post 1	

IN THE EVENT NO RESPONSE FROM POST #1 THEN CALL:

Land or Air Ambulance	Ravenna City Fire Dept	911 or 330 297-5738
Emergency Hospital Care	Robinson Memorial Hospital	330 297-0811
Police	Portage County Sheriff	330 296-5100
Police	Trumbull County Sheriff	330 675-2540
Fire Department (City of Ravenna)		330-297-5738
Irv Venger	Acting Facility Manager Radio Channel 1, Call	330 358-7304
Shelton Poole (Corps Off-Site Safety and Health Mgr.)		502-315-6290
Matthew Burg (Corps Chief Safety Officer-Louisville District)		502-315-7061

12. ON / OFF-SITE COMMUNICATION

Communication will be facilitated by the use of Ravenna provided radios. Access to off-site resources will be facilitated by use of cellular phones.

13. ACCIDENT PREVENTION AND REPORTING

In the event of an accident, immediate first aid will be sought. Within 24 hrs of any reportable accident, an Accident Report (ENG 3394) will be completed in accordance with AR 385-1-40, and notification to the District Safety and Occupational Health Office, within 48 hours. Any injury to 3 or more employees, requiring hospitalization, an accident resulting in a fatality, hospitalization and / or property damage in excess of $200,000 requires notification to OSHA within 24 hrs. Notification will also be required to the USACE.

14. APPENDICES

Appendix	Subject Reference
A	Site Map to Hospital
B	Hazards Inventory (See Attached)
C	Activity Hazard Analysis (See Attached)
D	Potential Exposures (See Attached)
E	Accident Report (ENG 3394) Hard Copy
F	Material Safety Data Sheets (See Attached)

APPENDIX A – HOSPITAL DIRECTIONS AND MAP

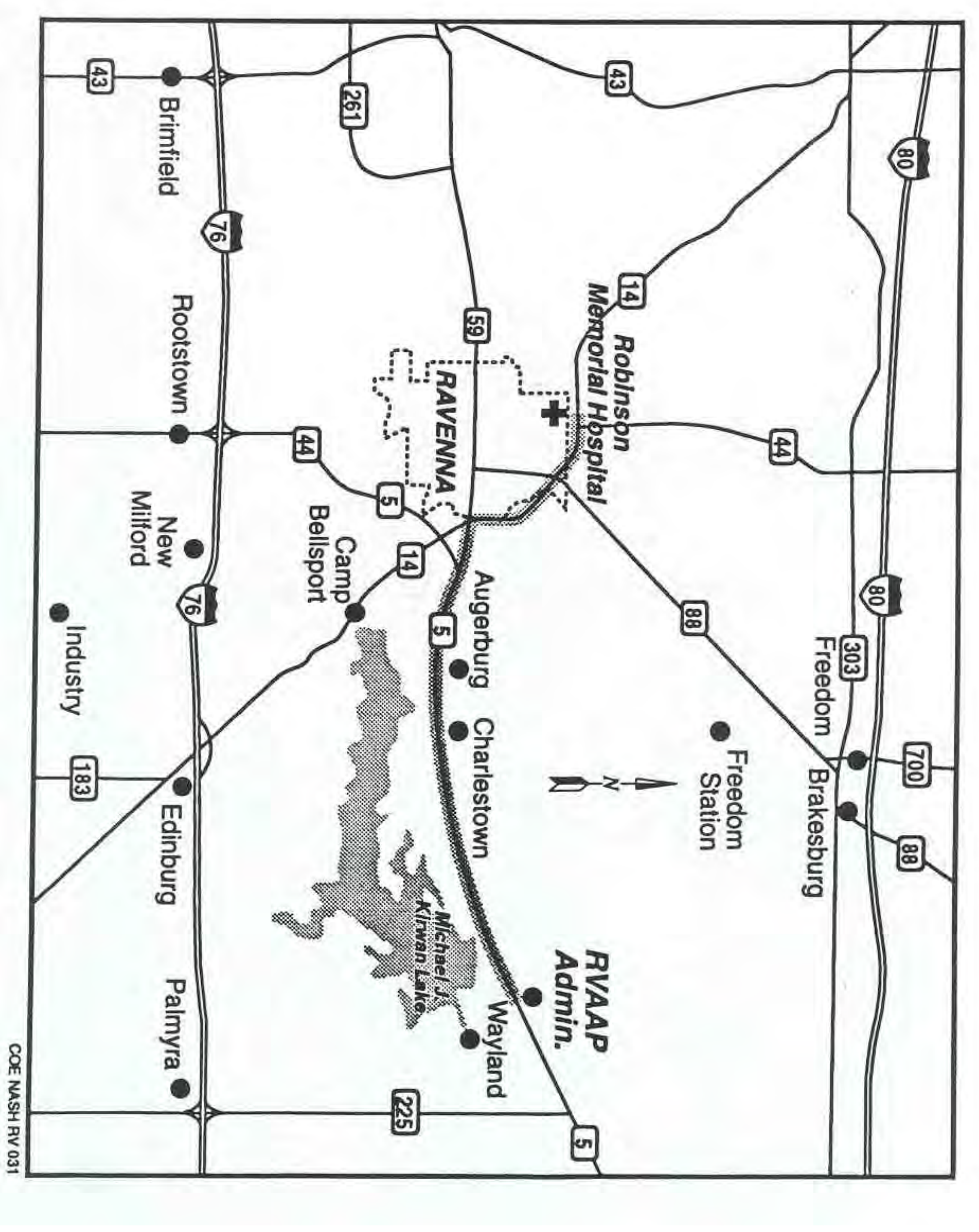


Figure 1 – Robinson Memorial Hospital, Ravenna, Ohio

Directions to the Hospital from the Site

Robinson Memorial Hospital is located approximately 16 km

(10 miles) from the site at

6847 N. Chestnut Street in Ravenna, Ohio.

330 297-0811

It can be reached by taking

Highway 5 west, approx 6.3 miles,

Stay straight on Highway 5, approx 0.7 miles to OH-14 (McDonalds)

Turn right onto OH-14, approx 2.3 miles

Turn left onto N. Chestnut St.

Go approx 0.1 to the hospital.

APPENDIX B – HAZARDS INVENTORY

APPENDIX B Hazards Inventory

Yes	No	Hazard
	X	Confined space entry [Not anticipated. Any confined space entry will require assessment in the SSHP Addendum and compliance with Section 9.4]
	X	Excavation entry [Not anticipated. Any excavation entry will require sloping or shoring excavation and compliance with all other applicable requirements.
	X	Heavy equipment (drill rigs, backhoes). [Not anticipated]
X		Potential dangerous tools (brush clearing with chainsaws, machetes, sling blades)
X		Heavy lifting (IDW handling), sample coolers
	X	Fire (fuels)
	X	Explosion (munitions and explosives of concern)
	X	Electrical shock (electrical equipment)
X		Exposure to chemicals (site contaminants and chemicals used during site work)
X		Temperature extremes
X		Biological hazards (poison ivy, Lyme disease, Histoplasmosis)
	X	Radiation or radioactive contamination
	X	Noise (equipment)

APPENDIX C – ACTIVITY HAZARD ANALYSIS

APPENDIX C ACTIVITY HAZARD ANALYSIS

Safety and Health Hazards	**Controls**	**Monitoring**
Surface Soil Sampling		
General safety hazards (moving or heavy equipment, slips, falls)	Level D PPE Hazardous waste safety training	Daily site and safety inspections.
Field marking sampling areas and points	Be cognizant of isolated above ground debris	Daily site and safety inspections.
Collecting sub-samples	Do any lifting with lower body. If use of mattock, beware of people close by. When extract soil sample from sampler, use hex-head screw wearing thumb protection.	Daily site and safety inspections.
Moving filled sample coolers	Do any lifting with lower body. Use two people to move heavy coolers.	Daily site and safety inspections.
Heat related stress	Provide plenty of water Provide breaks Wear hats Be alert for symptom of heat stress (profuse sweating, disorientation, changes in behavior, exhaustion)	Daily site and safety inspections.
Exposure to chemicals	PPE (Level D) plus nitrile or equivalent gloves for contact with contaminated material. Washing face and hands prior to anything by mouth. Staying upwind of any dust-generating activities. Minimal contact. Hazard communication training. MSDSs for chemical tools on site. Chemical containers labeled to indicate contents and hazard. Medical clearance for hazardous waste work. Decontamination of potentially contaminated equipment prior to servicing.	Photoionization detector or other sampling as appropriate.

