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BASE-WIDE BACKGROUND SOIL INVESTIGATION WORK PLAN WITH TRANSMITTALNSA CRANE IN
4/1/2000
TETRA TECH

TETRA TECH NUS, INC.
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PITT-05-0-005

May 3, 2000

Project Number 0087

Commander
Southern Division
Naval Facilities Engineering Command
Department of the Navy
SOUTHNAVFACENGCOM
North Charleston, South Carolina 29419-9010
ATTN: William H. Gates (Code 1864)

Reference: CLEAN Contract Number N62467-94-D-0888
Contract Task Order 0083

Subject: Final Quality Assurance Project Plan and Work Plan, Revision 2
Base-Wide Background Soil Investigation
Naval Surface Warfare Center Crane
Crane, Indiana

Dear Mr. Gates,

Enclosed are two copies of the page changes to the Final Quality Assurance Project Plan and Work Plan for the Base-Wide Background Soil Investigation at the Naval Surface Warfare Center Crane. These page changes and binder cover sheets should be inserted into the Final documents (sent on October 21, 1999) as appropriate replacing existing pages. The replaced pages should be taken out of the document as they represent revision 1 of the Final Draft.

These page changes have been prepared as a result of the U.S. Environmental Protection Agency (U.S. EPA) approved analysis of additional metals (lithium, strontium, and thorium) in a letter dated April 27, 2000.

As you and Tom Brent have requested, I have sent Tom five copies of the page changes described above for NSWC Crane and distribution to agency representatives at the U.S. EPA and Indiana Department of Environmental Management.

I have also attached an updated version of the signature page for each of the two aforementioned documents. Please sign these pages and forward them onto Tom Brent for his signature. I would ask that Tom forward them to the U.S. EPA for the appropriate signatures and then return them to me.

If you have any questions, feel free to call me at (412) 921-8146.

Sincerely,

Keith W. Henn
Task Order Manager

KWH/sic
Enclosure

c: Tom Brent, NSWC Crane (5 copies of the page changes for each document)
Tom Johnston (1 copy of the page changes for each document)
Laucks Laboratory (1 copy of the page changes for the QAPP)
Debbie Wroblewski/DER (cover letter only)
Mark Perry/file (1 copy of the page changes for each document)

N0087-3.15

0004

REVISION 2
APRIL 2000

Work Plan
for
Base-Wide Background Soil Investigation

Naval Surface Warfare Center Crane Division
Crane, Indiana

Southern Division Naval Facilities Engineering Command
Contract Number N62467-94-D-0888
Contract Task Order 0083

April 2000

WORK PLAN
FOR
BASE-WIDE BACKGROUND SOIL INVESTIGATION

NAVAL SURFACE WARFARE CENTER, CRANE DIVISION
CRANE, INDIANA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
Tetra Tech NUS, Inc.
661 Andersen Drive
Foster Plaza 7
Pittsburgh, Pennsylvania 15220

CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0083

APRIL 2000

Date 5/3/00
KEITH W. HENN, P.G.
TASK ORDER MANAGER
TETRA TECH NUS, INC.

Date 5/3/00
DEBBIE WROBLEWSKI
PROGRAM MANAGER
TETRA TECH NUS, INC.

Date 5/4/00
BILL GATES
REMEDIAL PROJECT MANAGER
NAVAL FACILITIES ENGINEERING COMMAND

Date 5-3-00
PAUL V. FRANK
QUALITY ASSURANCE MANAGER
TETRA TECH NUS, INC.

Date 5-19-00
PETER RAMANAUSKAS
PERMITTING PROJECT MANAGER
U.S. EPA REGION 5

Date 5-19-00
ALLEN DEBUS
QUALITY ASSURANCE REVIEWER
U.S. EPA REGION 5

Date 6/7/00
TOM BRENT
SITE MANAGER
NSWC CRANE

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APPENDICES

TABLES

FIGURES

ACRONYMS

ABG	Ammunition Burning Grounds
ANOVA	Analysis of Variance
ARARs	applicable, relevant, or appropriate requirements
ASTM	American Society for Testing of Materials
B&R Environmental	Brown and Root Environmental
BA1	Background Area 1
BA2	Background Area 2
BA3	Background Area 3
BGS	below ground surface
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
CTO	Contract Task Order
DQO	Data Quality Objectives
DE	Depositional Environmental
DR	Demolition Range
EMR	Environmental Monitoring Report
FOL	Field Operations Leader
FSP	Field Sampling Plan
ft	Foot; Feet
GIS	geographic information systems
GPS	global positioning system
GRITS/STAT	Ground Water Information Tracking System/Statistics
HASP	Health and Safety Plan
IAC	Indiana Administrative Code
IAS	Initial assessment study
IDEM	Indiana Department of Environmental Management
IDL	instrument detection limit
MSL	mean sea level
NAVFAC	Naval Facilities Engineering Command
Navy	U.S. Department of the Navy
NGVD	National Geodetic Vertical Datum
NSWC	Naval Surface Warfare Center
ORR	Old Rifle Range

OB	Open Burning
OD	Open Detonation
PID	Photo-ionization detector
QAPP	Quality Assurance Project Plan
QA/QC	Quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SOP	standard operating procedure
SOUTHNAVFACENGCOM	Southern Division, Naval Facilities Engineering Command
SQL	Sample Quantitation Limit
SWMA	Solid Waste Management Area
SWMU	Solid Waste Management Unit
SVOC	Semivolatile Organic Compound
TtNUS	TetraTech, NUS Inc.
USACE	United States Army Corps of Engineering
USDA/SCS	United States Department of Agriculture/Soil Conservation Service
EPA	United States Environmental Protection Agency
WES	Waterways Experiment Station

1.0 INTRODUCTION

This Work Plan (WP) has been prepared as a part of the Quality Assurance Project Plan (Tetra Tech NUS, 1999; hereinafter referred to as the QAPP) for the base-wide background soil investigation at the Naval Surface Warfare Center Crane (NSWC Crane), Indiana. The QAPP and this WP have been prepared for the U.S. Department of the Navy (Navy) by Tetra Tech NUS, Inc. (TtNUS) under the Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM) contract, Contract Number N62467-94-D-0888, Contract Task Order (CTO) 0083. A copy of this WP is maintained at the NSWC Crane Environmental Division office.

This WP outlines the site characteristics at NSWC Crane, the rationale for the collection of background samples, the procedure for collection of these samples and the plans for data reduction and the presentation of data. Data collected during this background investigation will be used in on-going and future environmental investigations to differentiate site-related environmental contamination from naturally occurring and anthropogenic background concentrations of inorganic constituents.

This work plan also contains the Field Sampling Plan (FSP) and the Health and Safety Plan (HASP). The FSP, which is integrated into the body of the WP text, describes the standard sampling procedures to be used for the base-wide background investigation at the NSWC Crane, Indiana. It supports the scope of work for purposes of completion of the Quality Assurance Project Plan (QAPP). This FSP specifies requirements for all field sampling work that may be undertaken under this QAPP at the NSWC Crane facility. This document has been prepared in accordance with the U.S. Environmental Protection Agency (U.S. EPA), Region 5, Model Quality Assurance Project Plan (1998). All field sampling activities will be conducted in accordance with the HASP (included as Appendix C to this report) developed for the field sampling activities described in this FSP.

This WP consists of seven sections. Section 1.0 is this introduction. Section 2.0 provides a description of the site characteristics and a brief summary of the Solid Waste Management Units (SWMUs) at the facility. Section 3.0 discusses the historical background data available at the site and an evaluation of this data. Section 4.0 provides the details of the data quality objective process and the sample network design and rationale. Section 5.0 provides detailed information on site-specific aspects of the environmental sampling procedures and field operations. Section 6.0 discusses the data evaluation process and procedures for determining background values for the NSWC Crane facility. Section 7.0 provides a project schedule for implementation of the QAPP and WP.

Field Forms and Standard Operating Procedures (SOPs) for these activities are included in Appendices A and B, respectively. Soil maps for NSWC Crane are included in Appendix D.

1.1 PROJECT ORGANIZATION AND RESPONSIBILITIES

This section presents the project management and organization for this background investigation at NSWC Crane. Included in the following sections are the staffing and coordination requirements.

1.1.1 Project Organization Chart

At the direction of the U.S. EPA Project Manager, TtNUS, on behalf of the U.S. Navy, is responsible for the overall management, implementation of contract field activities, and preparation of the report. Personnel from the Navy will be actively involved and will coordinate with TtNUS personnel in a number of areas. The authorities and organizational relationship of key personnel are depicted in Figure 1-1. Corresponding addresses and telephone numbers of key personnel are listed by organization in Table 1-1. Responsibilities for program management, project management, field operations, and laboratory operations are discussed in the following sections. It is intended that the individuals named will perform the designated responsibilities to the extent that the specific person is available to perform the stated activities.

1.1.2 Management Responsibilities

U.S. EPA Project Manager

The U.S. EPA Project Manager (PM) will oversee the implementation of the base-wide soil background investigation at NSWC Crane. The U.S. EPA PM represents agency's interests and will provide input from this perspective, and lend general historical and technical assistance to NSWC Crane field activities.

Indiana Department of Environmental Management

The Indiana Department of Environmental Management (IDEM) project manager will oversee the implementation of the background investigation at NSWC Crane.

Navy Project Managers

The Navy Remedial Project Manager (RPM) acts as the focal representative for the U.S. Navy, providing management, technical direction, and oversight for all NSWC Crane project activities performed by contractors (i.e., TtNUS) and their subcontractors. In matters such as facilitation of access, oversight, etc., the Navy RPM is assisted by the NSWC Crane Site Manager. Additional responsibilities of the RPM are:

- Define project objectives and develop a detailed work plan schedule;
- Establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task;
- Acquire and apply technical resources (i.e., contractors) as needed to ensure performance within budget and schedule constraints;
- Review the work performed on each task to ensure its quality, responsiveness, and timeliness;
- Review and analyze overall task performance with respect to planned requirements and authorizations;
- Approve all reports (deliverables) before their submission to U.S. EPA Region 5;
- Ultimately be responsible for the preparation and quality of interim and final reports; and
- Represent the project team at meetings and public hearings.

Contractor Project Management

Program Manager

The TtNUS Navy Southern Division Comprehensive Long-Term Environmental Action Navy (CLEAN) Program Manager provides operations, technical, and administrative leadership, and oversees and supports quality policies. The Program Manager assigns project Task Order Managers (TOMs) and oversees their performance. The Program Manager also ensures the availability of technical and support resources for Program operations, and maintains consistency in procedures and projects among Contract Task Order (CTO) assignments. In these matters, the Program Manager is assisted by the Task Order Manager.

Task Order Manager

The TtNUS Task Order Manager (TOM), has the overall responsibility for ensuring that the project meets U.S. EPA and IDEM objectives, and Navy and TtNUS quality standards. The TOM is responsible for the preparation and distribution of the QAPP, at the direction of the Navy RPM, to all parties connected with the project, including any subcontractors. The TOM will report to the Navy RPM and is responsible for technical quality control and project oversight. Additional responsibilities of the TOM are:

- Ensuring timely resolution of project-related technical, quality, safety, or waste management issues
- Functioning as primary interface with the Navy RPM and NSWC Crane Site Manager, field personnel, and subcontractor points-of-contact
- Monitoring and evaluating subcontractor laboratory performance
- Coordinating and overseeing work performed by field and office technical staff (including data validation, statistical evaluations, and report preparation)
- Coordinating and overseeing maintenance of all project records
- Coordinating and overseeing review of project deliverables
- Preparing and issuing final deliverables to the Navy
- Approving the implementation of corrective action

Health and Safety Manager

The TtNUS Health and Safety Manager (HSM) is responsible for the following:

- Overseeing the development and review of the Site Security and Health and Safety Plan
- Implementation of the Site Security and Health and Safety Plan
- Assigning the Site Safety Officer and supervising his/her performance
- Conducting Health and Safety audits
- Preparing Health and Safety reports for management

1.1.3 Quality Assurance Responsibilities

This section identifies the quality assurance responsibilities for the NSWC Crane Background Investigation. Responsibilities of the U.S. EPA Region 5, TtNUS personnel, and the analytical laboratory are discussed.

U.S. EPA Region 5 Quality Assurance Coordinator

The U.S. EPA Region 5 RCRA Quality Assurance Coordinator (ROAC) has the responsibility to review and approve the Quality Assurance Project Plan (QAPP) and provide overall Quality Assurance support and review. The IDEM project manager has the responsibility to review and approve the QAPP and provide overall quality assurance. Additional U.S. EPA and IDEM responsibilities may include:

- Coordinating external performance and system audits of the contracted laboratory
- Reviewing and evaluating analytical field and laboratory procedures

Navy QA Manager

The Navy QA manager will remain independent of direct job involvement and day-to-day operations, and have direct access to resources as necessary, to resolve any QA issues. The Navy QA manager is responsible for auditing the implementation of the QA program in conformance with the demands of specific investigations, TtNUS policies, and U.S. EPA requirements. The Navy QA manager has sufficient authority to stop work on the investigation as deemed necessary in the event of serious QA/QC issues. Specific functions and duties include:

- Performing QA audits on various phase of the field operations;
- Reviewing and approving QA plans and procedures;
- Providing QA technical assistance to project staff;
- Reporting on the adequacy, status, and effectiveness of the QA program on a regular basis to the program manager and executive vice president for technical operations.

TtNUS Quality Assurance Manager

The TtNUS Quality Assurance Manager (QAM) is responsible for overall quality assurance for the project, and reports directly to the TtNUS Program Manager. The QAM has the responsibility for the following specific activities:

- Developing, maintaining, and monitoring quality assurance policies and procedures
- Providing training to TtNUS staff in Quality Assurance/Quality Control (QA/QC) policies and procedures
- Conducting systems and performance audits to monitor compliance with environmental regulations, contractual requirements, QAPP and WP requirements, and corporate policies and procedures
- Auditing project records
- Monitoring subcontractor quality controls and records
- Assisting in the development of corrective action plans; ensuring correction of nonconformances reported in internal or external audits
- Overseeing the implementation of the QAPP
- Overseeing and reviewing the development and revision of the QAPP
- Overseeing the responsibilities of the TtNUS Site QA/QC Advisor
- Preparing quality assurance reports for management

TtNUS Project QA Advisor

The TtNUS Project QA Advisor provides support to the TOM in preparation and review of the QAPP, coordination of work performed by office technical staff, and performance of data assessment. The QA Project Advisor communicates directly with the QAM on matters of QA/QC.

TtNUS Data Validation Coordinator

The Data Validation Coordinator is responsible for organizing and managing the data validation effort. This requires:

- developing and maintaining current data validation processes according to U.S. EPA Regional guidelines,
- distributing work assignments to data validators,
- reviewing and approving the work of data validators,
- interfacing with other project personnel on matters concerning data validation,
- interfacing with the data management and GIS staff who perform work under the data management plan (Appendix C),
- interfacing with the analytical laboratory to assure that project and deliverable requirements are met,
- maintaining project-specific databases containing qualified analytical results after data validation,
- distributing data validation reports to project managers and maintaining project data validation report files.