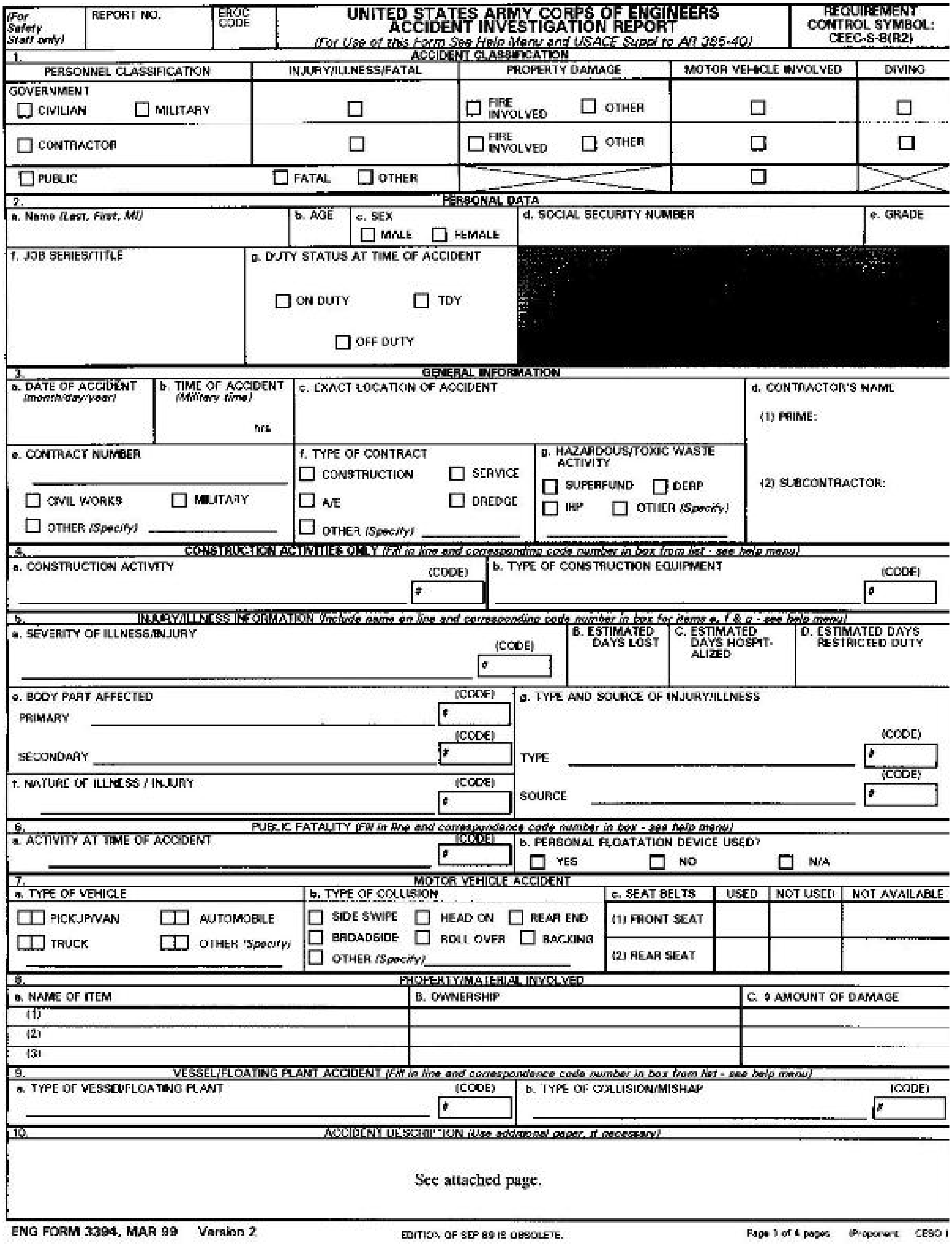
APPENDIX D – POTENTIAL EXPOSURES

Appendix D Potential Exposures

Chemical	Health Effects/Potential Hazards	Chemical and Physical Properties	Exposure Route(s)
Chromium	Eye irritation, sensitization	Solid; properties vary depending upon specific compound	Inhalation Congestion Contact
Dinitrotoluene (DNT)	Suspected human carcinogen, anorexia, cyanosis, reproductive effects	Orange-yellow solid, VP: 1 mm; FP: 404 degrees F	Inhalation Absorption Ingestion Contact
Gasoline (used for fuel)	Potential carcinogen per NIOSH., dizziness, eye irritation, dermatitis	Liquid with aromatic odor; FP: -45 degrees F; VP: 38-300 mm	Inhalation Absorption Ingestion Contact
Hydrochloric acid (HCl)	Eye and skin irritation and/or destruction	Liquid with acrid odor; FP: NA; IP:NA	Inhalation Absorption Ingestion Contact
Lead	Weakness, anorexia, abdominal pain, anemia	Solid metal; VP: 0 mm; FP: NA; IP: NA	Inhalation Ingestion Contact
Liquinox (used for decontamination)	Inhalation of eyes and skin; coughing, GI disturbance, anorexia	White powder, odorless, nonflammable	Inhalation Ingestion Contact
Mercury	Irritation of eyes and skin; coughing, GI disturbance, anorexia	Silver liquid; FP: NA; VP: 0.0012 mm	Inhalation Absorption Ingestion Contact
Methanol (potentially used for equipment decontamination)	Eye and skin irritation, headache, cough; optic nerve damage	Liquid; VP: 96 mm; FP: 52 degrees F; IP: 10.84 eV	Inhalation Absorption Ingestion Contact

APPENDIX E – ENG FORM 3394

ACCIDENT INVESTIGATION REPORT



(For Safety Staff only)	REPORT NO.	EROC CODE	**UNITED STATES ARMY CORPS OF ENGINEERS ACCIDENT INVESTIGATION REPORT** *(For Use of this Form See Help Menu and USACE Suppl to AR 385-40)*	REQUIREMENT CONTROL SYMBOL: CEEC-S-8(R2)

1. ACCIDENT CLASSIFICATION

PERSONNEL CLASSIFICATION	INJURY/ILLNESS/FATAL	PROPERTY DAMAGE	MOTOR VEHICLE INVOLVED	DIVING
GOVERNMENT ☐ CIVILIAN ☐ MILITARY	☐	☐ FIRE INVOLVED ☐ OTHER	☐	☐
☐ CONTRACTOR	☐	☐ FIRE INVOLVED ☐ OTHER	☐	☐
☐ PUBLIC	☐ FATAL ☐ OTHER		☐	

2. PERSONAL DATA

a. Name *(Last, First, MI)*

b. AGE

c. SEX ☐ MALE ☐ FEMALE

d. SOCIAL SECURITY NUMBER

e. GRADE

f. JOB SERIES/TITLE

g. DUTY STATUS AT TIME OF ACCIDENT
☐ ON DUTY ☐ TDY
☐ OFF DUTY

[redacted]

3. GENERAL INFORMATION

a. DATE OF ACCIDENT *(month/day/year)*

b. TIME OF ACCIDENT *(Military time)* hrs

c. EXACT LOCATION OF ACCIDENT

d. CONTRACTOR'S NAME
(1) PRIME:
(2) SUBCONTRACTOR:

e. CONTRACT NUMBER ____________
☐ CIVIL WORKS ☐ MILITARY
☐ OTHER *(Specify)* ____________

f. TYPE OF CONTRACT
☐ CONSTRUCTION ☐ SERVICE
☐ A/E ☐ DREDGE
☐ OTHER *(Specify)* ____________

g. HAZARDOUS/TOXIC WASTE ACTIVITY
☐ SUPERFUND ☐ DERP
☐ IRP ☐ OTHER *(Specify)*
____

4. CONSTRUCTION ACTIVITIES ONLY *(Fill in line and corresponding code number in box from list - see help menu)*

a. CONSTRUCTION ACTIVITY ____________ (CODE) #

b. TYPE OF CONSTRUCTION EQUIPMENT ____________ (CODE) #

5. INJURY/ILLNESS INFORMATION *(Include name on line and corresponding code number in box for items e, f & g - see help menu)*

a. SEVERITY OF ILLNESS/INJURY ____________ (CODE) #

B. ESTIMATED DAYS LOST

C. ESTIMATED DAYS HOSPITALIZED

D. ESTIMATED DAYS RESTRICTED DUTY

e. BODY PART AFFECTED
PRIMARY ____________ (CODE) #
SECONDARY ____________ (CODE) #

f. NATURE OF ILLNESS / INJURY ____________ (CODE) #

g. TYPE AND SOURCE OF INJURY/ILLNESS
TYPE ____________ (CODE) #
SOURCE ____________ (CODE) #

6. PUBLIC FATALITY *(Fill in line and correspondence code number in box - see help menu)*

a. ACTIVITY AT TIME OF ACCIDENT ____________ (CODE) #

b. PERSONAL FLOATATION DEVICE USED? ☐ YES ☐ NO ☐ N/A

7. MOTOR VEHICLE ACCIDENT

a. TYPE OF VEHICLE
☐ PICKUP/VAN ☐ AUTOMOBILE
☐ TRUCK ☐ OTHER *(Specify)*
____

b. TYPE OF COLLISION
☐ SIDE SWIPE ☐ HEAD ON ☐ REAR END
☐ BROADSIDE ☐ ROLL OVER ☐ BACKING
☐ OTHER *(Specify)* ____________

c. SEAT BELTS	USED	NOT USED	NOT AVAILABLE
(1) FRONT SEAT			
(2) REAR SEAT			

8. PROPERTY/MATERIAL INVOLVED

a. NAME OF ITEM	B. OWNERSHIP	C. $ AMOUNT OF DAMAGE
(1)		
(2)		
(3)		

9. VESSEL/FLOATING PLANT ACCIDENT *(Fill in line and correspondence code number in box from list - see help menu)*

a. TYPE OF VESSEL/FLOATING PLANT ____________ (CODE) #

b. TYPE OF COLLISION/MISHAP ____________ (CODE) #

10. ACCIDENT DESCRIPTION *(Use additional paper, if necessary)*

See attached page.

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11. **CAUSAL FACTOR(S)** *(Read Instruction Before Completing)*

a. (Explain YES answers in item 13)	YES	NO
DESIGN: Was design of facility, workplace or equipment a factor?	☐	☐
INSPECTION/MAINTENANCE: Were inspection & maintenance procedures a factor?	☐	☐
PERSON'S PHYSICAL CONDITION: In your opinion, was the physical condition of the person a factor?	☐	☐
OPERATING PROCEDURES: Were operating procedures a factor?	☐	☐
JOB PRACTICES: Were any job safety/health practices not followed when the accident occurred?	☐	☐
HUMAN FACTORS: Did any human factors such as, size or strength of person, etc., contribute to accident?	☐	☐
ENVIRONMENTAL FACTORS: Did heat, cold, dust, sun, glare, etc., contribute to the accident?	☐	☐

a. *(CONTINUED)*	YES	NO
CHEMICAL AND PHYSICAL AGENT FACTORS: Did exposure to chemical agents, such as dust, fumes, mists, vapors or physical agents, such as, noise, radiation, etc., contribute to accident?	☐	☐
OFFICE FACTORS: Did office setting such as, lifting office furniture, carrying, stooping, etc., contribute to the accident?	☐	☐
SUPPORT FACTORS: Were inappropriate tools/resources provided to properly perform the activity/task?	☐	☐
PERSONAL PROTECTIVE EQUIPMENT: Did the improper selection, use or maintenance of personal protective equipment contribute to the accident?	☐	☐
DRUGS/ALCOHOL: In your opinion, was drugs or alcohol a factor to the accident	☐	☐

b. WAS A WRITTEN JOB/ACTIVITY HAZARD ANALYSIS COMPLETED FOR TASK BEING PERFORMED AT TIME OF ACCIDENT?

☐ YES *(If yes, attach a copy.)* ☐ NO

12. **TRAINING**

a. WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK?	b. TYPE OF TRAINING.	c. DATE OF MOST RECENT FORMAL TRAINING.
☐ YES ☐ NO	☐ CLASSROOM ☐ ON JOB	(Month) (Day) (Year)

13. **FULLY EXPLAIN WHAT ALLOWED OR CAUSED THE ACCIDENT; INCLUDE DIRECT AND INDIRECT CAUSES** *(See instruction for definition of direct and indirect causes.) (Use additional paper, if necessary)*

a. DIRECT CAUSE

See attached page.

b. INDIRECT CAUSE(S)

See attached page.

14. **ACTION(S) TAKEN, ANTICIPATED OR RECOMMENDED TO ELIMINATE CAUSE(S).**

DESCRIBE FULLY:

See attached page.

15. **DATES FOR ACTIONS IDENTIFIED IN BLOCK 14.**

a. BEGINNING (Month/Day/Year)	b. ANTICIPATED COMPLETION (Month/Day/Year)

c. SIGNATURE AND TITLE OF SUPERVISOR COMPLETING REPORT	d. DATE *(Mo/Da/Yr)*	e. ORGANIZATION IDENTIFIER *(Div, Br, Sect)*	f. OFFICE SYMBOL
CORPS __________ CONTRACTOR __________			

16. **MANAGEMENT REVIEW** *(1st)*

a. ☐ CONCUR b. ☐ NON CONCUR c. COMMENTS

SIGNATURE	TITLE	DATE

17. **MANAGEMENT REVIEW** *(2nd - Chief Operations, Construction, Engineering, etc.)*

a. ☐ CONCUR b. ☐ NON CONCUR c. COMMENTS

SIGNATURE	TITLE	DATE

18. **SAFETY AND OCCUPATIONAL HEALTH OFFICE REVIEW**

a. ☐ CONCUR b. ☐ NON CONCUR c. ADDITIONAL ACTIONS/COMMENTS

SIGNATURE	TITLE	DATE

19. **COMMAND APPROVAL**

COMMENTS

COMMANDER SIGNATURE	DATE

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10.	**ACCIDENT DESCRIPTION** *(Continuation)*

13a.	**DIRECT CAUSE** *(Continuation)*

Page 3 of 4 pages

13b. **INDIRECT CAUSES** *(Continuation)*

14. **ACTION(S) TAKEN, ANTICIPATED, OR RECOMMENDED TO ELIMINATE CAUSE(S)** *(Continuation)*

APPENDIX F – Material Safety Data Sheets

MSDS Number: **H3880** * * * * * *Effective Date:* ***01/19/06*** * * * * * *Supercedes:* ***09/24/04***

MSDS *Material Safety Data Sheet*

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

HYDROCHLORIC ACID, 33 - 40%

1. Product Identification

Synonyms: Muriatic acid; hydrogen chloride, aqueous
CAS No.: 7647-01-0
Molecular Weight: 36.46
Chemical Formula: HCl
Product Codes:
J.T. Baker: 5367, 5537, 5575, 5800, 5814, 5821, 5839, 5861, 5862, 5894, 5962, 5972, 5994, 6900, 7831, 9529, 9530, 9534, 9535, 9536, 9538, 9539, 9540, 9544, 9548
Mallinckrodt: 2062, 2515, 2612, 2624, 2626, 3861, 5583, 5587, H611, H613, H987, H992, H999, V078, V628

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Hydrogen Chloride	7647-01-0	33 - 40%	Yes
Water	7732-18-5	60 - 67%	No

3. Hazards Identification

Emergency Overview

POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED. INHALATION MAY CAUSE LUNG DAMAGE.

SAF-T-DATA$^{(tm)}$ Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 0 - None
Reactivity Rating: 2 - Moderate
Contact Rating: 4 - Extreme (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: White (Corrosive)

Potential Health Effects

Inhalation:
Corrosive! Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death.
Ingestion:
Corrosive! Swallowing hydrochloric acid can cause immediate pain and burns of the mouth, throat, esophagus and gastrointestinal tract. May cause nausea, vomiting, and diarrhea. Swallowing may be fatal.
Skin Contact:
Corrosive! Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and discolor skin.
Eye Contact:
Corrosive! Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Chronic Exposure:
Long-term exposure to concentrated vapors may cause erosion of teeth. Long term exposures seldom occur due to the corrosive properties of the acid.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye disease may be more susceptible to the effects of this substance.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Ingestion:
DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

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5. Fire Fighting Measures

Fire:
Extreme heat or contact with metals can release flammable hydrogen gas.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
If involved in a fire, use water spray. Neutralize with soda ash or slaked lime.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Structural firefighter's protective clothing is ineffective for fires involving hydrochloric acid. Stay away from ends of tanks. Cool tanks with water spray until well after fire is out.

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6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker NEUTRASORB® or TEAM® 'Low Na+' acid neutralizers are recommended for spills of this product.

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7. Handling and Storage

Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Protect from physical damage. Keep out of direct sunlight and away from heat, water, and incompatible materials. Do not wash out container and use it for other purposes. When diluting, the acid should always be added slowly to water and in small amounts. Never use hot water and never add water to the acid. Water added to acid can cause uncontrolled boiling and splashing. When opening metal containers, use non-sparking tools because of the possibility of hydrogen gas being present. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Hydrochloric acid:
- OSHA Permissible Exposure Limit (PEL):
5 ppm (Ceiling)
- ACGIH Threshold Limit Value (TLV):
2 ppm (Ceiling), A4 Not classifiable as a human carcinogen

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, a full facepiece respirator with an acid gas cartridge may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:
Rubber or neoprene gloves and additional protection including impervious boots, apron, or coveralls, as needed in areas of unusual exposure to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Colorless, fuming liquid.
Odor:
Pungent odor of hydrogen chloride.
Solubility:
Infinite in water with slight evolution of heat.
Density:
1.18
pH:
For HCL solutions: 0.1 (1.0 N), 1.1 (0.1 N), 2.02 (0.01 N)
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
53C (127F) Azeotrope (20.2%) boils at 109C (228F)
Melting Point:
-74C (-101F)
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
190 @ 25C (77F)
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Containers may burst when heated.
Hazardous Decomposition Products:
When heated to decomposition, emits toxic hydrogen chloride fumes and will react with water or steam to produce heat and toxic and corrosive fumes. Thermal oxidative decomposition produces toxic chlorine fumes and explosive hydrogen gas.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
A strong mineral acid, concentrated hydrochloric acid is incompatible with many substances and highly reactive with strong bases, metals, metal oxides, hydroxides, amines, carbonates and other alkaline materials. Incompatible with materials such as cyanides, sulfides, sulfites, and formaldehyde.
Conditions to Avoid:
Heat, direct sunlight.

11. Toxicological Information

Inhalation rat LC50: 3124 ppm/1H; oral rabbit LD50: 900 mg/kg (Hydrochloric acid concentrated); investigated as a tumorigen, mutagen, reproductive effector.

```
  --------\Cancer  Lists\---------------------------------------------
-------
                                         ---NTP Carcinogen---
  Ingredient                               Known    Anticipated    IARC
Category
  ---------------------------------   -----    -----------    ------
-------
  Hydrogen Chloride (7647-01-0)         No          No             3
  Water  (7732-18-5)                               No             No
None
```

12. Ecological Information

Environmental Fate:
When released into the soil, this material is not expected to biodegrade. When released into the soil, this material may leach into groundwater.
Environmental Toxicity:
This material is expected to be toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: HYDROCHLORIC ACID
Hazard Class: 8
UN/NA: UN1789
Packing Group: II
Information reported for product/size: 475LB

International (Water, I.M.O.)

Proper Shipping Name: HYDROCHLORIC ACID
Hazard Class: 8
UN/NA: UN1789
Packing Group: II
Information reported for product/size: 475LB