1.1.4 Laboratory Responsibilities

As discussed in Section 7.0 of the attendant QAPP, Laucks Testing Laboratories, Inc., of Seattle, Washington, will perform all background soil sample analyses.

The subcontracted laboratory is responsible for analyzing all soil samples in accordance with the analytical methods and additional requirements specified in the attendant QAPP. It also will be the analytical laboratory's responsibility to properly dispose of unused sample aliquots. Responsibilities of key laboratory personnel are outlined in the following paragraphs.

Laboratory Project Manager

The Laboratory Project Manager will report directly to the TtNUS TOM and will perform the following:

- Ensure that method and project-specific requirements are properly communicated and understood by laboratory personnel
- Ensure that all laboratory resources are available on an as required basis
- Monitor analytical and project quality assurance (QA) requirements
- Review data packages for completeness, clarity, and compliance with project requirements
- Inform the TtNUS TOM of project status and any sample receipt or analytical problems

Laboratory Operations Manager

Responsibilities of the laboratory Operations Manager include the following:

- Support the QA program within the laboratory
- Provide management overview of both production and quality-related laboratory activities
- Maintain adequate staffing to meet project analytical and quality objectives
- Approve all laboratory Standard Operating Procedures (SOPs) and QA documents
- Supervise in hours chain-of-custody documentation
- Oversee the preparation of an approving final analytical reports prior to submittal to TtNUS

Laboratory Quality Assurance Officer (QAO)

The Laboratory QA officer has the overall responsibility for data after it leaves the laboratory. The Laboratory QA officer will be independent of the laboratory but will communicate data issues through the Laboratory project manager. In addition, the Laboratory QA officer will:

- Oversee laboratory QA
- Oversee QA/QC documentation
- Conduct detailed data review
- Determine whether to implement laboratory corrective actions, if required
- Define appropriate laboratory QA procedures
- Prepare laboratory SOPs
- Sign the title page of the QAPP

Final responsibility for project quality rests with TtNUS Project Manager. Independent QA will be provided by the Laboratory Project Manager and QA Officer prior to release of all data to TtNUS.

Laboratory Sample Custodian

The laboratory Sample Custodian will report to the laboratory Operations Manager. Responsibilities of the laboratory Sample Custodian include the following:

- Receive and inspect the incoming sample containers
- Record the condition of the incoming sample containers
- Sign appropriate documents
- Verify chain-of-custody
- Notify laboratory manager and laboratory supervisor of sample receipt and inspection
- Assign a unique identification number and customer number, and enter each into the sample receiving log
- With the help of the laboratory manager, initiate transfer of the samples to appropriate lab sections
- Control and monitor access/storage of samples and extracts

Laboratory Technical Staff

The Laboratory technical staff will be responsible for sample analysis and identification of corrective actions. The staff will report directly to the laboratory operations manager.

1.1.5 Field Responsibilities

TtNUS will be responsible for all field activities related to this background investigation. The TtNUS field team will be organized according to the activities planned. Field team members will be selected based on the type and extent of effort required. All team members will be appropriately skilled and trained for the tasks they are assigned to perform. The team will consist of a combination of the following personnel:

- Field Operations Leader (FOL)
- Site QA/QC Advisor
- Field Technical Staff

The FOL is responsible for coordinating all onsite personnel and for providing technical assistance, when required. The FOL, or designee, will coordinate and lead all sampling activities and will ensure the availability and maintenance of all sampling materials/equipment. The FOL is responsible for the completion of all sampling, field and chain-of-custody documentation, will assume custody of all samples, and will ensure the proper handling and shipping of samples. The FOL is a highly experienced environmental professional who will report directly to the TtNUS Task Order Manager. Specific FOL responsibilities include the following:

- Function as communications link between field staff members, the Site QA/QC Advisor, Site Safety Officer, the Site Manager, and the TOM
- Oversee the mobilization and demobilization of all field equipment and subcontractors
- Coordinate and manage the Field Technical Staff
- Adhere to the work schedules provided by the TOM
- Bear responsibility for maintenance of the site logbook, field logbook, and field recordkeeping
- Initiate field task modification requests when necessary
- Identify and resolve problems in the field; resolve difficulties in consultation with the NSWC Crane Site Manager; implement and document corrective action procedures and provides communication between the field team and upper management

The FOL (or his assistant) will act as the Site QA/QC Advisor, who is responsible for ensuring adherence to all QA/QC guidelines as defined in the FSP and QAPP. Strict adherence to these procedures is critical to the collection of acceptable and representative data. The following is a summary of the Site QA/QC Advisor's responsibilities:

- Ensure that field duplicates and field quality control blanks are collected with the proper frequency
- Ensure that additional volumes of sample are supplied to the analytical laboratory with the proper frequency to accommodate laboratory QA/QC analyses
- Ensure that measuring and test equipment are calibrated, used, and maintained in accordance with applicable procedures

- Act as liaison between site personnel, laboratory personnel, and the QAM
- Manage bottleware shipments and oversees field preservation

The FOL (or designee) will also serve as the Site Safety Officer (SSO). The duties of the SSO are detailed in the Health and Safety Plan. The SSO has stop-work authority which can be executed upon the determination of an imminent safety hazard.

Field Technical Staff

The field technical staff for this project will be drawn from TtNUS's pool of qualified personnel. All of the designated field team members will be experienced professionals who possess the degree of specialization and technical competence required to effectively and efficiently perform the required work.

Field staff are responsible for complying with field-related requirements as presented in the QAPP, as well as the requirements in this WP.

1.2 SPECIAL TRAINING REQUIREMENTS AND CERTIFICATIONS

No requirements for specialized training and/or certification other than those required for routine field sampling techniques, field analysis, laboratory analysis are necessary for this project.

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TABLE 1-1

CONTACT LIST
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

PERSON/ TITLE/ ORGANIZATION	ADDRESS	TELEPHONE
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Allen Debus QA Coordinator U.S. EPA Region V	EPA Region V 77 West Jackson Street Chicago, IL 60604	(312) 886-6186
Cheryl Firschkorn IDEM Hazardous Waste Geology Chief Indiana Department of Environmental Management	IDEM Office of Solid and Hazardous Waste Management 100 N. Senate Avenue Indianapolis, Indiana 46206-6015	To Be Determined
Bill Gates Remedial Project Manager U.S. Navy SOUTHNAVFACENGCOM	Department of Navy SOUTHNAVFACENGCOM Code 1829 2155 Eagle Drive Charleston, SC 29406	(843) 820-7360 FAX: (803) 820-7465
Jim Hunsiker Environmental Manager NSWC Crane	NSWC Crane Code 095 B-3260 300 Highway 361 Crane, Indiana 47522-5009	(812) 854-3233 FAX: (803) 820-7465
Tom Brent Site Manager NSWC Crane	NSWC Crane Code 095 B-3260 300 Highway 361 Crane, Indiana 47522-5009	(812) 854-6160 FAX: (812) 854-4177
Debbie Wroblewski Program Manager Tetra Tech NUS	Tetra Tech NUS 661 Andersen Drive Pittsburgh, PA 15220-2745	(412) 921-8968 FAX: (412) 921-4040
Paul Frank Quality Assurance Manager Tetra Tech NUS	Tetra Tech NUS 661 Andersen Drive Pittsburgh, PA 15220-2745	(412) 921-8950 FAX: (412) 921-4040
Matt Soltis Health and Safety Manager Tetra Tech NUS	Tetra Tech NUS 661 Andersen Drive Pittsburgh, PA 15220-2745	(412) 921-8912 FAX: (412) 921-4040
Keith Henn Task Order Manager Tetra Tech NUS	Tetra Tech NUS 661 Andersen Drive Pittsburgh, PA 15220-2745	(412) 921-8146 FAX: (412) 921-4040
Keith Simpson Field Operations Leader Tetra Tech NUS	Tetra Tech NUS 661 Andersen Drive Pittsburgh, PA 15220-2745	(412) 921-7090 FAX: (412) 921-4040

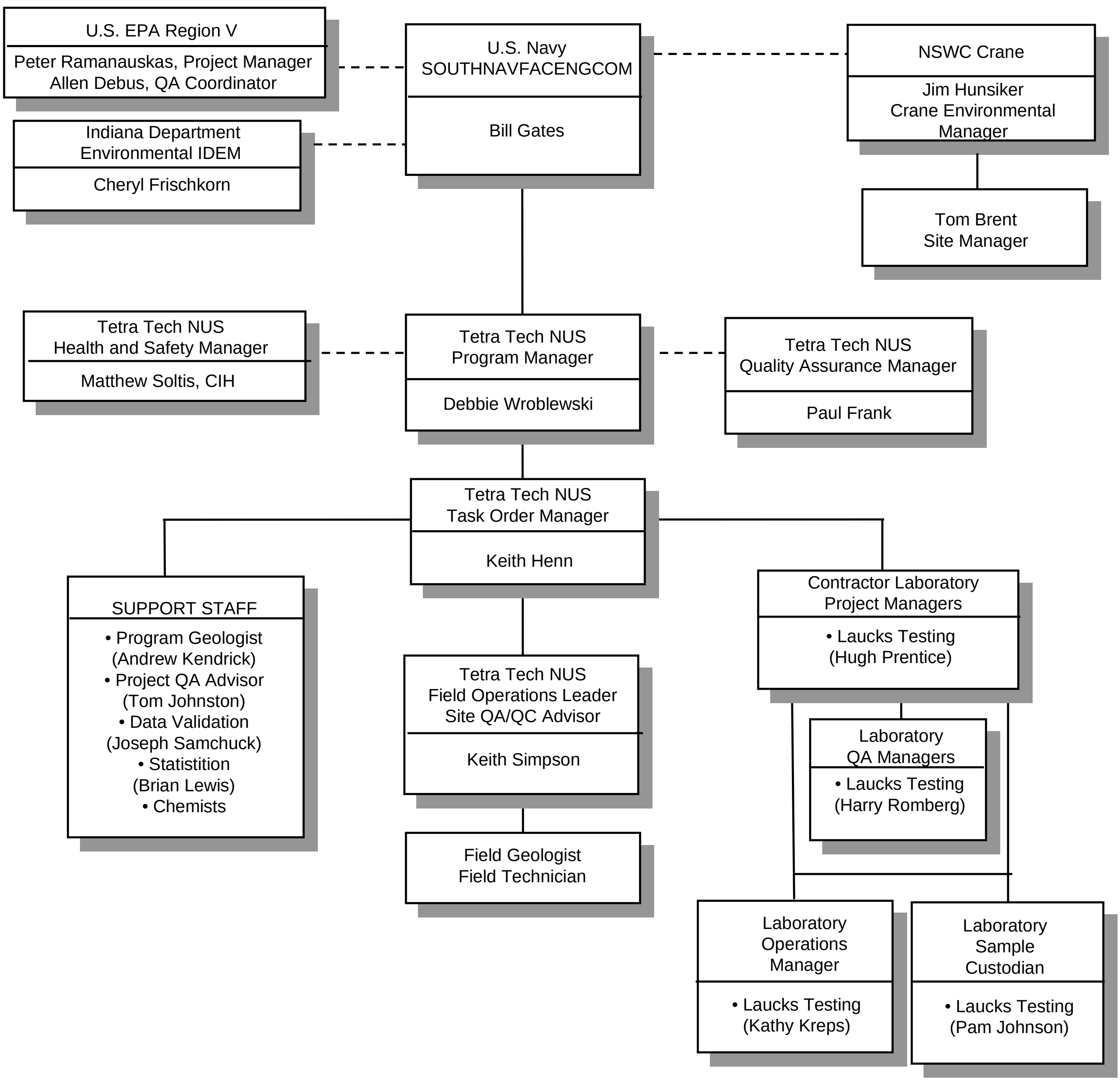
TABLE 1-1

CONTACT LIST
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA
PAGE 2 OF 2

PERSON/ TITLE/ ORGANIZATION	ADDRESS	TELEPHONE
Andrew Kendrick Program Geologist Tetra Tech NUS	Tetra Tech NUS 661 Andersen Drive Pittsburgh, PA 15220-2745	(412) 921-8623 FAX: (412) 921-4040
Tom Johnston Project QA Advisor Tetra Tech NUS	Tetra Tech NUS 661 Andersen Drive Pittsburgh, PA 15220-2745	(412) 921-8615 FAX: (412) 921-4040
Joseph Samchuck Data Validation Coordinator Tetra Tech NUS	Tetra Tech NUS 661 Anderson Drive Pittsburgh, PA 15220	(412) 921-8510 FAX: (412) 921-4040
Pat Hooper Statistician Tetra Tech NUS	Tetra Tech NUS 661 Anderson Drive Pittsburgh, PA 15220	(412) 921-8250 FAX: (412) 921-4040
Hugh Prentice Project Manager Laucks Testing	Laucks Testing 940 South Harney Street Seattle, WA 98053	(206) 767-5060 FAX: (206) 767-5491
Harry Romberg Lab QA Manager Laucks Testing	Laucks Testing 940 South Harney Street Seattle, WA 98053	(206) 767-5060 FAX: (206) 767-5491
Kathy Krepps Lab Operations Manager Laucks Testing	Laucks Testing 940 South Harney Street Seattle, WA 98053	(206) 767-5060 FAX: (206) 767-5491
Pam Johnson Lab Sample Custodian Laucks Testing	Laucks Testing 940 South Harney Street Seattle, WA 98053	(206) 767-5060 FAX: (206) 767-5491

FIGURE 1-1

PROJECT ORGANIZATION CHART
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA



2.0 BACKGROUND INFORMATION

This section consists of a discussion of the background information and general site characteristics at the NSWC Crane facility. It discusses such topics as site location, physiography, topography, land use classification, climatology/meteorology, hydrology, geology, hydrogeology, and site history.

2.1 SITE LOCATION AND DESCRIPTION

NSWC Crane is in the southern portion of Indiana, approximately 75 miles southwest of Indianapolis, 60 miles northwest of Louisville, Kentucky and immediately east of Burns City and Crane Village, Indiana. NSWC Crane encompasses approximately 62,463 acres or approximately 98 square miles of the northern portion of Martin County and smaller portions of Greene, Davies, and Lawrence Counties. A location map of the NSWC Crane facility is shown on Figure 2-1.

2.2 PHYSIOGRAPHY AND TOPOGRAPHY

NSWC Crane is in the unglaciated area of the Crawford Uplands Physiographic Province. This province is a rugged, highly vegetated, dissected plateau bounded by the Mitchell Plain Physiographic Province to the east and the Wabash Lowland Physiographic Province to the west (Murphy and Wade, 1995). The Mitchell Plain is a low dissected limestone plateau characterized by sinkholes and karst topographic features. The boundary between the Crawford Upland and the Mitchell Plain is marked by the highly irregular, eastern facing Chester Escarpment. Springs, caverns, caves, and other solution weathering features can be found along this escarpment and on the eastern edge of the NSWC Crane facility. The boundary between the Crawford Upland and the Mitchell Plain near the western boundary of NSWC Crane is gradual (Murphy and Wade, 1995).