15. Regulatory Information

Risk and Safety Phrases:
Symbol: C
Risk: 34-37
Safety: (1/2-)26-45

```
  --------\Chemical Inventory Status - Part 1\-------------------------
--------
  Ingredient                                        TSCA  EC   Japan
Australia
  -----------------------------------------------  ----  ---  -----  --
-------
  Hydrogen Chloride (7647-01-0)                     Yes   Yes   Yes
Yes
  Water (7732-18-5)                                 Yes   Yes   Yes
Yes

  --------\Chemical Inventory Status - Part 2\-------------------------
--------
                                                          --Canada--
  Ingredient                                        Korea  DSL   NDSL
Phil.
  -----------------------------------------------  -----  ---   ----  -
----
  Hydrogen Chloride (7647-01-0)                     Yes    Yes   No
Yes
```

```
  Water (7732-18-5)                                     Yes    Yes    No
Yes

  --------\Federal, State & International Regulations - Part 1\--------
--------
                                             -SARA 302-      ------SARA
313------
  Ingredient                                       RQ     TPQ      List
Chemical Catg.
  -----------------------------------------  ---   -----   ----  ------
--------
  Hydrogen Chloride (7647-01-0)                    5000   500*      Yes
No
  Water (7732-18-5)                                 No     No        No
No

  --------\Federal, State & International Regulations - Part 2\--------
--------
                                                          -RCRA-       -
TSCA-
  Ingredient                                 CERCLA     261.33     8(d)
  -----------------------------------------  ------     ------     -----
-
  Hydrogen Chloride (7647-01-0)              5000       No         No
  Water (7732-18-5)                          No         No         No


Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  Yes
SARA 311/312:  Acute: Yes      Chronic: Yes  Fire: No  Pressure: No
Reactivity: No          (Mixture / Liquid)
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Australian Hazchem Code: 2R
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

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16. Other Information

NFPA Ratings: Health: **3** Flammability: **0** Reactivity: **1**
Label Hazard Warning:
POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED. INHALATION MAY CAUSE LUNG DAMAGE.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe vapor or mist.
Use only with adequate ventilation.
Wash thoroughly after handling.
Store in a tightly closed container.

Remove and wash contaminated clothing promptly.

Label First Aid:
In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In all cases get medical attention immediately.

Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 16.
Disclaimer:
****

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Prepared by: Environmental Health & Safety
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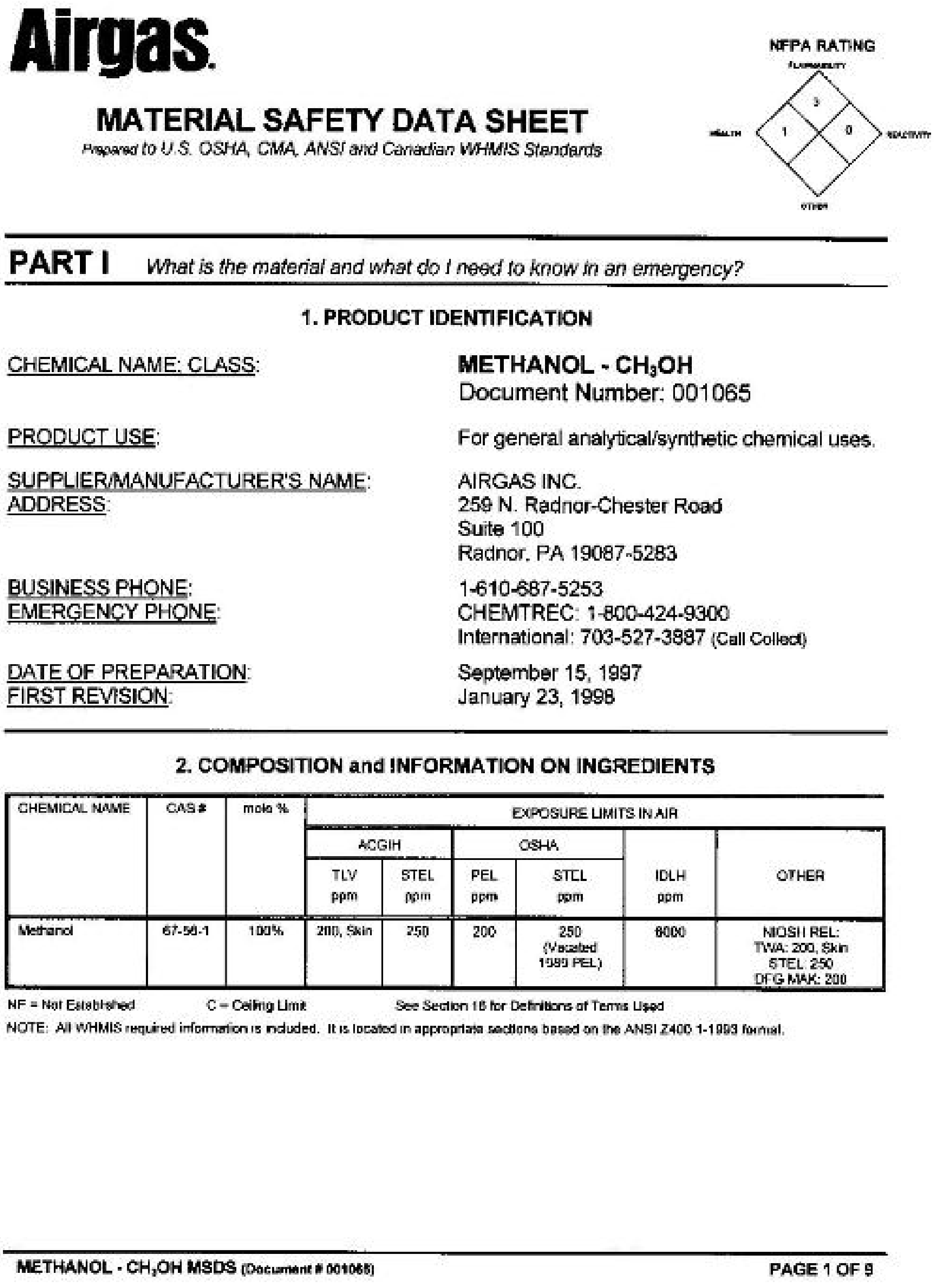


Airgas.

MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards

PART I *What is the material and what do I need to know in an emergency?*

1. PRODUCT IDENTIFICATION

CHEMICAL NAME: CLASS:	**METHANOL - CH_3OH** Document Number: 001065
PRODUCT USE:	For general analytical/synthetic chemical uses.
SUPPLIER/MANUFACTURER'S NAME: ADDRESS:	AIRGAS INC. 259 N. Radnor-Chester Road Suite 100 Radnor, PA 19087-5283
BUSINESS PHONE: EMERGENCY PHONE:	1-610-687-5253 CHEMTREC: 1-800-424-9300 International: 703-527-3887 (Call Collect)
DATE OF PREPARATION: FIRST REVISION:	September 15, 1997 January 23, 1998

2. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	mole %	EXPOSURE LIMITS IN AIR					
			ACGIH		OSHA			
			TLV ppm	STEL ppm	PEL ppm	STEL ppm	IDLH ppm	OTHER
Methanol	67-56-1	100%	200, Skin	250	200	250 (Vacated 1989 PEL)	6000	NIOSH REL: TWA: 200, Skin STEL: 250 DFG MAK: 200

NF = Not Established C = Ceiling Limit See Section 16 for Definitions of Terms Used

NOTE: All WHMIS required information is included. It is located in appropriate sections based on the ANSI Z400 1-1993 format.

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: Methanol is a clear, colorless, mobile, flammable liquid with a strong alcohol odor. Inhalation of Methanol's vapors can irritate the upper respiratory system and cause central nervous system depression (producing symptoms such as headaches, drowsiness, and confusion). Inhalation, skin contact or ingestion of Methanol may cause blindness and liver damage. Inhalation of high concentrations of the vapors may be fatal. Direct skin or eye contact may be irritating. Vapors of Methanol are heavier than air and may spread long distances; distant ignition and flashback are possible. Methanol is not reactive. Emergency responders must wear the proper personal protective equipment (and have appropriate fire-suppression equipment) suitable for the situation to which they are responding.

SYMPTOMS OF OVEREXPOSURE BY ROUTE OF EXPOSURE: The most significant routes of occupational overexposure are by inhalation, skin and eye contact. The symptoms of overexposure to Methanol are as follows:

INHALATION: Inhalation of Methanol vapors will cause central nervous system depression. The symptoms of such exposure can include headaches, nausea, dizziness, drowsiness, confusion, and unconsciousness. Irritation of the nose, throat, and other tissues of the upper respiratory system may also occur. There are reports that inhalation overexposures can cause blindness and liver damage. Other symptoms, similar to those described under "Ingestion", may also develop. Severe inhalation overexposures may be fatal.

CONTACT WITH SKIN or EYES: Contact of the liquid with the eyes may cause redness and pain. Direct contact with the skin (especially after prolonged overexposure) can cause irritation. Prolonged or repeated skin overexposures can cause dermatitis.

SKIN ABSORPTION: Skin absorption is a potential route of overexposure for Methanol. Severe cases of skin overexposure can result in blindness and liver damage. Overexposure can also result in other symptoms described under "Ingestion".

INGESTION: Methanol is toxic by ingestion. The fatal dose in man is between 2 and 8 ounces. Death may be prompt, but it is usually delayed for several days and the mortality rate is high. Ingestion of Methanol will cause visual disturbances, central nervous system depression, anorexia, leg cramps, vertigo, restlessness, nausea, vomiting, abdominal or back pain, apathy, and coma. One of the characteristic symptoms of Methanol poisoning is visual disturbance, including dimness of vision with dilated pupils which react poorly to light. The eyes are often sensitive to pressure, and eye movements are painful. Permanent blindness may also result. Acidosis may also occur, as a result of methanol oxidation to formic acid; this acidosis can severely reduce the body's alkali reserves.

HAZARDOUS MATERIAL INFORMATION SYSTEM

HEALTH	(BLUE)	1
FLAMMABILITY	(RED)	3
REACTIVITY	(YELLOW)	0
PROTECTIVE EQUIPMENT		C

EYES	RESPIRATORY	HANDS	BODY
	See Section 8		See Section 8

For routine industrial applications

See Section 16 for Definition of Ratings

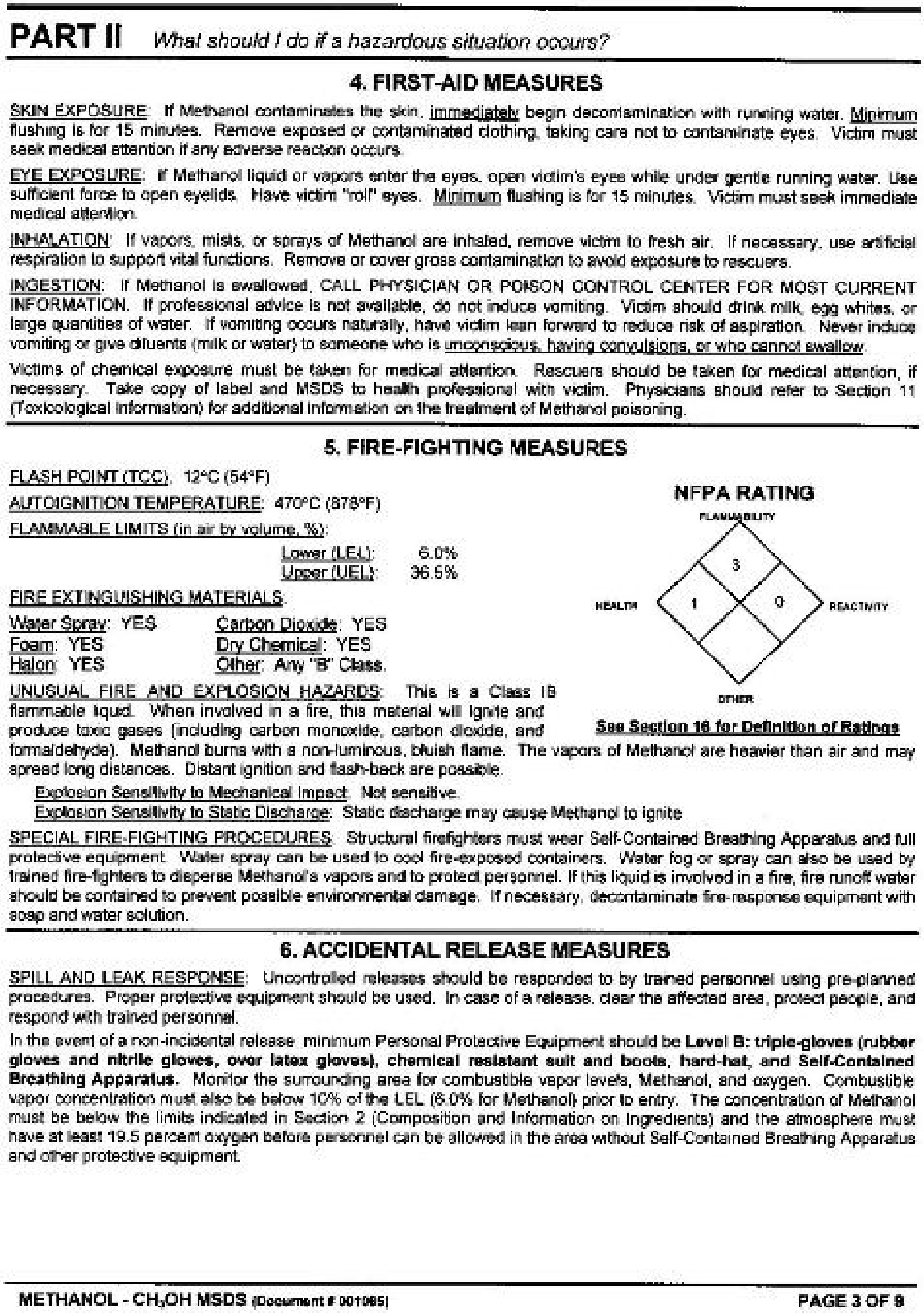
INJECTION: Injection is not anticipated to be a significant route of overexposure for Methanol. If Methanol is "injected" (as may occur through punctures by contaminated, sharp objects), local swelling and irritation can occur. Depending on the degree of injection overexposure, symptoms described under "Ingestion" may develop.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in Lay Terms.