The terrain is predominantly rolling with moderately incised stream valleys throughout and occasional flat areas in the central and northern portions of NSWC Crane. Most of the region is covered by deciduous trees and shrubs. The elevations across Crane range from about 500 feet above mean sea level (AMSL) to about 850 feet AMSL. Man-made Lake Greenwood extends west to east across the northern part of the facility. Topographic relief in the Crawford Upland ranges from 100 to 350 feet. Greater relief exists in the eastern part of NSWC Crane near the Chester Escarpment (Murphy and Wade, 1995). A topographic and surficial geology map of the entire facility has been compiled by Kvale (1992) and Blunck (1995) after US Geological Survey 7.5 minute quadrangle maps (Indian Springs, Scotland, Koleen, Owensburg, Odon, Williams, Loogootee, and Shoals). Portions of this topographic and surficial geology map (Blunck, 1995) of the facility can be found on Figures 5-1, 5-2, and 5-3.

2.3 LAND USE CLASSIFICATION

NSWC Crane is situated in a rural area of south-central Indiana. The surrounding communities are in transition from an economic base of agriculture, mining, and quarrying to an economy built on manufacturing and service industries. The patterns of settlement, population statistics, and median income are similar throughout the region (B & R Environmental, 1997). Because most of the region is covered by vegetation, the area is classified as rural (B&R Environmental, 1997).

There is no state or local planning within the vicinity of NSWC Crane. The only zoning and land use regulations are in the municipalities in the region. None of the municipalities are close enough to have an impact on NSWC Crane. None of the areas adjacent to NSWC Crane are zoned, and zoning is not anticipated in the near future. There are no known land use or community actions under consideration or proposed at this time (B & R Environmental, 1997).

2.4 ECOLOGICAL COMMUNITIES AND HABITAT

A biological characterization of NSWC Crane, including a listing of plants and animals found at the facility, is presented in the Installation Assessment (IA; Army, 1978) and the Initial Assessment Study (IAS; NEESA, 1983), and is summarized in the Environmental Monitoring Reports (EMR; Halliburton NUS August and November, 1992). A list of the species which may inhabit NSWC Crane and are protected under the U.S. Endangered Species Act, Indiana Department of Natural Resources Heritage Data Center, or the U.S. Fish and Wildlife Service is summarized in the RCRA Facility Permit (U.S. EPA, July 1995).

2.5 CLIMATOLOGY AND METEROLOGY

NSWC Crane is located in a warm temperate climatic zone. In general, the summers are warm and humid, and winters are mild with occasional short cold periods. The temperature ranges from an average maximum July temperature of 89^{o}F to an average minimum January temperature of 26^{o}F. Precipitation is fairly evenly distributed throughout the calendar year, with the maximum precipitation occurring during the spring and early summer. The average annual precipitation at the facility is 44 inches, consisting of 42 inches of rain and 15 inches of snow. The average humidity ranges from 40 to 90 percent in summer and 60 to 90 percent in winter.

Although the NSWC Crane Open Burning (OB) and Open Detonation (OD) treatment units (e.g., Ammunition Burning Grounds and Demolition Range) have onsite meteorological monitoring stations, data are collected for wind speed and wind direction only prior to and during treatment events. Therefore, insufficient data are available at the site to generate a climatological summary for the area. As a result, climatological data collected at the Indianapolis International Airport, approximately 65 miles northeast of Crane, were selected to describe the general climatology of the area occupied by the NSWC Crane. Indianapolis was chosen because it is the closest and most representative National Weather Service reporting station (B&R Environmental, 1997). The wind direction will be discussed in detail here, however if additional information is needed please refer to the RCRA Air Quality Assessment (B&R Environmental, 1997).

Long-term climatological records (NOAA, 1988) for the area indicate that the monthly prevailing wind direction is southwest during the period April through December, then shifts to the northwest during the months of January through March. The annual prevailing wind direction for the region is from the southwest. The annual average wind speed for the area is about 9.6 miles per hour. Figure 2-2 is a wind rose summarizing the wind direction and mean wind speed distribution for the Indianapolis International Airport over the 5-year period, 1985-1989. The least predominant wind direction is from the northeastern and southeastern quadrants. More specifically, Figure 2-2 shows that the wind blows from the southwest quadrant (from due west to due south) approximately 43% during this five year period. This is significantly larger than the wind frequency from the northeast quadrant (from west-northwest to due north, approximately 23.5%), from the southeast quadrant (south south-southeast to due east, approximately 18%), and from the northeast quadrant (the east-northeast to north-northeast, approximately 12%). It is also noted that the wind was calm 3.5% of the time during this period.

2.6 HYDROLOGY

The surface drainage at NSWC Crane has formed a dense, dendritic pattern throughout the installation that flows in a general southward or southwestward direction. Seven primary creeks in five drainage basins carry surface water off the installation, where they eventually drain into the East Fork of the White River and then to the Wabash River to the southwest. Figure 2-3 shows the basins and drainages of NSWC Crane.

Drainage Basin IV consists of Boggs and Turkey Creeks, which are the primary drainageways for the installation and drain the majority of the area. The northern and northwestern sections (Basin I) are drained by Furst Creek, the eastern portion (Basin III) is drained by the Sulphur Creek complex, the extreme eastern portion (Basin II) is drained by Indiana Creek (not shown on Figure 2-3), and the southwestern section (Basin V) is drained by Seed Tick Creek. Also located within the installation are several small ponds and Lake Greenwood, an 800-acre, spring-fed lake in the northwestern portion of the installation.

2.7 GEOLOGY

2.7.1 General Geology and Stratigraphy

The geology at NSWC Crane is generally characterized by thin overburden deposits overlying bedrock. The overburden deposits generally range in depth from the surface down to 0 to 65 feet (Nohrstedt, et. al, 1998a) below ground surface. These deposits generally consist of two types: Quaternary-age unconsolidated deposits and unconsolidated residual soil derived from the underlying bedrock. Bedrock underlying the Crane facility consists of sedimentary rocks from the Lower Pennsylvanian-age Raccoon Creek Group and the Upper Mississippian-age Stephensport and West Baden Groups. The following subsections describe the unconsolidated deposits and bedrock at NSWC Crane in greater detail.

2.7.2 Unconsolidated Deposits

The Quaternary-age deposits consist of alluvial, colluvial, and glacial outwash deposits consisting of silt, sand, and gravel, lacustrine deposits consisting of clay, silt, and sand, and loess deposits consisting of clay and silt.

Residual soils at NSWC Crane were derived from the underlying sedimentary rocks of the lower Pennsylvanian Raccoon Creek Group and the upper Mississippian Stephensport and West Baden Groups. These soils consist of clay, silt, sand, and fragmented and/or partially weathered bedrock.

Using the United States Department of Agriculture (USDA)/ Soil Conservation Service (SCS) soil classification system (McElrath, 1988), the soil at NSWC Crane has been classified under 23 soil series. More specifically, the soil at the 33 Solid Waste Management Units (SWMUs) at the facility has been classified under 15 soil series. Each of these soil series are defined by various soil characteristics (e.g., grain size, erosion, slope, drainage, parent material or depositional source, etc.) specific to the series. Within these soil series various sub-classes or soil map units have been defined. Table 2-1 lists the soil series and map units present throughout the facility and indicates the number of facility SWMUs where these soil series are present. USDA/SCS soil maps for NSWC Crane have been included in Appendix D.

For the purposes of this study the USDA/SCS soil classifications at NSWC Crane have been categorized by their depositional environment (DE). The DE refers to the parent material and/or the mechanism from which a soil was formed. Thus, the DE (more specifically the parent material) determines the chemical and mineralogical composition of the soil (McElrath, 1988). Other factors such as grain size also affect the chemical and mineralogical make-up of a particular soil. The soil at the facility has been subdivided into four DE classifications: (1) alluvium; (2) loess/glacial outwash; (3) residual soils derived from

Pennsylvanian bedrock/colluvium; and (4) residual soils derived from Mississippian bedrock/colluvium. The following sections describe each of these DEs and the USDA soil series which are classified within each DE. Table 2-1 illustrates this classification of soil.

2.7.2.1 Alluvial Deposits

Alluvial deposits are defined as material that has been deposited by streams or running water. The Quaternary sequences of alluvium generally correspond to the Bartle, Birds, Bonnie, Burnside, Haymond, Pekin, Wakeland, and Wilbur USDA soil series (McElrath, 1988). Alluvium was mapped by Kvale (1992) where it was found greater than 7 feet thick. These deposits generally were found in major river valleys in the area. Kvale (1992) classification of alluvium generally corresponds to the Haymond or Wakeland silt loam soil series.

2.7.2.2 Loess/Glacial Deposits

The glacial outwash in Martin County is typically stratified gravel, sand, and silt formed by running water from melting glaciers during the Illinoian period (McElrath, 1988). The glacial deposits have been classified by McElrath (1988) as Negley, Parke, and Pike USDA soil series. Due to topographic constraints, Kvale (1992) eliminated some Negley soils as glacial deposits. Glacial outwash deposits are found locally only in the northwest corner of the Crane facility.

As the Illinoian glacial ice receded, temporary glacial lakes formed. The fine grained material deposited in these glacial lakes was carried by wind out of the White River valley and deposited in the adjacent uplands. During the late Wisconsinan time, a thin mantle of these loess deposits (ranging from a few inches to several feet thick) were deposited throughout Martin County (McElrath, 1988) and the NSWC Crane facility. Loess deposits are typically fine grained material, dominated by silt-sized particles. Hosmer soils are an example of thick loess deposits primarily found on ridgetops (Kvale, 1992), whereas Zanesville soils are an example where only a thin layer of loess has formed on the surface (McElrath, 1988).

2.7.2.3 Residual Soil from Bedrock/Colluvium

Most of the soil in Martin County was developed from bedrock residuum (McElrath, 1988). As mentioned in Section 2.7.2 these residual soils developed from the underlying sedimentary rocks of the lower Pennsylvanian and upper Mississippian formations. Because the make-up and characteristics of these two bedrock types are significantly different, the residual soils developed are expected to be different. As discussed in section 2.7.3, the Pennsylvanian bedrock contains black shales, carbonaceous shales, and coal which are expected to have a higher metals content than the "cleaner" shale and limestone encountered in the Mississippian bedrock (Rupp, 1999). Colluvial deposits, which are soil and bedrock fragments that have been moved by gravity and deposited at the base of steep slopes, have been classified with the residual soils because they are expected to have similar characteristics.

2.7.3 Bedrock

Bedrock underlying the Crane facility consists of sedimentary rocks from the Lower Pennsylvanian-age and the Upper Mississippian-age bedrock. The Lower Pennsylvanian bedrock (Raccoon Creek Group) at the site primarily consists of interbedded sandstone, siltstone, shale, and coal with a total thickness varying from 0 to more than 300 feet (Fisher, 1996). The underlying Missisippian-age bedrock consists of limestone, shale and sandstone (Murphy and Wade, 1995, and Palmer, 1969). The relief of the unconformity between the Pennsylvanian and Mississippian bedrock has been measured to be as much as 100 feet (Kvale, 1992).

Pennsylvanian bedrock are absent in the deepest, present day drainage channels (e.g., Sulphur Creek, Turkey Creek) primarily due to erosion. In these locations the Mississippian age bedrock is exposed. A large number of SWMUs are located on ridges or other topographically high areas, primarily on top of Pennsylvanian bedrock. One exception to this generalization is the Ammunition Burning Ground (ABG) which is located over Mississippian bedrock (Fisher, 1996). The surficial geology of the mappable geologic units at NSWC Crane is shown on Figure 2-4. An outline of a select number of SWMUs is included as an illustration of the type of surface bedrock material underlying these SWMUs.

The following paragraphs provide a brief description of the geologic formations as described by Palmer (1969), Murphy and Wade (1995) and Kvale (1992). They are presented from youngest (first) to the oldest units. These geologic units are also illustrated on the stratigraphic column illustrated on Figure 2-5.

a. Mansfield Formation and Undifferentiated Lower Pennsylvanian, undifferentiated (Pennsylvanian Raccoon Creek Group). This unit consists of alternating beds of shales (e.g., black shale and carbonaceous shale), sandstone, mudstone, siltstone, thin discontinuous coal units.

b. Glen Dean Limestone, Hardinsburg Formation, Golconda/Haney Limestone, Indian Springs Member, undifferentiated (Mississippian Stephensport Group). This unit consists of limestone (Glen Dean Formation), soft shale and cross-bedded sandstone (Hardinsburg Formation), shaley limestone and limey shales (Golconda/Haney Formation), and dark gray shale (Indian Springs

Formation). Thickness of the unit ranges from 60-70 feet. This group is referred to as M6 (Kvale, 1992).

c. Big Clifty Sandstone member, Big Clifty Formation (Stephensport Group). The Big Clifty sandstone is a tan to green-gray, massive to thick-bedded, rippled, fine- to very fine-grained, well sorted, rounded, friable sandstone with occasional shaly partings. Thickness of this unit ranges from 30 to 40 feet. This group is referred to as M5 (Kvale, 1992).

d. Beech Creek Limestone Formation (Stephensport Group). The Beech Creek limestone consisted of fossiliferous, hard, dense limestone. Joints in the limestone were sparse to numerous in cores recovered from the 18 well borings penetrating the Beech Creek formation. The Beech Creek formation displayed moderate to extensive solution-enlarged jointing at another site within NSWC Crane (Hunt, 1988). Thickness of this unit ranges from 20 to 25 feet. This group is referred to as M4 (Kvale, 1992).

e. Elwren Formation, Reelsville Limestone, Upper Sample Formation, undifferentiated (West Baden Group). This unit consists of fine-grained interbedded sandstone and mudstone (Elwren Formation), a thin discontinuous limestone (Reelsville Limestone), and fine-grained sandstone (Upper Sample Formation). Thickness of this unit ranges from 65 to 75 feet. This group is referred to as M3 (Kvale, 1992).

e. Lower Sample Formation, Beaver Bend Limestone, Bethel Formation, undifferentiated (West Baden Group). This unit consists of dark greenish gray shale (Lower Sample), fossiliferous limestone (Beaver Bend Limestone), and a calcareous sandstone and shale (Bethel Formation). Thickness of this unit ranges from 50 to 60 feet. This group is referred to as M2 (Kvale, 1992).

f. Paoli Limestone, Ste. Genevieve, undifferentiated (Blue River). This unit consists of oolitic limestone and limestone (undifferentiated). Thickness of this unit is at least 35 feet (based upon exposure in Boone Hollow, northeastern corner of the facility). This group is referred to as M1 (Kvale, 1992).

Structurally, NSWC Crane is located on the eastern edge of the Illinois Structural Basin, where the Pennsylvanian and Mississippian age bedrock dips to the west-southwest and southwest at approximately 30 to 35 feet per mile (Dunbar, 1982, p. 10 and Kvale, 1992). Locally, however the dip of the Mississippian bedrock can range from 0 to 15 feet/mile to as much as 100 ft/mile (Sulphur Creek; Kvale, 1992).