ACUTE: Inhalation of Methanol vapors can irritate the upper respiratory system and cause central nervous system depression (producing symptoms such as headaches, drowsiness, and confusion). Inhalation, skin contact or ingestion of Methanol may cause blindness and liver damage. Inhalation of high concentrations of the vapors or ingestion may be fatal. Direct skin or eye contact may be irritating.

CHRONIC: Prolonged or repeated skin overexposures can cause dermatitis. Chronic inhalation of Methanol vapors can cause permanent blindness and liver damage. Refer to Section 11 (Toxicology Information) for additional information.

TARGET ORGANS: Skin, eyes, central nervous system.



PART II *What should I do if a hazardous situation occurs?*

4. FIRST-AID MEASURES

SKIN EXPOSURE: If Methanol contaminates the skin, immediately begin decontamination with running water. Minimum flushing is for 15 minutes. Remove exposed or contaminated clothing, taking care not to contaminate eyes. Victim must seek medical attention if any adverse reaction occurs.

EYE EXPOSURE: If Methanol liquid or vapors enter the eyes, open victim's eyes while under gentle running water. Use sufficient force to open eyelids. Have victim "roll" eyes. Minimum flushing is for 15 minutes. Victim must seek immediate medical attention.

INHALATION: If vapors, mists, or sprays of Methanol are inhaled, remove victim to fresh air. If necessary, use artificial respiration to support vital functions. Remove or cover gross contamination to avoid exposure to rescuers.

INGESTION: If Methanol is swallowed, CALL PHYSICIAN OR POISON CONTROL CENTER FOR MOST CURRENT INFORMATION. If professional advice is not available, do not induce vomiting. Victim should drink milk, egg whites, or large quantities of water. If vomiting occurs naturally, have victim lean forward to reduce risk of aspiration. Never induce vomiting or give diluents (milk or water) to someone who is unconscious, having convulsions, or who cannot swallow.

Victims of chemical exposure must be taken for medical attention. Rescuers should be taken for medical attention, if necessary. Take copy of label and MSDS to health professional with victim. Physicians should refer to Section 11 (Toxicological Information) for additional information on the treatment of Methanol poisoning.

5. FIRE-FIGHTING MEASURES

FLASH POINT (TCC): 12°C (54°F)

AUTOIGNITION TEMPERATURE: 470°C (878°F)

FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL):	6.0%
Upper (UEL):	36.5%

FIRE EXTINGUISHING MATERIALS:

Water Spray: YES	Carbon Dioxide: YES
Foam: YES	Dry Chemical: YES
Halon: YES	Other: Any "B" Class.

NFPA RATING

See Section 16 for Definition of Ratings

UNUSUAL FIRE AND EXPLOSION HAZARDS: This is a Class IB flammable liquid. When involved in a fire, this material will ignite and produce toxic gases (including carbon monoxide, carbon dioxide, and formaldehyde). Methanol burns with a non-luminous, bluish flame. The vapors of Methanol are heavier than air and may spread long distances. Distant ignition and flash-back are possible.

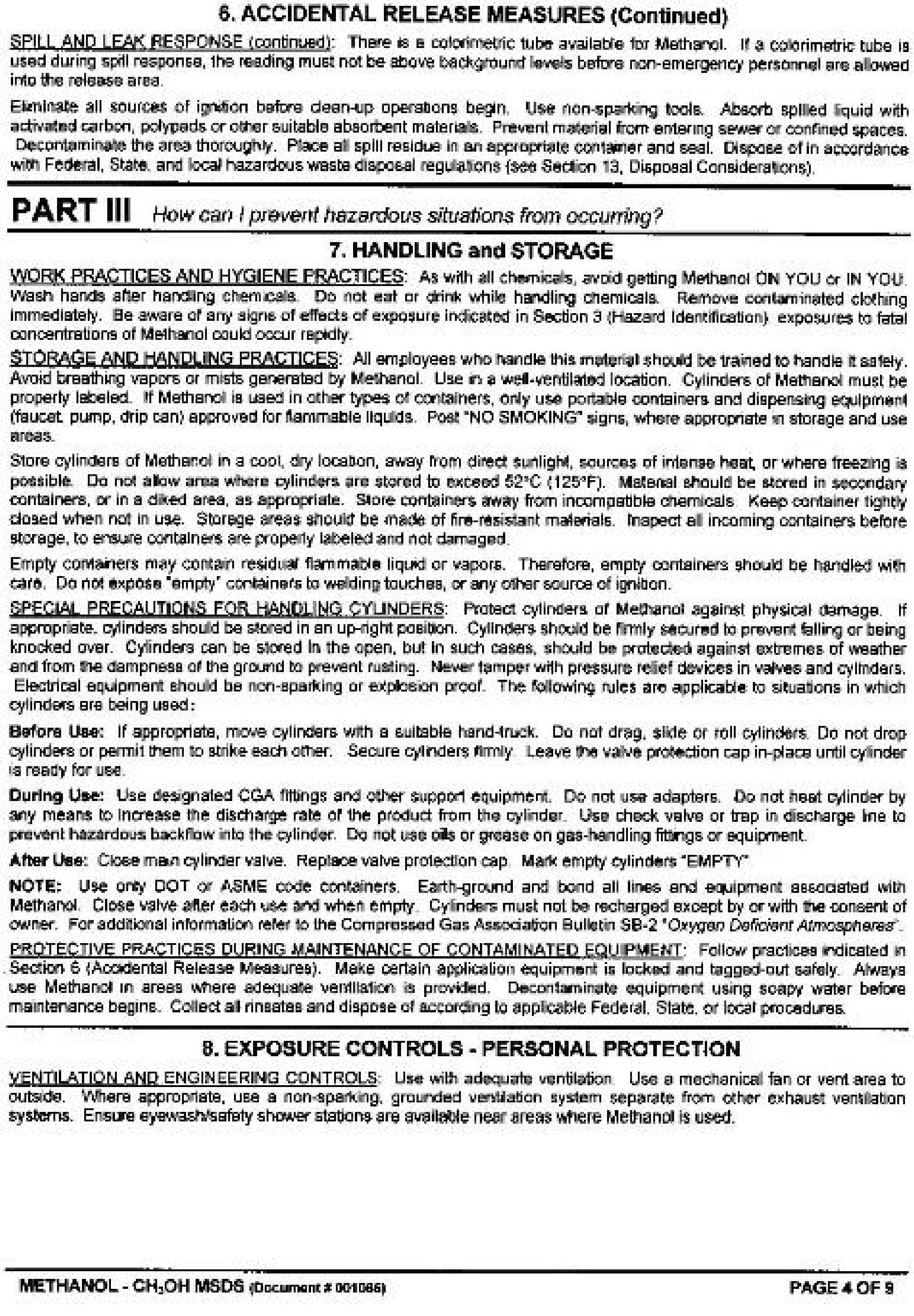
Explosion Sensitivity to Mechanical Impact: Not sensitive.
Explosion Sensitivity to Static Discharge: Static discharge may cause Methanol to ignite

SPECIAL FIRE-FIGHTING PROCEDURES: Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. Water spray can be used to cool fire-exposed containers. Water fog or spray can also be used by trained fire-fighters to disperse Methanol's vapors and to protect personnel. If this liquid is involved in a fire, fire runoff water should be contained to prevent possible environmental damage. If necessary, decontaminate fire-response equipment with soap and water solution.

6. ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of a release, clear the affected area, protect people, and respond with trained personnel.

In the event of a non-incidental release minimum Personal Protective Equipment should be **Level B: triple-gloves (rubber gloves and nitrile gloves, over latex gloves), chemical resistant suit and boots, hard-hat, and Self-Contained Breathing Apparatus.** Monitor the surrounding area for combustible vapor levels, Methanol, and oxygen. Combustible vapor concentration must also be below 10% of the LEL (6.0% for Methanol) prior to entry. The concentration of Methanol must be below the limits indicated in Section 2 (Composition and Information on Ingredients) and the atmosphere must have at least 19.5 percent oxygen before personnel can be allowed in the area without Self-Contained Breathing Apparatus and other protective equipment.



6. ACCIDENTAL RELEASE MEASURES (Continued)

SPILL AND LEAK RESPONSE (continued): There is a colorimetric tube available for Methanol. If a colorimetric tube is used during spill response, the reading must not be above background levels before non-emergency personnel are allowed into the release area.

Eliminate all sources of ignition before clean-up operations begin. Use non-sparking tools. Absorb spilled liquid with activated carbon, polypads or other suitable absorbent materials. Prevent material from entering sewer or confined spaces. Decontaminate the area thoroughly. Place all spill residue in an appropriate container and seal. Dispose of in accordance with Federal, State, and local hazardous waste disposal regulations (see Section 13, Disposal Considerations).

PART III *How can I prevent hazardous situations from occurring?*

7. HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting Methanol ON YOU or IN YOU. Wash hands after handling chemicals. Do not eat or drink while handling chemicals. Remove contaminated clothing immediately. Be aware of any signs of effects of exposure indicated in Section 3 (Hazard Identification) exposures to fatal concentrations of Methanol could occur rapidly.

STORAGE AND HANDLING PRACTICES: All employees who handle this material should be trained to handle it safely. Avoid breathing vapors or mists generated by Methanol. Use in a well-ventilated location. Cylinders of Methanol must be properly labeled. If Methanol is used in other types of containers, only use portable containers and dispensing equipment (faucet, pump, drip can) approved for flammable liquids. Post "NO SMOKING" signs, where appropriate in storage and use areas.

Store cylinders of Methanol in a cool, dry location, away from direct sunlight, sources of intense heat, or where freezing is possible. Do not allow area where cylinders are stored to exceed 52°C (125°F). Material should be stored in secondary containers, or in a diked area, as appropriate. Store containers away from incompatible chemicals. Keep container tightly closed when not in use. Storage areas should be made of fire-resistant materials. Inspect all incoming containers before storage, to ensure containers are properly labeled and not damaged.

Empty containers may contain residual flammable liquid or vapors. Therefore, empty containers should be handled with care. Do not expose "empty" containers to welding touches, or any other source of ignition.

SPECIAL PRECAUTIONS FOR HANDLING CYLINDERS: Protect cylinders of Methanol against physical damage. If appropriate, cylinders should be stored in an up-right position. Cylinders should be firmly secured to prevent falling or being knocked over. Cylinders can be stored in the open, but in such cases, should be protected against extremes of weather and from the dampness of the ground to prevent rusting. Never tamper with pressure relief devices in valves and cylinders. Electrical equipment should be non-sparking or explosion proof. The following rules are applicable to situations in which cylinders are being used:

Before Use: If appropriate, move cylinders with a suitable hand-truck. Do not drag, slide or roll cylinders. Do not drop cylinders or permit them to strike each other. Secure cylinders firmly. Leave the valve protection cap in-place until cylinder is ready for use.

During Use: Use designated CGA fittings and other support equipment. Do not use adapters. Do not heat cylinder by any means to increase the discharge rate of the product from the cylinder. Use check valve or trap in discharge line to prevent hazardous backflow into the cylinder. Do not use oils or grease on gas-handling fittings or equipment.

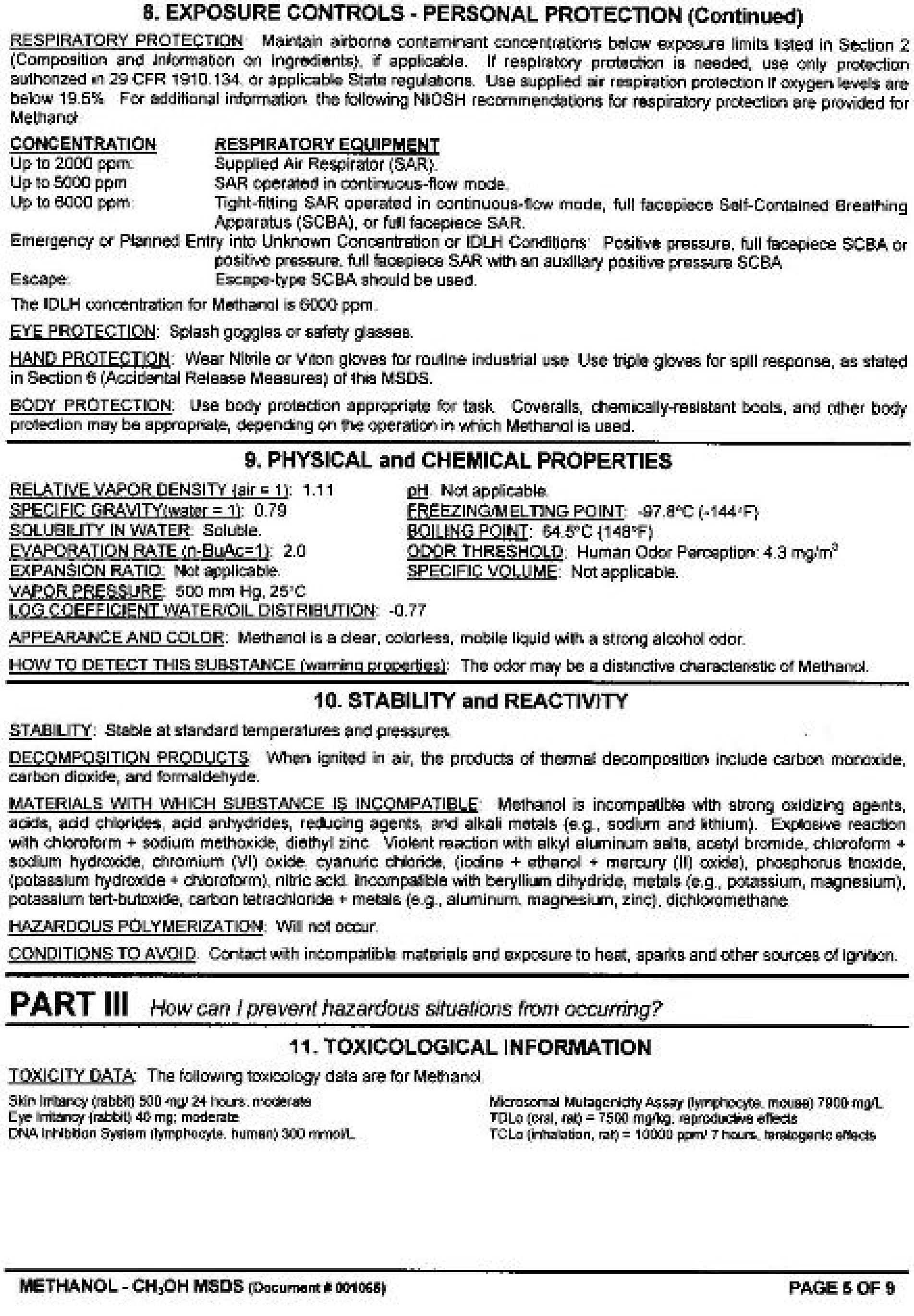
After Use: Close main cylinder valve. Replace valve protection cap. Mark empty cylinders "EMPTY".

NOTE: Use only DOT or ASME code containers. Earth-ground and bond all lines and equipment associated with Methanol. Close valve after each use and when empty. Cylinders must not be recharged except by or with the consent of owner. For additional information refer to the Compressed Gas Association Bulletin SB-2 "*Oxygen Deficient Atmospheres*".

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Make certain application equipment is locked and tagged-out safely. Always use Methanol in areas where adequate ventilation is provided. Decontaminate equipment using soapy water before maintenance begins. Collect all rinsates and dispose of according to applicable Federal, State, or local procedures.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation. Use a mechanical fan or vent area to outside. Where appropriate, use a non-sparking, grounded ventilation system separate from other exhaust ventilation systems. Ensure eyewash/safety shower stations are available near areas where Methanol is used.



8. EXPOSURE CONTROLS - PERSONAL PROTECTION (Continued)

RESPIRATORY PROTECTION: Maintain airborne contaminant concentrations below exposure limits listed in Section 2 (Composition and Information on Ingredients), if applicable. If respiratory protection is needed, use only protection authorized in 29 CFR 1910.134, or applicable State regulations. Use supplied air respiration protection if oxygen levels are below 19.5%. For additional information, the following NIOSH recommendations for respiratory protection are provided for Methanol:

CONCENTRATION	RESPIRATORY EQUIPMENT
Up to 2000 ppm:	Supplied Air Respirator (SAR).
Up to 5000 ppm:	SAR operated in continuous-flow mode.
Up to 6000 ppm:	Tight-fitting SAR operated in continuous-flow mode, full facepiece Self-Contained Breathing Apparatus (SCBA), or full facepiece SAR.
Emergency or Planned Entry into Unknown Concentration or IDLH Conditions:	Positive pressure, full facepiece SCBA or positive pressure, full facepiece SAR with an auxiliary positive pressure SCBA
Escape:	Escape-type SCBA should be used.

The IDLH concentration for Methanol is 6000 ppm.

EYE PROTECTION: Splash goggles or safety glasses.

HAND PROTECTION: Wear Nitrile or Viton gloves for routine industrial use. Use triple gloves for spill response, as stated in Section 6 (Accidental Release Measures) of this MSDS.

BODY PROTECTION: Use body protection appropriate for task. Coveralls, chemically-resistant boots, and other body protection may be appropriate, depending on the operation in which Methanol is used.

9. PHYSICAL and CHEMICAL PROPERTIES

RELATIVE VAPOR DENSITY (air = 1): 1.11
SPECIFIC GRAVITY(water = 1): 0.79
SOLUBILITY IN WATER: Soluble.
EVAPORATION RATE (n-BuAc=1): 2.0
EXPANSION RATIO: Not applicable.
VAPOR PRESSURE: 500 mm Hg, 25°C
LOG COEFFICIENT WATER/OIL DISTRIBUTION: -0.77

pH: Not applicable.
FREEZING/MELTING POINT: -97.8°C (-144°F)
BOILING POINT: 64.5°C (148°F)
ODOR THRESHOLD: Human Odor Perception: 4.3 mg/m^3
SPECIFIC VOLUME: Not applicable.

APPEARANCE AND COLOR: Methanol is a clear, colorless, mobile liquid with a strong alcohol odor.

HOW TO DETECT THIS SUBSTANCE (warning properties): The odor may be a distinctive characteristic of Methanol.

10. STABILITY and REACTIVITY

STABILITY: Stable at standard temperatures and pressures.

DECOMPOSITION PRODUCTS: When ignited in air, the products of thermal decomposition include carbon monoxide, carbon dioxide, and formaldehyde.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Methanol is incompatible with strong oxidizing agents, acids, acid chlorides, acid anhydrides, reducing agents, and alkali metals (e.g., sodium and lithium). Explosive reaction with chloroform + sodium methoxide, diethyl zinc. Violent reaction with alkyl aluminum salts, acetyl bromide, chloroform + sodium hydroxide, chromium (VI) oxide, cyanuric chloride, (iodine + ethanol + mercury (II) oxide), phosphorus trioxide, (potassium hydroxide + chloroform), nitric acid. Incompatible with beryllium dihydride, metals (e.g., potassium, magnesium), potassium tert-butoxide, carbon tetrachloride + metals (e.g., aluminum, magnesium, zinc), dichloromethane.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Contact with incompatible materials and exposure to heat, sparks and other sources of ignition.

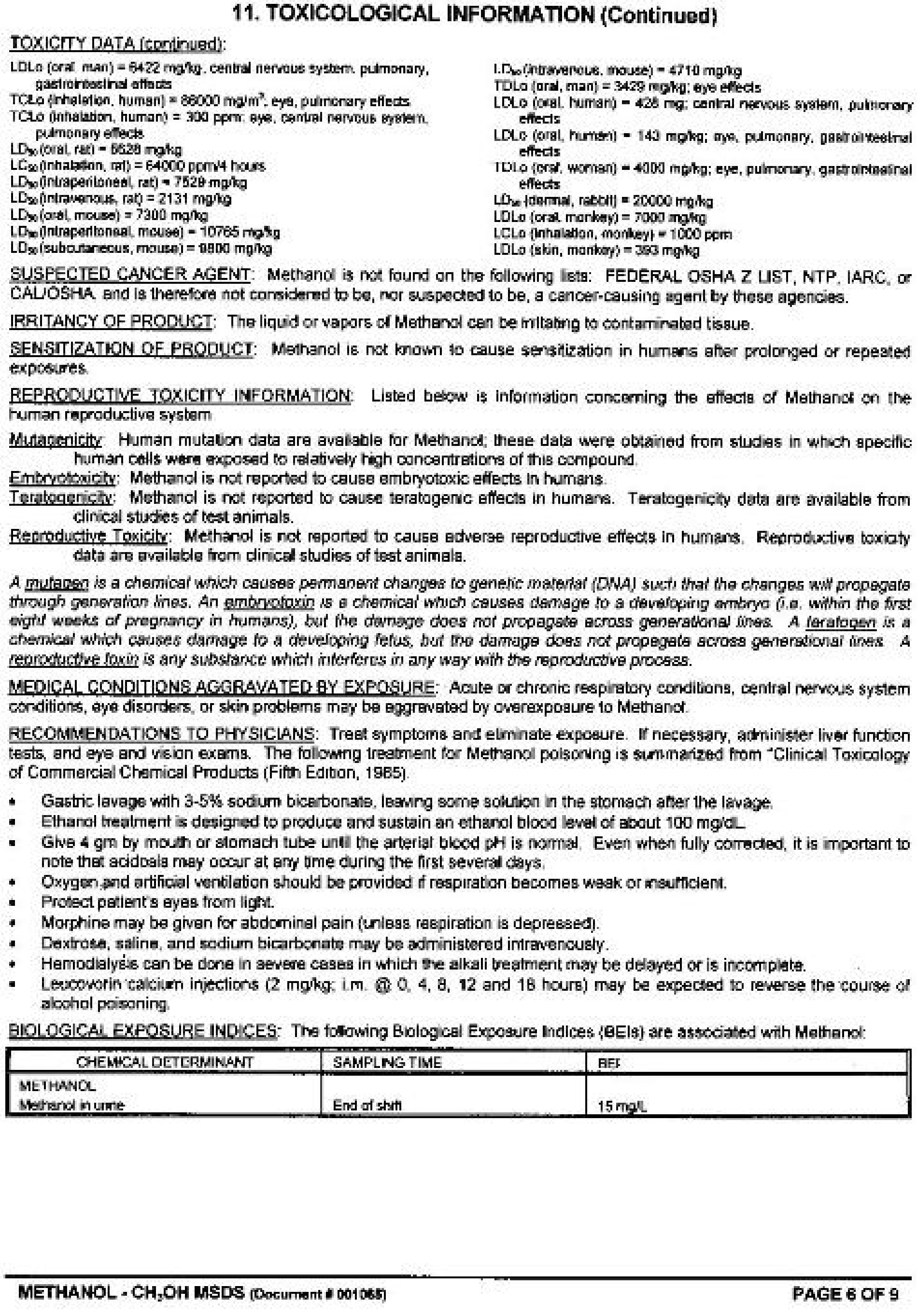
PART III *How can I prevent hazardous situations from occurring?*

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The following toxicology data are for Methanol.

Skin Irritancy (rabbit) 500 mg/ 24 hours: moderate
Eye Irritancy (rabbit) 40 mg; moderate
DNA Inhibition System (lymphocyte, human) 300 mmol/L

Microsomal Mutagenicity Assay (lymphocyte, mouse) 7900 mg/L
TDLo (oral, rat) = 7500 mg/kg, reproductive effects
TCLo (inhalation, rat) = 10000 ppm/ 7 hours, teratogenic effects



11. TOXICOLOGICAL INFORMATION (Continued)

TOXICITY DATA (continued):

LDLo (oral, man) = 6422 mg/kg, central nervous system, pulmonary, gastrointestinal effects
TCLo (inhalation, human) = 86000 mg/m^3; eye, pulmonary effects
TCLo (inhalation, human) = 300 ppm: eye, central nervous system, pulmonary effects
LD$_{50}$ (oral, rat) = 5628 mg/kg
LC$_{50}$ (inhalation, rat) = 64000 ppm/4 hours
LD$_{50}$ (intraperitoneal, rat) = 7529 mg/kg
LD$_{50}$ (intravenous, rat) = 2131 mg/kg
LD$_{50}$ (oral, mouse) = 7300 mg/kg
LD$_{50}$ (intraperitoneal, mouse) = 10765 mg/kg
LD$_{50}$ (subcutaneous, mouse) = 9800 mg/kg
LD$_{50}$ (intravenous, mouse) = 4710 mg/kg
TDLo (oral, man) = 3429 mg/kg; eye effects
LDLo (oral, human) = 428 mg; central nervous system, pulmonary effects
LDLo (oral, human) = 143 mg/kg; eye, pulmonary, gastrointestinal effects
TDLo (oral, woman) = 4000 mg/kg; eye, pulmonary, gastrointestinal effects
LD$_{50}$ (dermal, rabbit) = 20000 mg/kg
LDLo (oral, monkey) = 7000 mg/kg
LCLo (inhalation, monkey) = 1000 ppm
LDLo (skin, monkey) = 393 mg/kg

SUSPECTED CANCER AGENT: Methanol is not found on the following lists: FEDERAL OSHA Z LIST, NTP, IARC, or CAL/OSHA and is therefore not considered to be, nor suspected to be, a cancer-causing agent by these agencies.

IRRITANCY OF PRODUCT: The liquid or vapors of Methanol can be irritating to contaminated tissue.

SENSITIZATION OF PRODUCT: Methanol is not known to cause sensitization in humans after prolonged or repeated exposures.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of Methanol on the human reproductive system.

Mutagenicity: Human mutation data are available for Methanol; these data were obtained from studies in which specific human cells were exposed to relatively high concentrations of this compound.
Embryotoxicity: Methanol is not reported to cause embryotoxic effects in humans.
Teratogenicity: Methanol is not reported to cause teratogenic effects in humans. Teratogenicity data are available from clinical studies of test animals.
Reproductive Toxicity: Methanol is not reported to cause adverse reproductive effects in humans. Reproductive toxicity data are available from clinical studies of test animals.