2.8 HYDROGEOLOGY

Ground water in the unglaciated southwestern portion of Indiana in general is contained in joint openings of limestone and sandstone aquifers. Aquifers are generally isolated from one another vertically by less permeable shale units. Ground water enters the aquifers through outcrops and infiltration, and flows by gravity down the dip of the strata or locally in directions controlled by the potentiometric gradient.

Regionally, ground water flow is expected to conform to the southwestward-dipping bedrock with a gradient approaching the dip. Locally, groundwater flow is likely to parallel the surface drainage on the installation. Wells installed for the groundwater monitoring network generally showed groundwater flow agreed with local drainage. Seasonal fluctuations in the water table are expected to be slight since precipitation is well distributed throughout the year (Murphy, 1994; Murphy and Wade, 1995).

2.9 FACILITY HISTORY

This section contains a brief summary of the general history of NSWC Crane and the Solid Waste Management Units (SWMUs) present at the facility.

2.9.1 General History

The facility was commissioned in 1941 as the Naval Ammunition Depot (NAD) Burns City, to serve as an inland munitions production and storage center for the US Navy. The name of the facility was changed in 1943 to NAD Crane, in 1975 to the Naval Weapons Support Center, and in 1992 to NSWC Crane. The facility was constructed on land publicly acquired under the White River Land Utilization Project (35,000 acres) and land purchased from private ownership (26,830 acres) beginning in 1934. Prior to its acquisition by the Navy, the land was largely used for timber and agriculture (Poynter, 1999). The Department of Defense (DOD) ammunition procurement responsibility was transferred to the Army in 1977. The Army assumed ordnance production, storage, and related responsibilities under the single service management directive. All environmental activities on the installation, including permitting activities, remain the responsibility of the Navy.

2.9.2 Past Data Collection Activities

This section includes a brief description of the historical data collection activities conducted at NSWC Crane. The following summary has been generated using reports and supporting documents (submitted by other contractors) provided by NSWC Crane.

The first investigations performed at the NSWC Crane were the Installation Assessment (IA; Army, 1978) and the Initial Assessment Study (IAS; NEESA, 1983). Performed in 1977, the IA consisted of an extensive records search and interviews with former and present employees at NSWC Crane. The purpose of the IA was to investigate potential contaminant releases to the environment from past operations and to determine the potential of these releases to migrate off of the facility boundaries. The IAS began in April 1981 in response to the Navy Assessment and Control of Installation Pollutants (NACIP) Program and was completed in May 1983 by the Naval Energy and Environmental Support Agency (NEESA) with assistance from the Ordnance Environmental Support Agency and the United States Army Corps of Engineers (USACE) Waterways Experiment Station (WES). The intent of the IAS was to identify and assess sites posing a potential threat to human health and the environment from past hazardous materials operations. Although none of the sites investigated were determined to represent immediate human health and environmental threats, 14 of the sites were recommended for further study to evaluate potential long-term impacts.

Based on these investigations and others (submitted by other contractors), thirty-three Solid Waste Management Units (SWMUs) have been identified at NSWC Crane (U.S. EPA, 1995). Table 2-2 lists each SWMU and briefly summarizes the Solid Waste Management Area (SWMA) classification, processes, and presumed metals of potential concern at each of these SWMUs. Figure 2-6 illustrates the location of each of these SWMUs.

2.9.2.1 Air Quality Assessment

Due to the predominant wind direction determined for NSWC Crane (Section 2.5) the southwest quadrant of the facility is less likely to have received fallout from airborne emissions from the OB/OD (e.g., Ammunition Burning Grounds, Old Rifle Range, and Demolition Range) operations. Due to the predominant wind direction this area also is less likely to experience any potential contaminants from the Field Testing Ranges (Pyrotechnic Test Area, Annex, and Rocket Range [SWMU 19/00]) which are located to the west.

The RCRA Air Quality Assessment Report (B&R Environmental, 1997) assessed the effects of airborne particulates from OB/OD (e.g., Ammunition Burning Grounds, Old Rifle Range, and Demolition Range) activities on the surrounding areas. This report however did not determine the maximum distance of impact on the surrounding areas due to particulates released from OB/OD activities. Areas at the greatest distance downgradient (downwind) from these areas are least likely to be affected by any airborne releases.

The Old Open Burn Pit (SWMU 05/03) may have released particulate during the daily open burning of refuse. Activities at this site were discontinued in 1972. Based upon the prevailing wind direction (Section 2.5), areas to the west of the Old Burn Pit are less likely to have been impacted from airborne particulates released from this area than would areas to the east.

The CAAA QA/QC Test Area (SWMU 20/00, which is located in the center of the NSWC Facility (see Figure 2-6) also may be a source for airborne emissions. At this site flare testing was conducted which produced a lot of smoke (there are even signs in the area of operation which warn that the visibility on the road way be observed by smoke). Although no longer in operation, the Building 146 incinerator (SWMU 16/16) was also a source for airborne emissions. This site is located in the north-central portion of the NSWC facility (Figure 2-6).

TABLE 2-1

USDA/SCS SOIL CLASSIFICATIONS PRESENT AT NSWC CRANE[1]
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

Soil Series	Soil Type	Present at # of SWMUs	Soil Classification[2] Surface Soil[4]	Soil Classification[2] Subsurface Soil[5]	Soil Classification[3] Surface Soil[4]	Soil Classification[3] Subsurface Soil[5]	Description	Location	Depositional Environment
Alluvium									
Bartle	Ba	NP	silt loam	silt loam to silty clay loam	CL, CL- ML	CL, CL- ML	0 to 2 percent slopes, gently sloping, deep, poorly drained	lowlands	Lake plains & stream terraces
Birds	Bk	2	silt loam	silt loam	CL	CL	frequently flooded, nearly level, deep, poorly drained; on broad bottom land.	lowlands	Alluvium derived from loess uplands
Bonnie	Bo	NP	silt loam	silt loam	CL	CL	0 to 2 percent slopes, gently sloping, deep, poorly drained	lowlands	Alluvium derived from loess uplands
Burnside	Bu	4	loam	loam to channery loam	ML, CL, ML-CL	ML-CL, SC, GC, SM, GM	occassionally flooded, nearly level, deep, well drained; on flood plains	flood plains	Alluvium derived from sandstone, siltstone, and shale
Haymond	Hd	3	silt loam	silt loam	ML	ML, SM	frequently flooded, nearly level, deep, well drained; on bottom land	lowlands	Silty alluvium
Pekin	PeB	NP	silt loam	silt loam to silty clay loam	CL-ML	CL-ML	2 to 6 percent slopes, deep, well drained	outwash terraces	Loess and underlying alluvium
Wakeland	Wa	4	silt loam	silt loam	ML	ML	frequently flooded, nearly level, deep, somewhat poorly drained	flood plains	Silty alluvium derived from loess uplands
Wilbur	Wr	NP	silt loam	silt loam	ML, CL-ML	ML, CL-ML	0 to 2 percent slopes, deep, poorly drained	lowlands	Alluvium derived from loess uplands
Loess/Glacial Outwash									
Hosmer	HoB	2	silt loam	silt loam to silty clay loam	ML, ML-CL, CL	ML, ML-CL, CL	2 to 6 degree slopes, gently sloping, deep, well drained	uplands & ridgetops and on loess-capped lake plains.	Loess
Camden	CaB	NP	silt loam	silt loam,clay loam, sandy loam	CL, ML-CL	ML, CL, SM, SC	1 to 5 percent slopes, deep, well drained	stream terraces	Loess and underlying outwash material
Negley	NeE	2	silt loam to loam	loam, clay loam, gravely loam	ML, ML-CL, CL	SM, ML	8 to 35 percent slopes, moderately steep to steep, deep, well drained	loess and outwash	Loess capped and underlying outwash material
Parke	PaC2	1	silt loam	silty clay loam to sandy clay loam	CL-ML	SC, CL	6 to 18 percent slopes	uplands & sideslopes	Loess capped and underlying outwash material
Pike	Pk	NP	silt loam	silt loam to silty clay loam	CL	CL, SC	2 to 6 percent slopes, deep, well drained	outwash terraces	Loess capped and underlying outwash material
Residual Soils from Bedrock (both Pennsylvanian & Mississippian)/Colluvium									
Johnsburg	Jo	NP	silt loam	silty clay loam, silt loam, to sandy loam	CL, ML-CL	ML, CL, SM, SC	0 to 2 percent slopes, deep, poorly drained	uplands	Loess and material weathered from ss, siltstone, shale.
Udorthents	UhD	1	shaly silty clay loam	shaly silty clay loam	CL-ML, CL, ML	CL-ML, CL, ML	6 to 14 percent slopes, moderately steep to steep, moderately deep to deep, well drained	uplands	Excavated areas formerly used as landfills
Udorthents-Pits complex	Up	1	gravelly sand	gravel	GM	GM	NA	uplands	Material left from sandstone quarries and sand pits
Wellston	WeB	1	silt loam	silt loam, silty clay loam, to channery loam	ML	CL-ML, CL, SC, SM-SC	2 to 6 percent slopes, gently sloping, deep, well drained	ridgetops	Loess and material weathered from ss, siltstone, shale.
	WeC2	5	silt loam	silt loam, silty clay loam, to channery loam	ML	CL-ML, CL, SC, SM-SC	6 to 12 percent slopes, eroded, moderately sloping, deep, well drained	ridgetops and sideslopes in uplands	Loess and material weathered from ss, siltstone, shale.
	WeD2	8	silt loam	silt loam, silty clay loam, to channery loam	ML	CL-ML, CL, SC, SM-SC	12 to 18 percent slopes, eroded, steeply sloping, deep, well drained	sideslopes in uplands	Loess and material weathered from ss, siltstone, shale.
	WeD3	3	silt loam	silt loam, silty clay loam, to channery loam	ML	CL-ML, CL, SC, SM-SC	12 to 18 percent slopes, severly eroded, steeply sloping, deep, well drained	sideslopes in uplands	Loess and material weathered from ss, siltstone, shale.

TABLE 2-1

USDA/SCS SOIL CLASSIFICATIONS PRESENT AT NSWC CRANE[1]
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

Soil Series	Soil Type	Present at # of SWMUs	Soil Classification[2]		Soil Classification[3]		Description	Location	Depositional Environment
			Surface Soil[4]	Subsurface Soil[5]	Surface Soil[4]	Subsurface Soil[5]			
Wellston-Ebal	WlD	NP	silt loam	silt loam, silty clay loam, to channery loam	ML	CL-ML, CL, SC, SM-SC, CH, GC	10 to 18 percent slopes, deep, well drained	sideslopes in uplands	Loess, colluvium, and material weathered from ss, siltstone, shale.
Wellston-Berks-Gilpin complex	WgG	5	silt loam to channery silt loam	silt loam, silty clay loam, to channery loam	ML, CL, CL-ML, SC, GM, GC	CL-ML, CL, SC, SM-SC	18 to 70 percent slopes, moderately to very steep, deep, well drained	sideslopes in uplands	Loess and material weathered from ss, siltstone, shale.
Wellston-Gilpin complex	WnE	16	silt loam to channery silt loam	silt loam, silty clay loam, to channery loam	ML, CL, CL-ML, SC, GM, GC	CL-ML, CL, SC, SM-SC	12 to 30 percent slopes, strongly sloping to steep, moderately deep	sideslopes in uplands	Loess and material weathered from ss, siltstone, shale.
Wellston-Udorthents complex	WpD[6]	8	silt loam to silty clay loam	silt clay loam to channery loam	ML, CL, CL-ML	CL-ML, CL, SC, SM-SC	12 to 18 percent slopes, strongly sloping, very shallow to deep	sideslopes in uplands	Loess and material weathered from ss, siltstone, shale.
Zanesville	ZaB	6	silt loam to silty clay loam	silty loam, to sandy clay loam	CL-ML, CL, ML	CL-ML, CL, ML, SC, SM, GM	2 to 6 percent slopes, gently sloping, deep, moderately to well drained	ridgetops in uplands	Loess and material weathered from ss, siltstone, shale.
	ZaC2	7	silt loam to silty clay loam	silty loam, to sandy clay loam	CL-ML, CL, ML	CL-ML, CL, ML, SC, SM, GM	6 to 12 percent slopes, eroded, moderately sloping, deep, moderately to well drained	ridgetops and sideslopes in uplands	Loess and material weathered from ss, siltstone, shale.
	ZaC3	2	silt loam to silty clay loam	silty loam, to sandy clay loam	CL-ML, CL, ML	CL-ML, CL, ML, SC, SM, GM	6 to 12 percent slopes, severally eroded, moderately sloping, deep, moderately to well drained	ridgetops and sideslopes in uplands	Loess and material weathered from ss, siltstone, shale.
Zanesville-Udorthents complex	ZnB[6]	13	silt loam to silty clay loam	silt loam, silty clay loam to loam	CL-ML, CL, ML	CL-ML, CL, ML, SC, SM, GM	2 to 6 percent slopes, gently sloping, moderately to well drained	ridgetops in uplands	Loess and material weathered from ss, siltstone, shale.
	ZnC[6]	17	silt loam to silty clay loam	silt loam, silty clay loam to loam	CL-ML, CL, ML	CL-ML, CL, ML, SC, SM, GM	6 to 12 percent slopes, gently sloping, moderately to well drained	ridgetops in uplands	Loess and material weathered from ss, siltstone, shale.

Notes:

USDA United States Department of Agriculture
SCS Soil Conservation Service
NP - Not present at any SWMUs
SWMU - solid waste management units
SS - Sandstone
NA - Not available

1 Information taken from McElrath, G., Jr., 1998, Soil Survey of Martin County, Indiana, Soil Conservation Service, United States Department of Agriculture.
2 United States Department of Agriculture (USDA) classification system
3 Unified Soil Classification System (USCS), abbreviations are as follows
CL - Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
ML - Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity
SC - Clayey sands, poorly graded sand-clay mixtures
SM - Silty sands, poorly graded sand-silt mixtures
GM - Silty gravels , poorly graded gravel-sand-silt mixtures
GC - Clayey gravels, poorly graded gravel-sand-clay mixtures.
4 Surface soil is from 0 to 12 inches below ground surface (bgs).
5 Subsurface soil is between 12 and 70 inches bgs or to the top of bedrock.
6 Soil at areas at the NSWC where a significant amount of construction and earth moving has removed most of the original soil, which has been deposited as fill on building sites.