A mutagen is a chemical which causes permanent changes to genetic material (DNA) such that the changes will propagate through generation lines. An embryotoxin is a chemical which causes damage to a developing embryo (i.e. within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A teratogen is a chemical which causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance which interferes in any way with the reproductive process.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Acute or chronic respiratory conditions, central nervous system conditions, eye disorders, or skin problems may be aggravated by overexposure to Methanol.

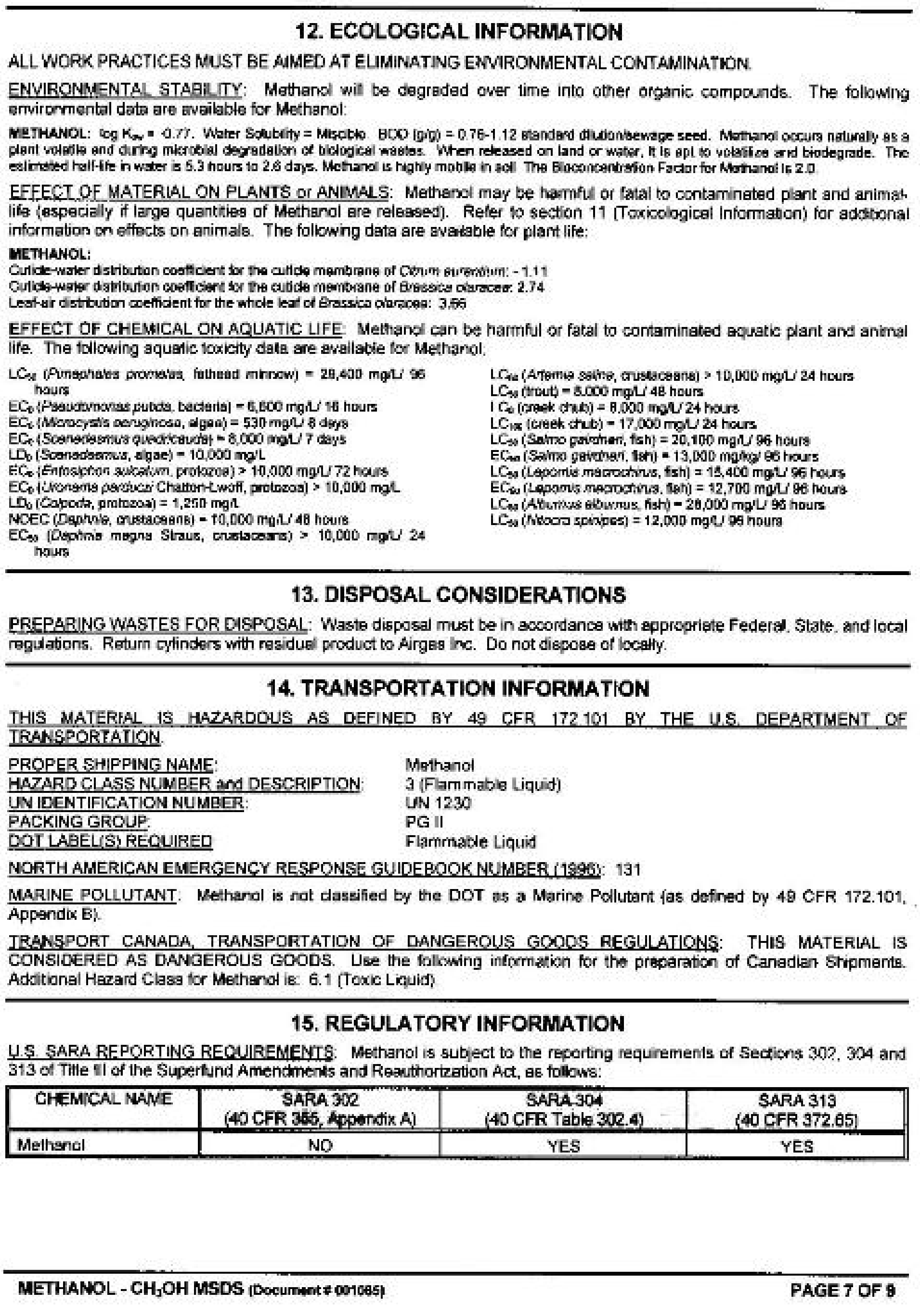
RECOMMENDATIONS TO PHYSICIANS: Treat symptoms and eliminate exposure. If necessary, administer liver function tests, and eye and vision exams. The following treatment for Methanol poisoning is summarized from "Clinical Toxicology of Commercial Chemical Products (Fifth Edition, 1985).

- Gastric lavage with 3-5% sodium bicarbonate, leaving some solution in the stomach after the lavage.
- Ethanol treatment is designed to produce and sustain an ethanol blood level of about 100 mg/dL.
- Give 4 gm by mouth or stomach tube until the arterial blood pH is normal. Even when fully corrected, it is important to note that acidosis may occur at any time during the first several days.
- Oxygen and artificial ventilation should be provided if respiration becomes weak or insufficient.
- Protect patient's eyes from light.
- Morphine may be given for abdominal pain (unless respiration is depressed).
- Dextrose, saline, and sodium bicarbonate may be administered intravenously.
- Hemodialysis can be done in severe cases in which the alkali treatment may be delayed or is incomplete.
- Leucovorin calcium injections (2 mg/kg; i.m. @ 0, 4, 8, 12 and 16 hours) may be expected to reverse the course of alcohol poisoning.

BIOLOGICAL EXPOSURE INDICES: The following Biological Exposure Indices (BEIs) are associated with Methanol:

CHEMICAL DETERMINANT	SAMPLING TIME	BEI
METHANOL Methanol in urine	End of shift	15 mg/L

METHANOL - CH$_3$OH MSDS (Document # 001068) PAGE 6 OF 9



12. ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION.

ENVIRONMENTAL STABILITY: Methanol will be degraded over time into other organic compounds. The following environmental data are available for Methanol:

METHANOL: log K_{ow} = -0.77. Water Solubility = Miscible. BOD (g/g) = 0.76-1.12 standard dilution/sewage seed. Methanol occurs naturally as a plant volatile and during microbial degradation of biological wastes. When released on land or water, it is apt to volatilize and biodegrade. The estimated half-life in water is 5.3 hours to 2.6 days. Methanol is highly mobile in soil. The Bioconcentration Factor for Methanol is 2.0.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: Methanol may be harmful or fatal to contaminated plant and animal life (especially if large quantities of Methanol are released). Refer to section 11 (Toxicological Information) for additional information on effects on animals. The following data are available for plant life:

METHANOL:
Cuticle-water distribution coefficient for the cuticle membrane of *Citrum aurantium*: - 1.11
Cuticle-water distribution coefficient for the cuticle membrane of *Brassica olaracea*: 2.74
Leaf-air distribution coefficient for the whole leaf of *Brassica olaracea*: 3.56

EFFECT OF CHEMICAL ON AQUATIC LIFE: Methanol can be harmful or fatal to contaminated aquatic plant and animal life. The following aquatic toxicity data are available for Methanol:

LC_{50} (*Pimephales promelas*, fathead minnow) = 28,400 mg/L/ 96 hours
EC_0 (*Pseudomonas putida*, bacteria) = 6,600 mg/L/ 16 hours
EC_0 (*Microcystis aeruginosa*, algae) = 530 mg/L/ 8 days
EC_0 (*Scenedesmus quadricauda*) = 8,000 mg/L/ 7 days
LD_0 (*Scenedesmus*, algae) = 10,000 mg/L
EC_0 (*Entosiphon sulcatum*, protozoa) > 10,000 mg/L/ 72 hours
EC_0 (*Uronema parduczi* Chatton-Lwoff, protozoa) > 10,000 mg/L
LD_0 (*Colpoda*, protozoa) = 1,250 mg/L
NOEC (*Daphnia*, crustaceans) = 10,000 mg/L/ 48 hours
EC_{50} (*Daphnia magna* Straus, crustaceans) > 10,000 mg/L/ 24 hours
LC_{50} (*Artemia salina*, crustaceans) > 10,000 mg/L/ 24 hours
LC_{50} (trout) = 8,000 mg/L/ 48 hours
LC_0 (creek chub) = 8,000 mg/L/ 24 hours
LC_{100} (creek chub) = 17,000 mg/L/ 24 hours
LC_{50} (*Salmo gairdneri*, fish) = 20,100 mg/L/ 96 hours
EC_{50} (*Salmo gairdneri*, fish) = 13,000 mg/kg/ 96 hours
LC_{50} (*Lepomis macrochirus*, fish) = 15,400 mg/L/ 96 hours
EC_{50} (*Lepomis macrochirus*, fish) = 12,700 mg/L/ 96 hours
LC_{50} (*Alburnus alburnus*, fish) = 28,000 mg/L/ 96 hours
LC_{50} (*Nitocra spinipes*) = 12,000 mg/L/ 96 hours

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations. Return cylinders with residual product to Airgas Inc. Do not dispose of locally.

14. TRANSPORTATION INFORMATION

THIS MATERIAL IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

PROPER SHIPPING NAME:	Methanol
HAZARD CLASS NUMBER and DESCRIPTION:	3 (Flammable Liquid)
UN IDENTIFICATION NUMBER:	UN 1230
PACKING GROUP:	PG II
DOT LABEL(S) REQUIRED	Flammable Liquid

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (1996): 131

MARINE POLLUTANT: Methanol is not classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B).

TRANSPORT CANADA, TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: THIS MATERIAL IS CONSIDERED AS DANGEROUS GOODS. Use the following information for the preparation of Canadian Shipments. Additional Hazard Class for Methanol is: 6.1 (Toxic Liquid)

15. REGULATORY INFORMATION

U.S. SARA REPORTING REQUIREMENTS: Methanol is subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act, as follows:

CHEMICAL NAME	SARA 302 (40 CFR 355, Appendix A)	SARA 304 (40 CFR Table 302.4)	SARA 313 (40 CFR 372.65)
Methanol	NO	YES	YES

15. REGULATORY INFORMATION (Continued)

U.S. SARA THRESHOLD PLANNING QUANTITY: Not applicable.

U.S. CERCLA REPORTABLE QUANTITIES (RQ): 5000 lb.

CANADIAN DSL/NDSL INVENTORY STATUS: Methanol is listed on the Canadian DSL Inventory.

U.S. TSCA INVENTORY STATUS: Methanol is listed on the TSCA Inventory.

OTHER U.S. FEDERAL REGULATIONS: Depending on specific operations involving the use of Methanol, the regulations of the Process Safety Management of Highly Hazardous Chemicals may be applicable (29 CFR 1910.119). Under this regulation, Methanol is not listed in Appendix A; however, any process that involves a flammable liquid on-site, in one location, in quantities of 10,000 lb (4,553 kg) or greater is covered under this regulation unless it is used as a fuel.

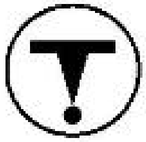
U.S. STATE REGULATORY INFORMATION: Methanol is covered under specific State regulations, as denoted below:

Alaska - Designated Toxic and Hazardous Substances: Methanol.
California - Permissible Exposure Limits: Methanol.
Florida - Substance List: Methanol.
Illinois - Toxic Substance List: Methanol.
Kansas - Section 302/313 List: Methanol.
Minnesota - List of Hazardous Substances: Methanol.
Massachusetts - Substance List: Methanol.
Michigan - Critical Materials Register: No.
Missouri - Employer Information/Toxic Substance List: Methanol.
New Jersey - Right to Know Hazardous Substance List: Methanol.
North Dakota - List of Hazardous Chemicals, Reportable Quantities: Methanol.
Pennsylvania - Hazardous Substance List: Methanol.
Rhode Island - Hazardous Substance List: Methanol.
Texas - Hazardous Substance List: Methanol.
West Virginia - Hazardous Substance List: Methanol.
Wisconsin - Toxic and Hazardous Substances: Methanol.

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): Methanol is not on the California Proposition 65 List.