TABLE 2-2

SUMMARY SOLID WASTE MANAGEMENT UNITS
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

SWMU No.	SWMU Name	Abbreviated Name	Solid Waste Management Area (SWMA) Classification[1]	Process	Presumed Contaminants of Potential Concern[(4)] (metals only)	Source
01/12	Mustard Gas Burial Grounds	MGBG	Burial Area	burial of mustard agent, pyrotechnic mixtures containing radioactive thorium	NA	Army, 1978
02/11	Dye Burial Grounds	DBG	Burial Area	disposal of military smoke dyes (open and closed containers) in trenches	NA[2]	Army, 1978
03/10	Ammunition Burning Grounds/Old Jeep Trail	ABG/OJT	Explosive Type Waste (open burning/open detonation)	destruction of unwanted materials contaminated with explosives, bare explosives, rocket motors, candles, flares, solvents, detonators, and fuse materials.	aluminum, barium, lead, manganese, copper, silver, zinc	B&R Environmental, Oct., 1997 and B&R Environmental Nov., 1997
04/02	McComish Gorge	McCG	Solid Waste/Debris Landfill Unit	undefined garbage and trash burial (consisting of wood, paper, construction material, plaster filled warheads, metal shavings and industrial wastes).	antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, selenium, thallium, and zinc	Nohrstedt, J.S., et. al, September 1998a[3]
05/03	Old Burn Pit	OBP	Solid Waste/Debris Landfill Unit	open burning of solid and liquid wastes; ash/material from burning pushed into gully north of pit	antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, mercury, nickel, selenium, silver, thallium, and zinc	Albertson et. al, September 1998[3]
06/09	Demolition Range	DR	Explosive Type Waste	open burning/open detonation	arsenic, aluminum, beryllium, copper, lead, manganese, nickel, vanadium, zinc	B&R Environmental, Oct., 1997 and B&R Environmental Nov., 1997
07/09	Old Rifle Range	ORR	Explosive Type Waste/Contamination	open burning/flashing of explosives, thermal destruction of explosive waste	arsenic, aluminum, barium, beryllium, manganese, lead, and zinc	B&R Environmental Nov., 1997
08/17	Load & Fill Area, Bldg 106 Pond	106P	Unique Explosive, Dye Type Waste/Contamination	unlined surface impoundment from wastewater generated from Buildings 106 and 107	mercury, chromium, zinc, lead, cadium,	Haliburton NUS, Aug 1992
09/03	Pesticide Control Area/ R-150-Tank	PCA	Organic Type Waste/Contamination	pesticide rinsing and container storage; solvents underground storage tanks	arsenic, barium, cadmium, chromium, lead, mercury, nickel, selenium, and zinc	Nohrstedt, J.S., et. al, September 1998b[3]
10/15	Rockeye	RKT	Explosive Type Waste/Contamination	press-loading operation for projectiles and case-filling operation to produce cluster bombs	antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, nickel, tin, and zinc.	US Army Corps WES, September 1992[3]
11/00	Old Storage, B-255	B225	Unique Explosive, Dye Type Waste/Contamination	NA	NA	NA
12/14	Mine Fill A	MFA	Explosive Type Waste/Contamination	manufactured mines, depth charges, rocket heads, aerial bombs, and projectiles	aluminum	Halliburton NUS, Aug 1992
13/14	Mine Fill B	MFB	Explosive Type Waste/Contamination	manufactured mines, depth charges, rocket heads, aerial bombs, and projectiles - currently the site is used for renovation and rework of munition items	none	Halliburton NUS, Aug 1992

TABLE 2-2

SUMMARY SOLID WASTE MANAGEMENT UNITS
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

SWMU No.	SWMU Name	Abbreviated Name	Solid Waste Management Area (SWMA) Classification[1]	Process	Presumed Contaminants of Potential Concern[(4)] (metals only)	Source
14/00	Sanitary Landfill/Lithium Battery	SLF&LB	Burial Area	receives trash and garbage from production operations and residential and food preparation areas; also the burial of neutralized lithium batteries	barium, magnesium, lithium	Halliburton NUS, Nov. 1992
15/06	Roads and Grounds Area	R&GA	Solid Waste/Debris Landfill Unit	asphalt production, steam generation, and inert storage	barium, chromium, lead, arsenic, barium, cadium, mercury, selenium, silver	Halliburton NUS, Nov. 1992
16/16	Cast High Explosive Fill/ Incinerator Bldg 146	B146	Explosive Type Waste/Contamination	explosive fill and pressure washout facility; oil-fed rotary kiln incinerators; currently used for renovation and breakdown of munitions	barium, cadmium, chromium, lead, mercury	Halliburton NUS, Nov. 1992
17/04	PCB Burial/Pole Yard	PCB	Burial Area	NA	NA	NA
18/13	Load & Fill Area Buildings	L&FAB	Unique Explosive, Dye Type Waste/Contamination	loading of ammunition, storage of paints, solvents, dyes, inks, wood perservatives, etc.	NA	Army, 1978
19/00	Pyrotechnic Test Area/ Annex/ Rocket Range/ Impact Area	PTA	Explosive Type Waste/Contamination	functional tests on flares, signals, other marking devices, and Rockeye bomblets	lead, aluminum, magnesium, manganese, barium, chromium, copper, iron, zinc	Halliburton NUS, Aug 1992
20/00	CAAA QA/QC Test Area	CAAA	Explosive Type Waste/Contamination	NA	NA	NA
21/00	DRMO Storage Lot	DRMO	Heavy Metal Type Waste/Contamination	NA	NA	NA
22/00	Lead Azide	PbA	Heavy Metal Type Waste/Contamination	NA	NA	NA
23/00	Battery Shop	BS	Solid Waste/Debris Landfill Unit	NA	Arsenic, beryllium, cobalt and lead	Morrison Knudsen, 1996
24/00	Sludge Drying Beds A	SDBA	Heavy Metal Type Waste/Contamination	NA	NA	NA
24/00	Sludge Drying Beds B	SDBB	Heavy Metal Type Waste/Contamination	NA	NA	NA
25/07 D	Highway 58 Dump Site A	H58DSA	Solid Waste/Debris Landfill Unit	NA	NA	NA
26/06 D	Highway 58 Dump Site B	H58DSB	Solid Waste/Debris Landfill Unit	NA	NA	NA
27/00	Illuminant Building	IB	Heavy Metal Type Waste/Contamination	NA	NA	NA
28/00	Maintenance Shop, B-1820	MS	Organic Type Waste/Contamination	NA	NA	NA
29/07	PCP Dip Tank	PCP	Organic Type Waste/Contamination	NA	NA	NA
30/00	Landfarm	LF	Heavy Metal Type Waste/Contamination	sludge application from waste water treatment plant	barium, cadmium, chromium	USACE WES 1995
31/00	Compressed Gas Cylinder Site	CGC	Removal of Materials Completed	No Further Action Required[1]	--	RCRA Permit, USEPA, July, 1995
32/00	Tank Farm	TF	Organic Type Waste/Contamination	NA	NA	NA
33/00	Composting Unit (Bioremediation Facility)	COMP	Explosive Type Waste/Contamination	remediation facility	NA	NA

Notes:

-- Not applicable
NA Not Available
1 RCRA Permit, USEPA, July, 1995
2 Soil analyses not conducted at site. RCRA cap prevents exposure to contaminated soil.
3 Contaminants of potential concern identified based on comparison of historical data to human health and ecological risk-based criteria.
4 Metals listed are based upon analytical data; also see note 3 where applicable.

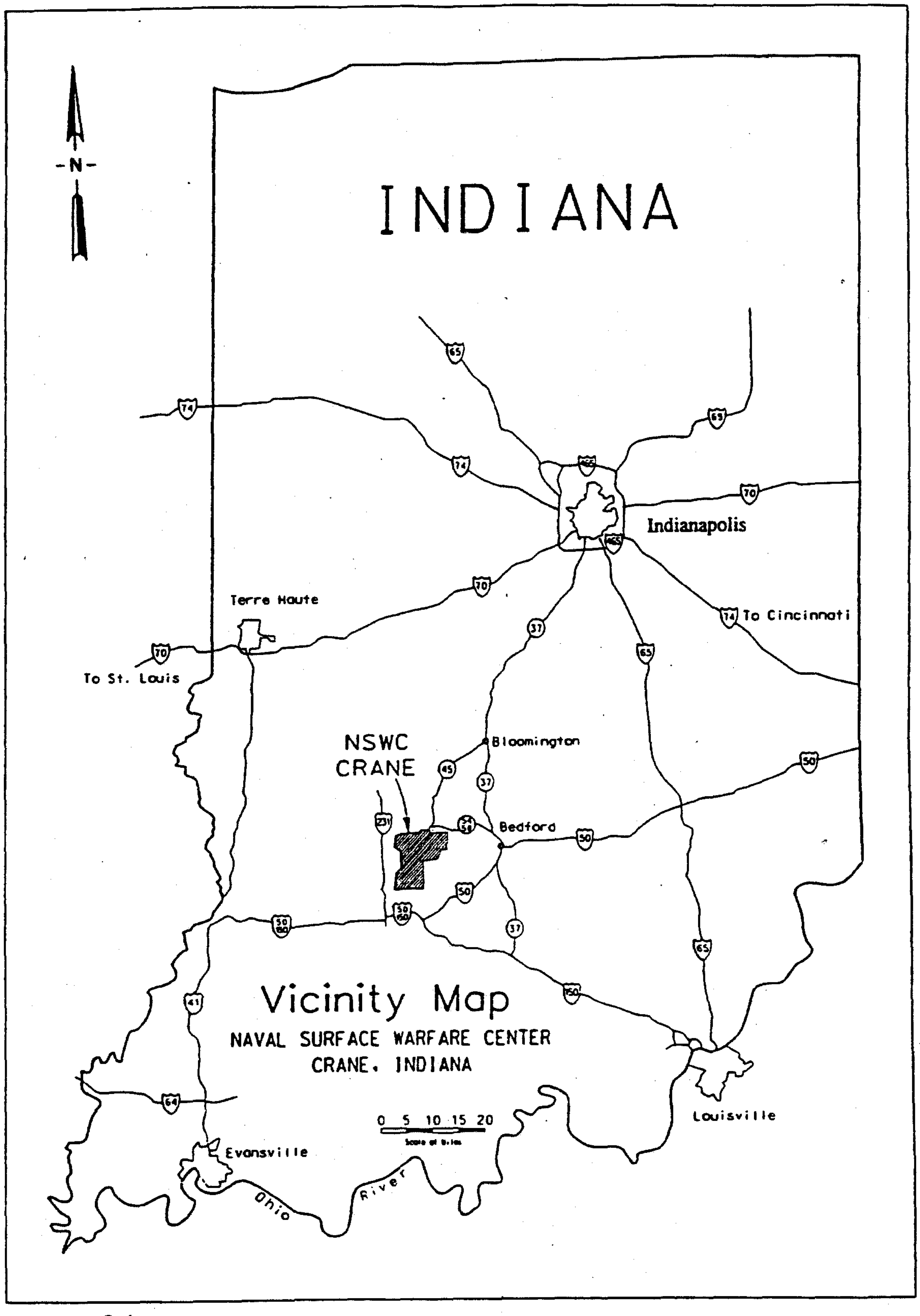
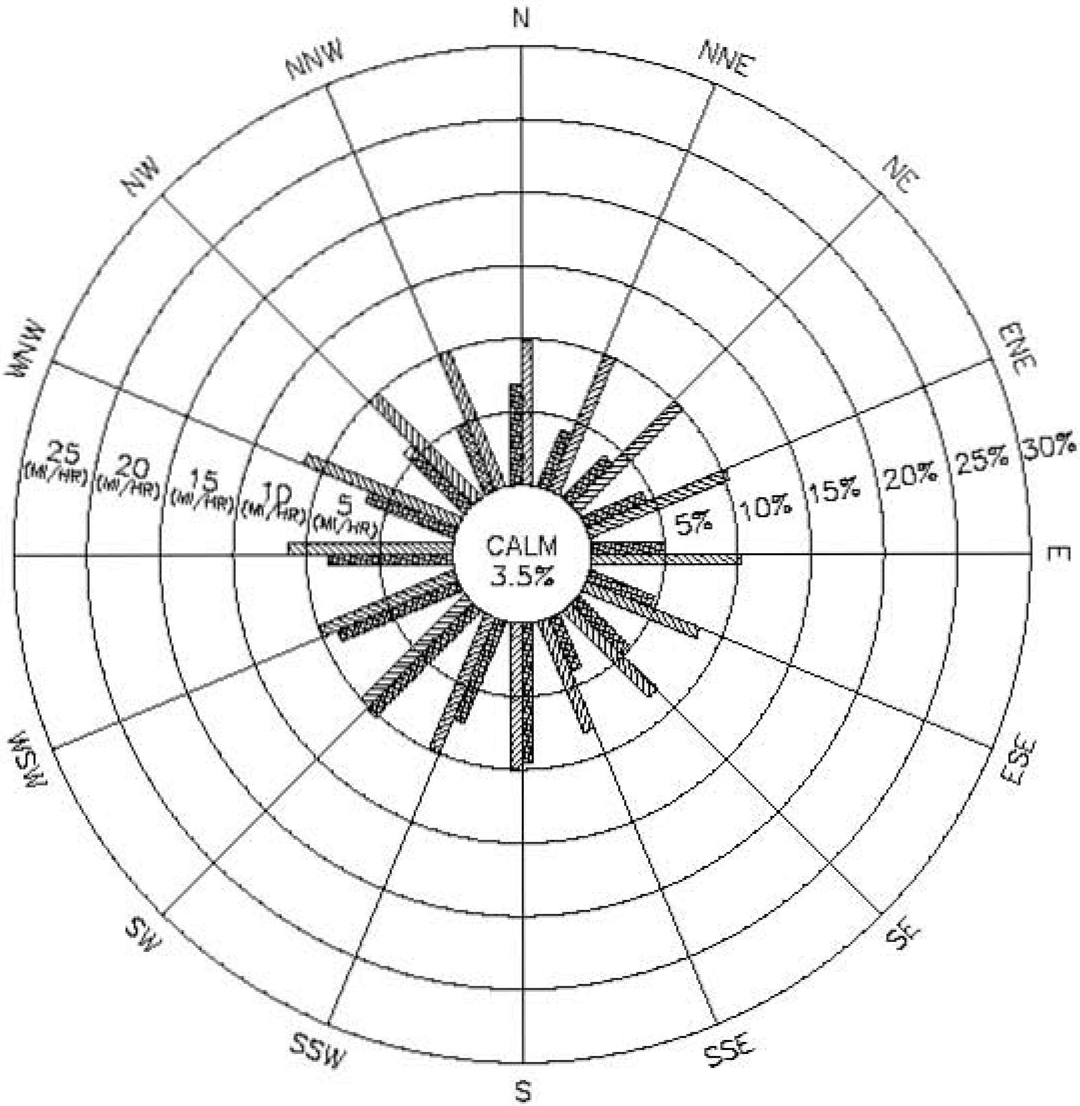


Figure 2-1
General Location Map
Naval Surface Warfare Center
Crane, Indiana

Draft Report, RCRA Facility Investigation Phase II Groundwater Release Assessment, SWMU 06/09 Demolition Area and Phase III Release Characterization SWMU 07/09 Old Rifle Range Naval Surface Warfare Center, Crane, Indiana, William L. Murphy and Roy Wade, November 1995 - Figure 1



LEGEND

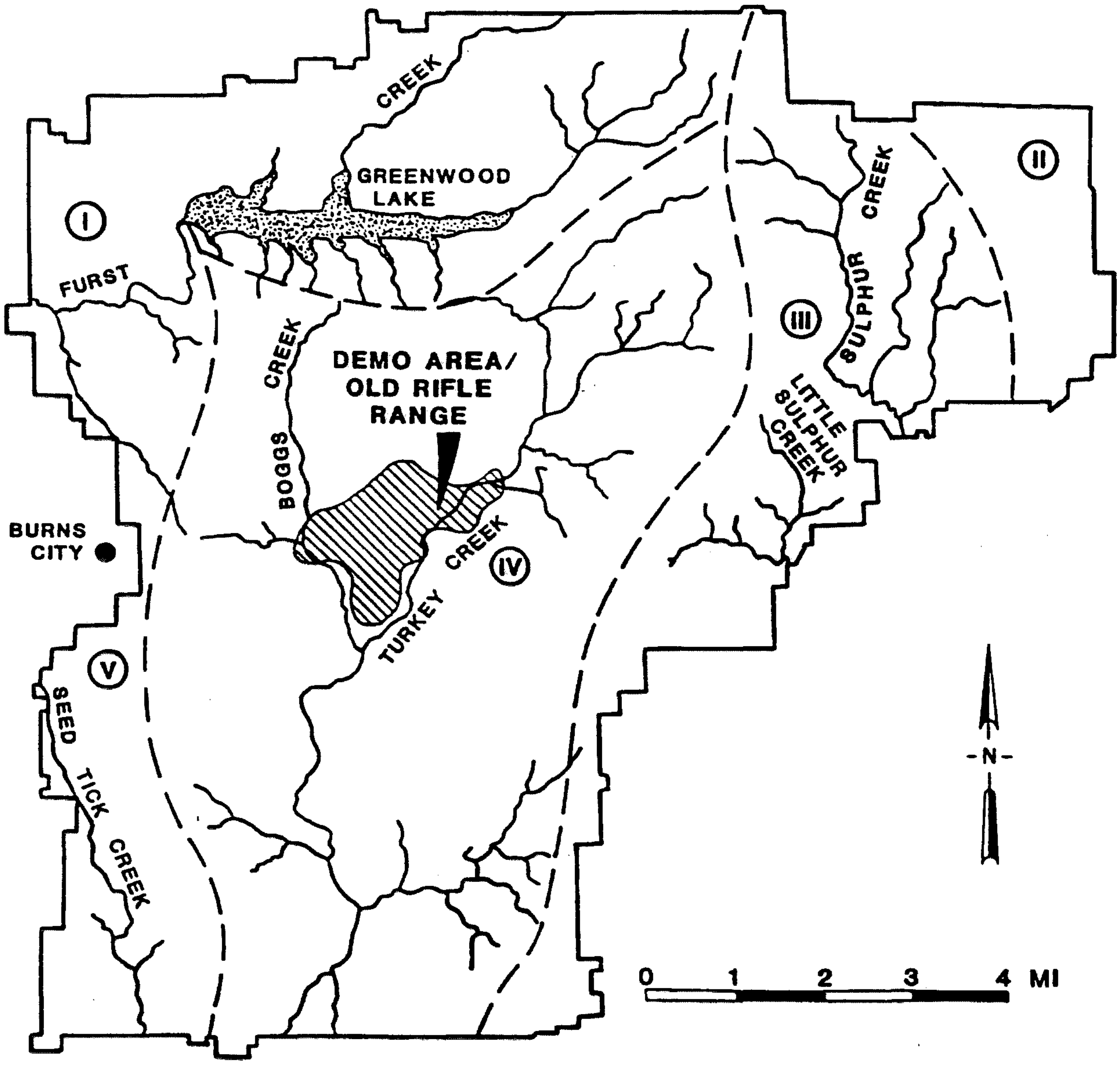
WIND DIRECTION FREQUENCY (PERCENT) (DIRECTION FROM WHICH THE WIND IS BLOWING)

MEAN WIND SPEED (MI/HR)

DATA SOURCE: INDIANAPOLIS, INDIANA AIRPORT

PERIOD OF RECORD: 1985–1989
43,824 OBSERVATIONS

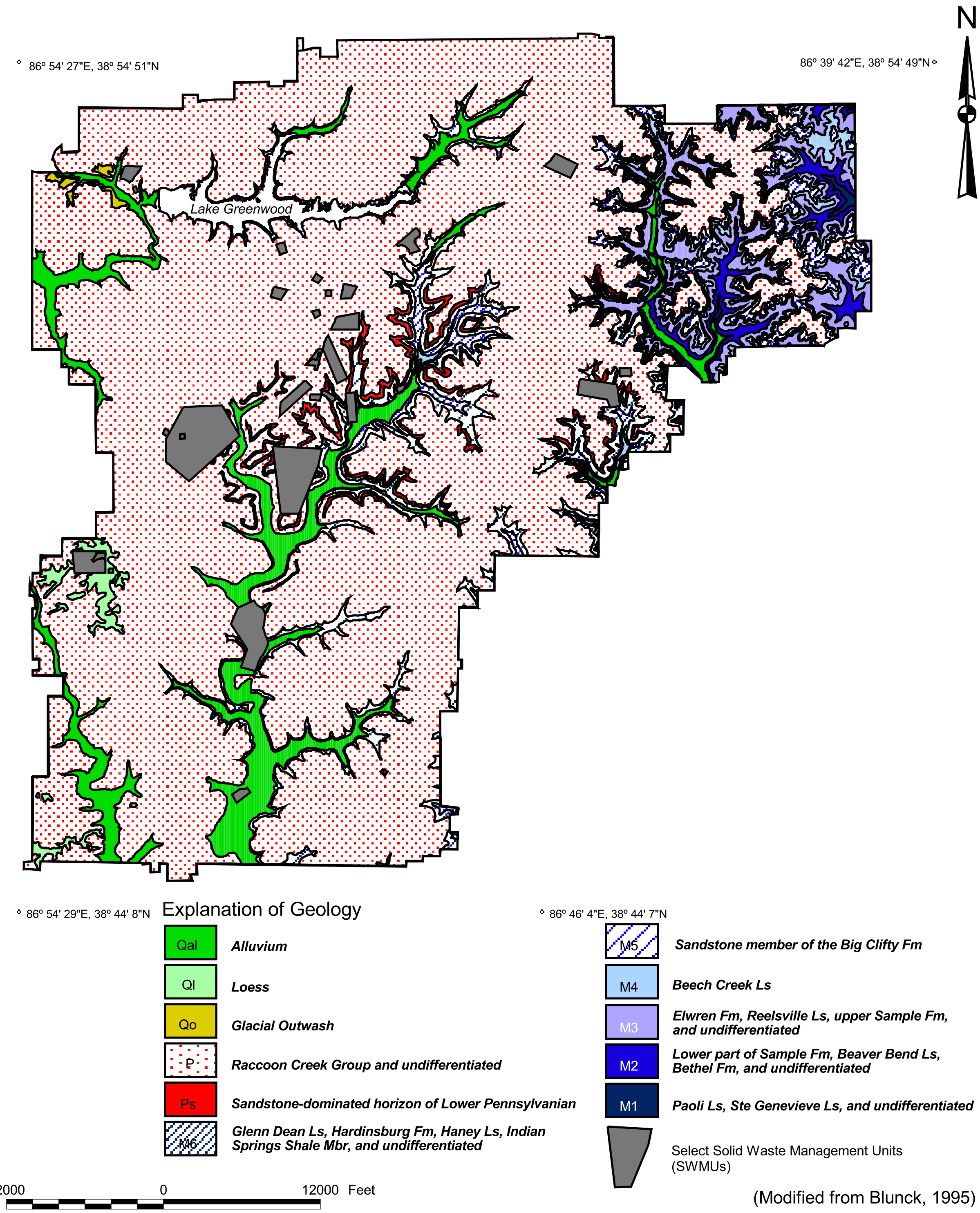
DRAWN BY MF — DATE 3/16/99		FIVE–YEAR WINDROSE SUMMARY FOR INDIANAPOLIS, INDIANA NAVAL SURFACE WARFARE CENTER CRANE, INDIANA	CONTRACT NO. 0087
CHECKED BY — DATE			APPROVED BY K. HENN — DATE 3/9/00
COST/SCHED–AREA			APPROVED BY — DATE
SCALE NOT TO SCALE			DRAWING NO. FIGURE 2–2 — REV. 2



Source: Draft Report, RCRA Facility Investigation
Phase II Groundwater Release Assessment, SWMU 06/09
Demolition Area and Phase III Release
Characterization SWMU 07/09 Old Rifle Range
Volume 2: Appendices A-H
January 1994 - Figure 3
by William L. Murphy and Roy Wade

Figure 2-3

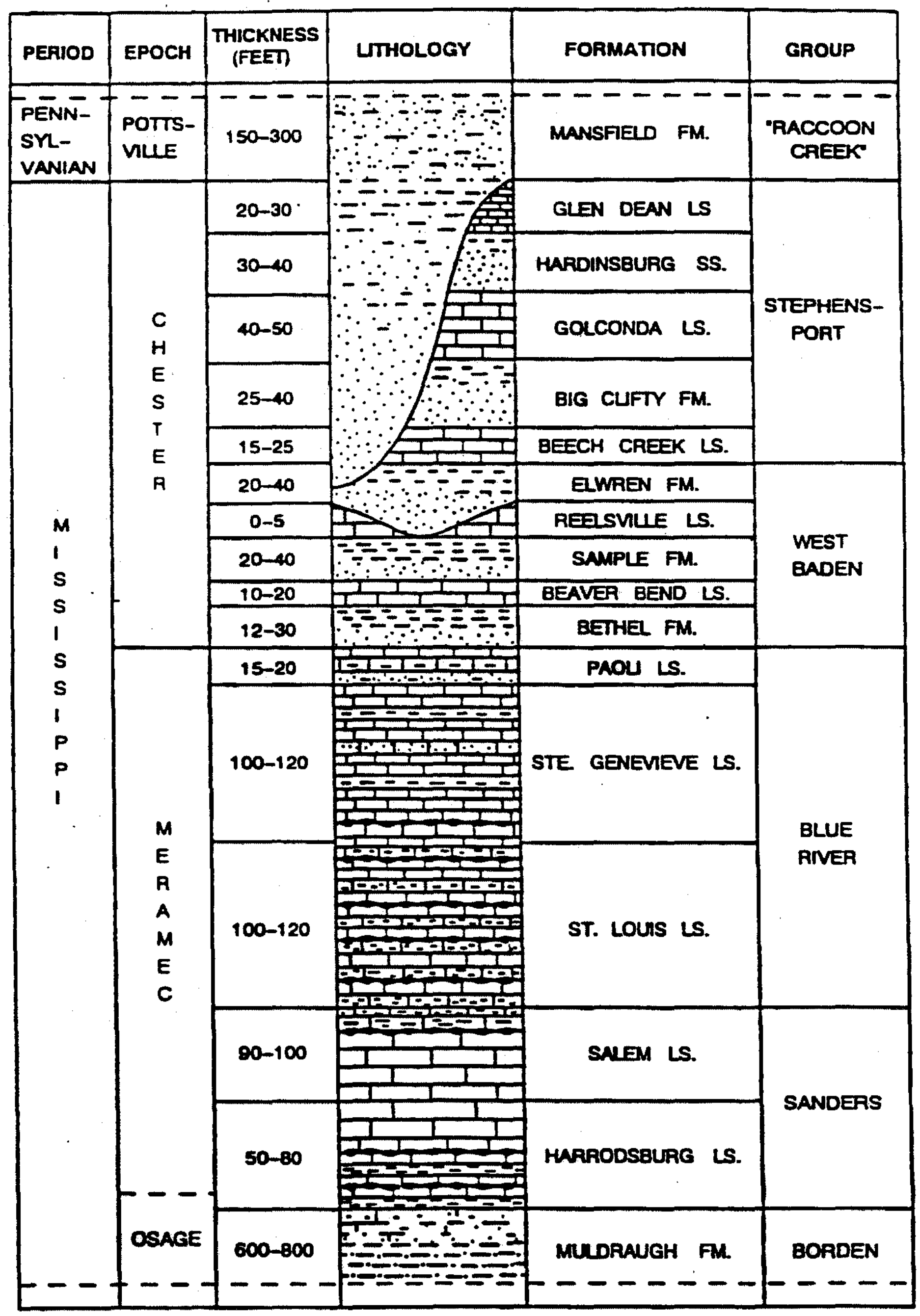
Surface Drainage at the Naval Surface Warfare Center (Source: Murphy and Wade, January 1994) Naval Surface Warfare Center Crane, Indiana



(Modified from Blunck, 1995)

DRAWN BY	DATE	Tetra Tech NUS, Inc.	CONTRACT NUMBER	OWNER NO.
D. PERRY	15-MAR-99		—	—
CHECKED BY	DATE	SURFICIAL GEOLOGY MAP NAVAL SURFACE WARFARE CENTER CRANE, INDIANA	APPROVED BY	DATE
—	—		—	—
COST/SCHEDULE-AREA			APPROVED BY	DATE
			—	—
SCALE			DRAWING NO.	REV
AS NOTED			FIGURE 3-3	0

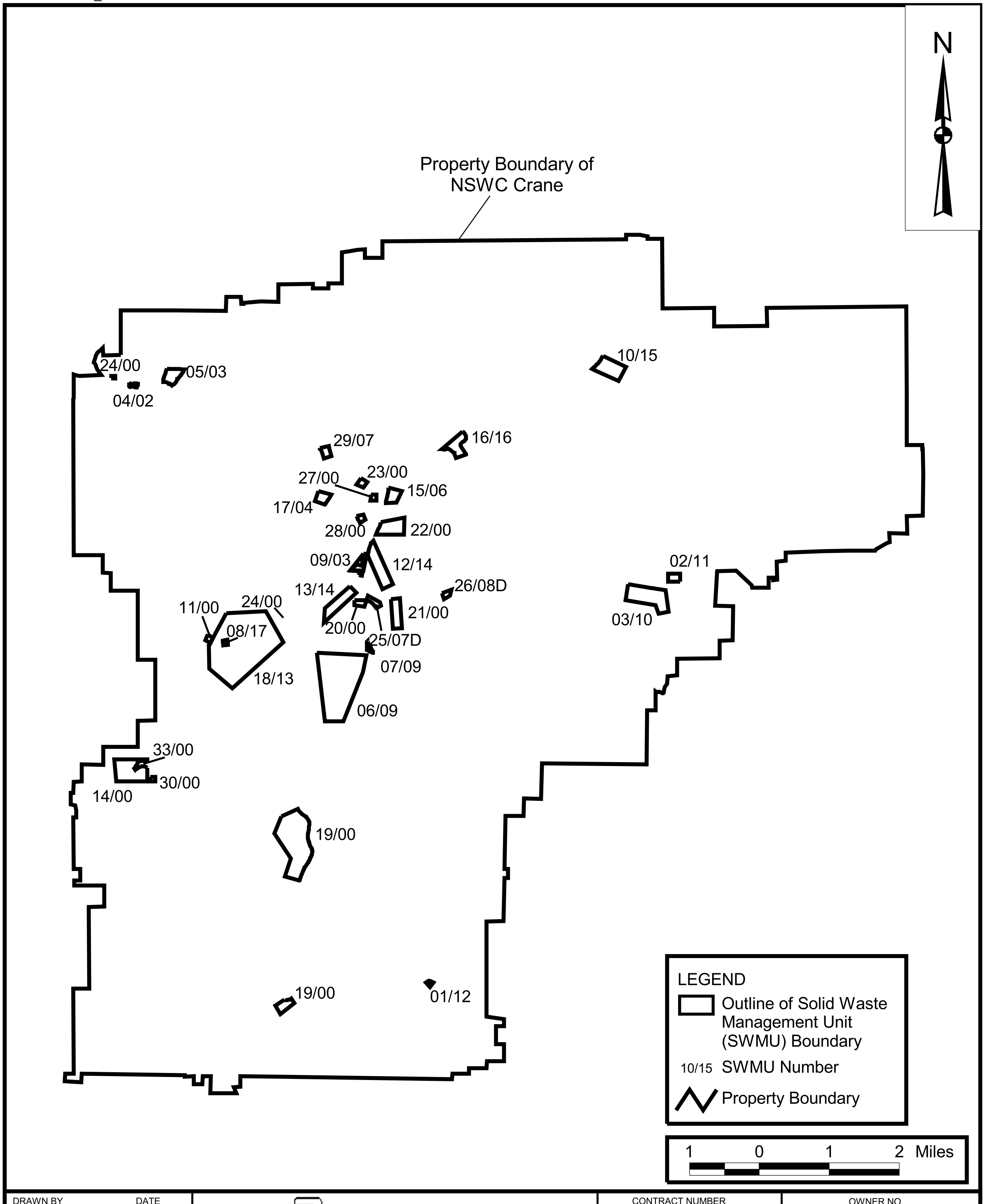
P:\GIS\NSWC_CRANE\0087.APR 5/25/99 JAL SURFICIAL GEOLOGY MAP LAYOUT



Source: Draft Report, RCRA Facility Investigation
Phase II Groundwater Release Assessment, SWMU 06/09
Demolition Area and Phase III Release
Characterization SWMU 07/09 Old Rifle Range
November 1995 - Figure 13
by William L. Murphy and Roy Wade