LABELING: **WARNING!** FLAMMABLE LIQUID AND VAPOR. PROLONGED OR REPEATED SKIN CONTACT MAY DRY SKIN AND CAUSE IRRITATION. HARMFUL OR FATAL IF SWALLOWED. CAN CAUSE CENTRAL NERVOUS SYSTEM EFFECTS, BLINDNESS OR LIVER DAMAGE. CAN CAUSE DEATH IF TOO MUCH VAPOR IS BREATHED. Keep away from heat, sparks and flame. Keep container closed. Use only with adequate ventilation. Avoid contact with skin and clothing. Avoid exposure to vapor. Wash thoroughly after handling. FIRST-AID: In case of contact, immediately flush skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if irritation develops or persists. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. If swallowed, do not induce vomiting. Get medical attention. IN CASE OF FIRE: Use water fog, foam, dry chemical, or CO_2. IN CASE OF SPILL: Absorb spill with inert materials (e.g. activated carbon, dry sand). Flush residual spill with water. Consult Material Safety Data Sheet for additional information.

CANADIAN WHMIS SYMBOLS:
Class B2: Flammable Liquid
Class D1A: Poisonous and Toxic Material
Class D2A/D2B: Materials Causing Other Toxic Effects



16. OTHER INFORMATION

PREPARED BY:

CHEMICAL SAFETY ASSOCIATES, Inc.
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619/565-0302

The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof. AIRGAS, Inc. assumes no responsibility for injury to the vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, AIRGAS, Inc. assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in his use of the material.

DEFINITIONS OF TERMS

A large number of abbreviations and acronyms appear on a MSDS. Some of these which are commonly used include the following:

CAS #: This is the Chemical Abstract Service Number which uniquely identifies each constituent. It is used for computer-related searching.

EXPOSURE LIMITS IN AIR:

ACGIH - American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits.

TLV - **Threshold Limit Value** - an airborne concentration of a substance which represents conditions under which it is generally believed that nearly all workers may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour **Time Weighted Average (TWA)**, the 15-minute **Short Term Exposure Limit**, and the instantaneous **Ceiling Level**. Skin absorption effects must also be considered.

OSHA - U.S. Occupational Safety and Health Administration.

PEL - Permissible Exposure Limit - This exposure value means exactly the same as a TLV, except that it is enforceable by OSHA. The OSHA Permissible Exposure Limits are based in the 1989 PELs and the June, 1993 Air Contaminants Rule (Federal Register: 58: 35338-35351 and 58: 40191). Both the current PELs and the vacated PELs are indicated. The phrase, "Vacated 1989 PEL," is placed next to the PEL which was vacated by Court Order.

IDLH - Immediately Dangerous to Life and Health - This level represents a concentration from which one can escape within 30-minutes without suffering escape-preventing or permanent injury. **The DFG - MAK** is the Republic of Germany's Maximum Exposure Level, similar to the U.S. PEL. **NIOSH** is the National Institute of Occupational Safety and Health, which is the research arm of the U.S. **Occupational Safety and Health Administration** (OSHA). NIOSH issues exposure guidelines called Recommended Exposure **Levels (RELs)**. When no exposure guidelines are established, an entry of **NE** is made for reference.

HAZARD RATINGS:

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM: Health Hazard: **0** (minimal acute or chronic exposure hazard); **1** (slight acute or chronic exposure hazard); **2** (moderate acute or significant chronic exposure hazard); **3** (severe acute exposure hazard; onetime overexposure can result in permanent injury and may be fatal); **4** (extreme acute exposure hazard; onetime overexposure can be fatal). Flammability Hazard: **0** (minimal hazard); **1** (materials that require substantial pre-heating before burning); **2** (combustible liquid or solids; liquids with a flash point of 38-93°C [100-200°F]); **3** (Class IB and IC flammable liquids with flash points below 38°C [100°F]); **4** (Class IA flammable liquids with flash points below 23°C [73°F] and boiling points below 38°C [100°F]. Reactivity Hazard: **0** (normally stable); **1** (material that can become unstable at elevated temperatures or which can react slightly with water); **2** (materials that are unstable but do not detonate or which can react violently with water); **3** (materials that can detonate when initiated or which can react explosively with water); **4** (materials that can detonate at normal temperatures or pressures).

NATIONAL FIRE PROTECTION ASSOCIATION: Health Hazard: **0** (material that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials); **1** (materials that on exposure under fire conditions could cause irritation or minor residual injury); **2** (materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); **3** (materials that can on short exposure could cause serious temporary or residual injury); **4** (materials that under very short exposure could cause death or major residual injury). Flammability Hazard and Reactivity Hazard: Refer to definitions for "Hazardous Materials Identification System".

FLAMMABILITY LIMITS IN AIR:

Much of the information related to fire and explosion is derived from the **National Fire Protection Association (NFPA)**. Flash Point - Minimum temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air. Autoignition Temperature: The minimum temperature required to initiate combustion in air with no other source of ignition. LEL - the lowest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source. UEL - the highest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source.

TOXICOLOGICAL INFORMATION:

Possible health hazards as derived from human data, animal studies, or from the results of studies with similar compounds are presented. Definitions of some terms used in this section are: **LD$_{50}$** - Lethal Dose (solids & liquids) which kills 50% of the exposed animals; **LC$_{50}$** - Lethal Concentration (gases) which kills 50% of the exposed animals; **ppm** concentration expressed in parts of material per million parts of air or water; **mg/m^3** concentration expressed in weight of substance per volume of air; **mg/kg** quantity of material, by weight, administered to a test subject, based on their body weight in kg. Data from several sources are used to evaluate the cancer-causing potential of the material. The sources are: **IARC** - the International Agency for Research on Cancer; **NTP** - the National Toxicology Program, **RTECS** - the Registry of Toxic Effects of Chemical Substances, **OSHA** and **CAL/OSHA**. IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4. Subrankings (2A, 2B, etc.) are also used. Other measures of toxicity include **TDLo**, the lowest dose to cause a symptom and **TCLo** the lowest concentration to cause a symptom; **TDo**, **LDLo**, and **LDo**, or TC, **TCo**, **LCLo**, and **LCo**, the lowest dose (or concentration) to cause death. **BEI** - Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV.

REGULATORY INFORMATION:

This section explains the impact of various laws and regulations on the material. **EPA** is the U.S. Environmental Protection Agency. **WHMIS** is the Canadian Workplace Hazardous Materials Information System. **DOT** and **TC** are the U.S. Department of Transportation and the Transport Canada, respectively. **Superfund Amendments and Reauthorization Act (SARA)**; the **Canadian Domestic Substances List** (DSL); the U.S. Toxic **Substance Control Act** (TSCA); Marine Pollutant status according to the DOT; California's Safe Drinking Water Act (**Proposition 65**); the **Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund)**; and various state regulations. This section also includes information on the precautionary warnings which appear on the materials package label.