Figure 2-5
Stratigraphic Column for Rock Units Encountered at the Naval Surface Warfare Center
(Source: Palmer, 1969;
Cited in Murphy and Wade, 1995)
Naval Surface Warfare Center
Crane, Indiana

P:\GIS\NSWC_CRANE\0087.APR 5/25/99 JAL SWMUS LAYOUT 2



DRAWN BY	DATE	Tetra Tech NUS, Inc.	CONTRACT NUMBER	OWNER NO.
D. PERRY	15-MAR-99		—	—
CHECKED BY	DATE	LOCATION MAP OF SOLID WASTE MANAGEMENT UNITS NAVAL SURFACE WARFARE CENTER CRANE, INDIANA	APPROVED BY —	DATE —
COST/SCHEDULE-AREA			APPROVED BY —	DATE —
SCALE	AS NOTED		DRAWING NO. FIGURE 2-6	REV 0

3.0 HISTORICAL BACKGROUND DATA EVALUATION

3.1 INTRODUCTION

The purpose of this section is to identify background soil samples collected in previous investigations at the NSWC Crane and evaluate their value for use in determining base-wide background concentrations for metals. In accordance with these objectives, Section 3.1 presents the criteria used to evaluate the historical data, Section 3.2 identifies locations at the facility where background samples have been collected and discusses factors affecting the usability of these data. Section 3.3 summarizes this information and provides recommendations regarding the inclusion of data into a base-wide background database.

This historical background investigation was conducted with reference to the following guidance documents:

- Determination of Background Concentrations of Inorganics in Soils and Sediments at Hazardous Waste Sites, EPA/540-5-96/500, December 1995.
- Procedural Guidance for Statistically Analyzing Environmental Data, prepared by SWDIV and EFA WEST of Naval Facilities Engineering Command, September 1998.
- U.S. Navy Policy for Statistically Analyzing Background Data Supporting Environmental Risk Assessment in the State of California, October 1997.
- Region 5 Policy Regarding Historical Data Usage in the RCRA Facility Investigation, RCRA QAPP Instructions, U.S. EPA Region 5, Appendix A, April 1998.
- Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A), EPA/540/1-89/002, December 1989.

These documents provided guidance in order to determine whether historical data should be included or excluded from the base-wide background database. The evaluation of historical data for inclusion in the background data set could involve the following, if sufficient data were available:

- A review of site history, including construction and installation maps; identification of geologic materials in areas of concern (i.e., native soil and non-native soil, such as fill materials) and an evaluation of background sampling location(s)

- Determination of whether the soil in background areas are geologically, physically, and chemically similar to specific SWMUs

- Evaluation of data quality. This evaluation involves an examination of data validation results (if data were validated), detection limits, sample collection procedures, sample analytical methods, sample matrix interferences, and other factors affecting the quality and usability of the historical data.

3.2 EVALUATION OF PREVIOUS INVESTIGATIONS

This section identifies areas where historical background soil samples have been collected and analyzed for metals, discusses factors affecting the usability of the background data, and provides recommendations for the use of this data in the base-wide background value database. The locations of the SWMUs evaluated in the following sections are presented in Section 2.9.2. Table 3-1 provides a list of these SWMUs and summarizes details and results of the background evaluation.

3.2.1 Old Burn Pit (SWMU No. 05/03)

Soil background results for the Old Burn Pit (OBP) were reported in the Phase II RCRA Facility Investigation (RFI) report for the Old Burn Pit (Albertson et. al, 1998). Six background samples were collected at three background locations (05/03-01-90, 05/03-02-90, and 05/03-03-90). Refer to Albertson et. al (1998) for a description of the background sample location and analysis.

The samples were analyzed by U.S. EPA SW-846 Methods 6010, 7060, 7471 and 7740 and the analytical data were validated (Albertson et. al, 1998). In 1997, the U.S. EPA (1997) rejected all non-explosive data from the U.S. Army Corps of Engineers (USACE) laboratory due to incomplete QC documentation (Section 3.2.5). Because the background samples at the OBP were performed by the USACE WES laboratory, in accordance with the EPA ruling (U.S. EPA, 1997), these samples should not be included in the base-wide background data set. These data however, may provide an undetermined value as reference information specifically for this SWMU.

3.2.2 McComish Gorge (SWMU No. 04/02)

Soil background results for McComish Gorge were reported in the Phase II RFI for McComish Gorge (Nohrstedt, J.S., et. al, 1998). Soil samples were collected from soil borings 1, 1A, 2, and 3. Subsequent analysis indicated that the area thought to be background was a dump area. Thus, these data were eliminated as background information (Nohrstedt, J.S., et. al, 1998).

3.2.3 Rockeye (SWMU No. 10/15)

Soil background results for Rockeye were reported in the Phase II RFI for Rockeye (Nohrstedt, et. al, 1998c). One background surface soil sample (BN #2) was collected and analyzed for metals. Sample BN#2 was taken “adjacent to and north (Background North) of Rockeye” although the exact location could not be located on maps included in the report (Nohrstedt, et. al, 1998c). This background sample was analyzed by USACE WES laboratory for metals using SW-846 Methods 6010 and 7060 (arsenic). The list of metals analyzed was abbreviated compared to a typical Target Analyte List (TAL) analysis (e.g., analysis was not performed for mercury, selenium or thallium). No evidence could be found in the report (Nohrstedt, et. al, 1998c) that the data were formally validated although a summary table in the report provides laboratory qualifiers with the results.

Additional surface samples (C-0-1, C-1-2, C-2-3, and C-3-2) collected from Area C, located on the northeast edge of Rockeye, were also included as background (Nohrstedt, et. al 1998c). These samples were “included after chemical analysis indicated that this area was as least as ‘clean’ of contaminants as Background North”, even though these samples were not originally intended as background samples (Nohrstedt, et. al, 1998c). The rationale for the selection of Area C samples as background, as stated in Nohrstedt, et. al (1998c) and above, is unclear. Further, Figure 16 in Nohrstedt et., al (1998c) illustrates that several ditches are located in close proximity to these samples. Thus, the soil in Area C may have been affected by Navy operations and may not be representative of “true background” conditions.

Primarily due to the U.S. EPA ruling (U.S. EPA 1997) regarding the data quality of USACE WES laboratory analysis and secondarily because of the uncertainty regarding the quality of sample locations, it is recommended that these data not be included in the Crane base-wide background database. These data however, may provide an undetermined value as reference information specifically for this SWMU.

3.2.4 Pest Control Area (SWMU No. 09/05)

Soil background results for the Pest Control Area were reported in the Phase II RFI (Nohrstedt, et. al, 1998b). Eleven soil background samples were collected at three locations (09/05-1-92, 09/05-2-92, and 09/05-3-92). The three sampling locations are situated in Area A south of Building 2189. Nohrstedt et. al (1998b) does not provide a rationale for the choice of these locations for background samples.

The samples were analyzed by the USACE WES laboratory for eight metals by various U.S. EPA SW-846 and ASTM Methods. Arsenic, cadmium, mercury, and selenium were analyzed by SW-846 Methods 7060, 6010, 7471, and 7740 respectively. Barium, chromium, lead, and silver were analyzed by ASTM Method D4190-82. Evidence of data validation are included in Appendix D of Nohrstedt, et. al (1998b).

Because the analytical methods used are not CLP or SW-846 methods the comparability of these data to ongoing and future investigations is uncertain. Due to the U.S. EPA ruling (U.S. EPA 1997) regarding the data quality of USACE WES laboratory analysis, it is recommended that the data from Pest Control Area not be included in the Crane base-wide background database. These data however, may provide an undetermined value as reference information specifically for this SWMU.

3.2.5 Ammunition Burning Ground (SWMU No. 03/10)

Soil background results for the Ammunition Burning Ground (ABG) were discussed in the environmental assessment report prepared by Rust Environment & Infrastructure (REI; 1997). REI (1997) stated that the USACE collected background data in 1990 and 1993 at the ABG. The U.S. EPA (1997) determined that all non-explosive data from the USACE WES laboratory must be rejected due to incomplete QC documentation. Consequently, it is recommended that no metal background data collected for the ABG or other sites using metals data from USACE WES laboratory should be used in the NSWC Crane base-wide background data set.

Based upon recommendations that additional background samples were needed for the ABG (REI, 1997) additional samples were collected. A summary of these analytical results was prepared by Tetra Tech NUS (1999).

3.2.6 Old Rifle Range (SWMU No. 07/09)

Soil background samples for the Old Rifle Range (ORR) were discussed by REI (1997). As with the ABG, soil background samples for the ORR were analyzed by USACE WES laboratory. The U.S. EPA (1997) rejected the use of all metals analysis (see Section 3.2.5) for risk assessment purposes. Thus, it is recommended that this data not be included in the NSWC Crane base-wide background data set.

Three soil background samples (CR95-07SS-A01-01, CR95-07SS-A02-01, and CR95-07SS-A03-01) were collected by REI in 1995 and analyzed for TAL metals and cyanide. According to REI (1997), these background samples were located upgradient of the Old Rifle Range, were within the same soil type, and were considered complete and adequate for risk assessment purposes for the ORR. Due to the predominant wind direction (discussed in section 2.5) these samples may have been impacted by open burning/open detonation emissions from the Old Rifle Range and Demolition Range. As a result, it is recommended that results from these samples not be included in the NSWC Crane base-wide background database. These data however, may provide an undetermined value as reference information specifically for this SWMU.

3.2.7 Demolition Range (SWMU No. 06/09)

Soil background results for the Demolition Range (DR) were discussed in the environmental assessment prepared by REI (1997). Three background soil samples plus one duplicate (CR95-06SS-A01-01 [and CR95-06SS-A01-D], CR95-06SS-A02-01, and CR95-06SS-A03-01) were collected by REI and analyzed by Southwest Laboratories in 1995. The sample locations were approximately 1,500 feet north of the DR to the west of the ORR. The samples were analyzed for TAL metals and cyanide and validated. According to REI (1997), these background samples characterized the samples as complete and adequate for risk assessment at the DR. Due to the predominant wind direction (discussed in section 2.5) these samples may have been impacted by open burning/open detonation emissions from the ORR and DR. As a result of this potential impact, it is recommended that the data from the samples collected in 1995 not be included in the NSWC Crane base-wide background database. These data however, may provide an undetermined value as reference information specifically for this SWMU.

3.2.8 Cast High Explosive Fill/Incinerator Building 146 (SWMU 16/16)

Soil background results for the Cast High Explosive Fill/Incinerator Building 146 area were discussed in the Phase I RFI (Halliburton NUS, Nov., 1992). Appendix N-2 of this report lists sixteen (16) soil background samples collected from four (4) locations around Building 146. The samples were collected by NSWC Crane personnel and analyzed using SW-846 method by Anacon, Inc. for arsenic (Method 7060), mercury (Method 7470), selenium (Method 7770), silver (Method 7760), and barium, cadmium, chromium and lead (Method 6010). There is no evidence in the Phase I report that the data had been validated. The laboratory reporting form indicates that the units of analysis are in mg/L. The report

(Table 5-9) states that the values are in mg/kg but does not confirm this. Because of the uncertainty involving the data and the quality of the data, it is recommended that the background samples collected around Building 146 not be included in the base-wide background database. These data however, may provide an undetermined value as reference information specifically for this SWMU.

3.2.9 Samples Collected at Bioremediation Facility

Fourteen (14) soil samples (BIOF001 through BIOF014) were collected by Morrison Knudsen (MK) in March 1996 in the local vicinity of the Bioremediation Facility (SWMU 33/00). These 14 samples were collected prior to construction of the Bioremediation Facility. The samples were analyzed for an abbreviated list of metals plus lithium and tin by SW-846 Method 6010A. The analytical data indicates that lithium was found in every sample. Thus it is recommended that these samples shall not be included in the base-wide background database. These data however, may provide an undetermined value as reference information specifically for the vicinity of the Bioremediation Facility.

3.2.10 Borrow Pit Samples

Six (6) borrow pit samples (BP/BF-001 through BP/BF-004 and 02/11BP1 – 02/11BP2), were collected by MK in August and October 1995 and October 1997. Samples BP/BF-001 through BP/BF-004 were collected from a borrow pit nearby to the present day Bioremediation Facility. These samples were analyzed for Appendix IX metals by SW-846 Method 6010A. These samples appear to have been validated but the validated results are not available. Lithium was detected in all four samples. Samples 02/11BP1 and 02/11BP2 collected at a borrow pit approximately 0.5 miles west of the ABG. These samples were were analyzed for sixteen (16) metals by SW-846 Method 6010A. It is not clear if these samples were validated, however, laboratory qualifiers shown on the lab reporting forms indicates that analytical problems were encountered in 13 of the 16 analytes in both samples. Because of the uncertainty concerning the quality of these data, the possibility of site-related contamination in four samples, and the abbreviated list and poor data quality in the other two samples, it is recommended that the borrow pit samples not be included in the Crane base-wide background database.

3.2.11 Lithium Battery Burial Site (SWMU 14/00)

One sample (NSWC-14/00-002) collected by MK in June 1995 was intended to be the background sample for the Lithium Battery Burial Site. This sample was collected approximately 60 feet northeast of the actual Lithium Battery Burial Site. The sample was analyzed for an abbreviated list of metals plus tin and lithium. No information is available regarding the data validation of this sample. Because of the uncertainty in data quality and because a number of metals were not included on the list of analytes, it is recommended that this sample not be included in the Crane base-wide background database.

3.3 SUMMARY OF HISTORICAL BACKGROUND EVALUATION

It is recommended that none of the historical background data evaluated be used in the base-wide background database. This recommendation is based primarily on uncertainties regarding data quality, rejection of data by the U.S. EPA (1997), and the concern that some data may have been impacted by on-site activities, thereby affecting its value to the base-wide background database. Although it is recommended that the data discussed herein should not be included in the base-wide database, it may provide useful reference information as a point of comparison with the proposed background samples collected as a part of this investigation (Sections 4.0 and 5.0). At a minimum, this data may provide some value as a point of reference in investigations at each of the respective SWMUs.

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TABLE 3-1

SUMMARY OF HISTORICAL SOIL BACKGROUND DATA FOR METALS
NAVAL SURFACE WARFARE CENTER
CRANK, INDIANA

SWMU No.	SWMU Name	Abbreviated Name	Soil Background Data Available	Background Sample Identifiers	Validity of Background Samples	Source	Remarks
01/12	Mustard Gas Burial Grounds	MGBG	no			1	no data/reports
02/11	Dye Burial Grounds	DBG	no			5	
03/10	Ammunition Burning Grounds/Old Jeep Trail	ABG/OJT	yes		invalid for RA	4, 12	Data rejected by USEPA, 1997
04/02	McCormish Gorge	McCG	no		invalid for RA	6	no valid samples for McComish G.; bgnd samples from OBP used at both sites
05/03	Old Burn Pit	OBP	yes	05/03-01-90, 05/03-02-90, 05/03-03-90	invalid for RA	7	3 samples are located very close to each other; treat as one datum. Data rejected by USEPA, 1997.
06/09	Demolition Range	DR	yes	CR95-06SS-A01-01; CR95-06SS-A01-01-AVG; CR95-06SS-A01-01-D; CR95-06SS-A02-01; CR95-06SS-A03-01;	invalid for RA	4	Data questionable due to proximity to nearby road. 1990 and 1993 data rejected by USEPA, 1997. 1995 data is suspect because soil may have been impacted by deposition from ABG, DR, and ORR
07/09	Old Rifle Range	ORR	yes	CR95-07SS-A01-01; CR95-07SS-A02-01; CR95-07SS-A03-01;	invalid for RA	4	1990 and 1993 data rejected by USEPA, 1997. 1995 data questionable due to historical land use (Pistol Range) and possibility that soil had been impacted by deposition from the ABG, DR, and ORR
08/17	Load & Fill Area, Bldg 106 Pond	106P	no			2	source is most recent available for site
09/03	Pesticide Control Area/ R-150-Tank	PCA	yes		invalid for RA	8, 9	samples analyzed using an ASTM method (not an EPA method SW-846). Data rejected by USEPA, 1997
10/15	Rockeye	RKT	yes	BN#1(90), BN#2(90), and BN#3 (90)	invalid for RA	10	no accurate sample location; only BN#2 analyzed for metals. Data rejected by USEPA, 1997.
11/00	Old Storage, B-255	B225	no			1	no data/reports
12/14	Mine Fill A	MFA	no			2	no data
13/14	Mine Fill B	MFB	no			2	no data

TABLE 3-1

SUMMARY OF HISTORICAL SOIL BACKGROUND DATA FOR METALS
NAVAL SURFACE WARFARE CENTER
CRANK, INDIANA

SWMU No.	SWMU Name	Abbreviated Name	Soil Background Data Available	Background Sample Identifiers	Validity of Background Samples	Source	Remarks
14/00	Sanitary Landfill/Lithium Battery	SLF&LB	yes	NSWC-14/00-002	questionable due to uncertainty in data quality	3	validation status uncertain; incomplete target analyte list
15/06	Roads and Grounds Area	R&GA	no			3	source is most recent available for site
16/16	Cast High Explosive Fill/ Incinerator Bldg 146	B146	yes	B-146-BG1a-03140 thru B-146-BG1d-03140; B-146-BG2a-03140 thru B-146-BG2d-03140; B-146-BG3a-03140 thru B-146-BG4d-03140; B-146-BG4a-03140 thru B-146-BG4d-03140;	questionable due to reporting	3	uncertain if dry or wet weight analysis was reported; uncertainty in data quality
17/04	PCB Burial/Pole Yard	PCB	no			1	no data/reports
18/13	Load & Fill Area Buildings	L&FAB	no			1	no data/reports
19/00	Pyrotechnic Test Area/ Annex/ Rocket Range/ Impact Area	OTA or PTA	no			2	source is most recent available for site
20/00	CAAA QA/QC Test Area	CAAA	no			1	no data/reports
21/00	DRMO Storage Lot	DRMO	no			1	no data/reports
22/00	Lead Aside	PbA	no			1	no data/reports
23/00	Battery Shop	BS	no			1	no data/reports
24/00	Sludge Drying Beds A	SDBA	no			1	no data/reports
24/00	Sludge Drying Beds B	SDBB	no			1	no data/reports
25/07 D	Highway 58 Dump Site A	H58DSA	no			1	no data/reports
26/06 D	Highway 58 Dump Site B	H58DSB	no			1	no data/reports
27/00	Illuminant Building	IB	no			1	no data/reports
28/00	Maintenance Shop	MS	no			1	no data/reports
29/07	PCP Dip Tank	PCP	no			1	no data/reports
30/00	Landfarm	LF	no			1	gw issue only
31/00	Compressed Gas Cylinder Site	CGC	no			1	no data/reports
32/00	Tank Farm	TF	no			1	no data/reports
33/00	Compositing Unit (Bioremediation Facility)	COMP	yes	BIOF001 through BIOF014	questionable due to possible site contamination	1	Samples were not intended as background and may have been impacted by previous site activities
	Borrow Pit	BP	yes	BP/BF-001 through BP/BF-004, 02/11BP1 and 02/11BP2	questionable due to poor data quality		Several locations; Uncertainty in quality of data; analytical problems; possibility of impact due to site activities

TABLE 3-1

SUMMARY OF HISTORICAL SOIL BACKGROUND DATA FOR METALS
NAVAL SURFACE WARFARE CENTER
CRANK, INDIANA

SWMU No.	SWMU Name	Abbreviated Name	Soil Background Data Available	Background Sample Identifiers	Validity of Background Samples	Source	Remarks

Notes:
RA Risk assessment
NA Not available
OBP Open Burn Pit
ABG Ammunition Burning Grounds
DR Demolition Range
ORR Old Rifle Range

Sources:
1 Tom Brent, personal communication, December, 1998
2 HNUS, August 1992, RFI Phase I, Environmental Montoring Report, SWMUs 19/00, 08/17. 12/14, 13/14, NorthDiv, CTO 15
3 HNUS, November 1992, RFI Phase I, Environmental Montoring Report, SWMUs 15/06, 14/10, 16/16, NorthDiv, CTO 15
4 HNUS, November 1997, Draft Current Contamination Conditions Risk Assessment, SWMUs 03/10, 07/09, 06/09
5 Murphy and Wade, July 1998, RCRA Facility Investigation Phase III Groundwater Release Characterization, SWMU 02/11, Dye Burial Grounds, NSWC Crane, Final Report, US Army C
6 Nohrstedt, J.S., et. al, September 1998, RCRA Facility Investigation Phase II Soils Release Characterization, SWMU 04/02, McCormish Gorge, NSWC Crane, Final Report, Army Corp
7 Albertson et. al, September 1998, RCRA Facility Investigation Phase II Soils, SWMU 05/03, Old Burn Pit, NSWC Crane, Final Report, US Army Corps Waterways Experimental Station
8 US Army Corps Waterways Experimental Station, Feburary 1992, RCRA Facility Investigation Phase II and Phase III Soils, SWMU 09/05, Pest Control Area/ R150 Tank Site, NSWC Cr
9 Analytical Data, SWMU 09/05, Pest Control Area/ R150 Tank Site, NSWC Crane
10 Nohrstedt, J.S., et al, September 1998c, RCRA Facility Investigation Plahse II Soil Release Characterizatin, NSWC Crane
11 Nohrstedt, J.S., et. al, September 1998, RCRA Facility Investigation Phase II Soils Release Characterization, SWMU 10/15, Rockeye Munitions Facility, Final Report, Army Corps WES
12 Rust E&I, July 1997, Environmental Data Assessment Memorandum, SWMUs 03/10, 06/09, and 07/09, NSWC Crane, Draft Report.

4.0 PLANNING FOR DATA COLLECTION

4.1 INTRODUCTION

Planning for data collection involved the use of the U.S. EPA Data Quality Objectives (DQO; U.S. EPA, 1994) process which emphasizes data use and decision-making. This process requires a logically sequenced, iterative, approach to problem solving. The process begins with establishing communications among, and involvement of, key decision-makers and stakeholders. Summarizing briefly, this is followed by clearly defining the problem to be solved, then formulating a concise problem statement, identifying the information needed to solve the problem, establishing the problem's temporal and spatial boundaries and applying to the extent reasonable an objective statistical approach to the problem solution.

The primary decision-makers for this investigation are the US EPA Region 5 and the U.S. Navy and secondarily the Indiana Department of Environmental Management (IDEM). US EPA Region 5 exercises jurisdiction over all environmental investigations conducted at NSWC Crane and the Navy is the owner/operator of the site. Tetra Tech NUS (TtNUS), acting on behalf of the Navy, provides technical support in project management, chemistry, statistics, geology, hydrogeology, hydrology, human health, and ecological risk assessment.

Data sets obtained under this investigation are intended to be the benchmarks to which future foreseeable NSWC Crane SWMU investigation soil data are compared to determine if metal soil contaminants exceed background concentrations. Consequently, comparability of the soil metals background data to data from ongoing and future investigations is crucial to success of the project. The background analytes of interest, the soil types, analytical methods, potential use of historical data, future land use, risk-based cleanup levels likely to be used in future investigations, methods of comparing data distributions, sampling schemes, and other pertinent considerations were examined. Classification of soils in a manner that would facilitate comparability among data sets was examined at length. This critical aspect of the DQO planning, with rationales for selecting the soil types, are summarized in Section 4.2.1.

The primary objective of this investigation is to collect a sufficient number of soil samples to adequately characterize, by the depositional environment, depth, and soil grain size, the background soil concentrations of Target Analyte List (TAL) metals plus lithium, strontium, thorium, and tin at NSWC Crane. Additional information regarding the project objectives, decision statement and decision rule for this investigation are found in Sections 1.1.1 and 1.4 of the QAPP.

The number of soil samples that need to be collected and analyzed to permit discrimination between data sets is an important consideration because it affects current and future project costs. Discussions were held on sample collection and analysis costs incurred for the background study *versus* costs likely to be incurred during future SWMU investigations. A simple statistical model was used to arrive at initial estimates of the number of samples that would satisfy project objectives. A discussion of this model is presented in Section 4.2.3. The model incorporates some assumptions and the impact of those assumptions is also discussed.

4.2 SAMPLE NETWORK DESIGN AND RATIONALE

4.2.1 <u>Determination of Background Areas</u>

The background areas and specific sampling locations selected for background sample collection were selected to meet five criteria. Close adherence to these criteria is essential in order to ensure that the data collected represents "true background" information. The criteria, followed by a brief description are listed below:

1. Background areas must be within the NSWC Crane property boundary.

2. The background areas and the specific sampling locations within a background area must have a soil composition similar to the soil encountered in the presently defined SWMUs and across the entire NSWC Crane facility. The soil composition in the background areas must have similar geological, biological, chemical, and physical characteristics as the soil encountered in the SWMUs and across the facility to ensure a high degree of data comparability. To achieve this the background areas and specific background sample locations were determined using the classification of soil according to their depositional environment (DE), grain size, and depth. Classification of soil according to its depositional environment was defined in Section 2.7.2. Classification of soil according to its depth and grain size is presented below.

   Soil depth will be classified according to surface and subsurface soil with surface soil ranging from 0 to 1 foot and subsurface soil ranging from 2 to 6 feet in depth. A surface soil interval of 0 to 1 foot was determined as a compromise between several risk-based conventions that range from 0 to 0.5 feet and 0 to 2.0 feet bgs. However, it is assumed that background samples from 0-1 foot collected in this study will be used when comparing SWMU data within the 0 to 2 foot interval.

Because the location of soil of a specified grain size is not known in advance of sampling, a specific sampling strategy was developed to aid in characterizing grain size in background soil. It is assumed that the surface soils will not differ significantly according to grain size. This assumption is based upon the findings of McElrath (1988) which stated that a thin mantle of loess has been deposited throughout the NSWC Crane facility. Furthermore, the surface soil at the site is predominantly a silt loam (McElrath, 1988). Thus surface soil samples will not be collected according to grain size. The grain size of subsurface soil, however will be collected according to three gross soil grain size classifications: clay, silt and sand, based upon visual classification in the field by a field geologist using the Unified Soil Classification System (USCS).

3. Background areas must be known or have evidence to suggest that they are unaffected by past or present Navy site activities. To determine this, background areas and specific sample locations were identified using facility operation maps (Naval Facilities Engineering Command, 1993 and Explosive Safety Officer, 1997), historical aerial photographs, and interviews with site personnel (Brent, 1999 and Poynter, 1999). The historical aerial photographs were compiled from 1935, 1953, 1958, 1966, 1984, 1998 (Natural Resources Office, 1999) and from 1975-1976 (McElrath, 1988).

   To locate specific sampling areas within a given background area an attempt will be made to stay:

   - Approximately 400 feet from any primary or secondary roads to minimize impact from vehicular traffic.
   - Approximately 400 feet from any developed areas related to Navy operations (e.g., buildings, storage facilities), past or present, to minimize impact from Navy operations.

   Due to the fact that any potential impact from these areas is unknown, a distance of 400 feet was selected to allow a "buffer zone" between the background sample location and these features.

4. Background areas must be upwind from any sites releasing airborne emissions to minimize impact from airborne contamination. The predominant upgradient wind direction was determined from the monthly prevailing wind directions determined for the facility according to the RCRA Air Quality Assessment (B & R Environmental, 1997) as discussed in Sections 2.5 and 2.9.2.1. Areas with known or suspected contamination from airborne emissions include the Ammunition Burning Grounds (ABG), Old Rifle Range (ORR), Demolition Range (DR), Pyrotechnic Test Areas (PTA), Old Burn Pit (OBP) CAAA QA/QC Test Area, and Building 146 (B146) incinerator.

5. Background sample locations must not be downslope from surface runoff from any SWMUs in order to eliminate contamination from surface runoff. To determine if each background area and specific sampling locations met this criteria, surface drainage patterns were analyzed using regional and local surface water maps and a topographic map of the facility (Kvale, 1992 and Blunck, 1995).

4.2.2 Description of Background Areas

Three general areas have been identified that meet the criteria discussed above. Each of these areas is described in the following sections. Figure 4-1 illustrates in general the extent of these potential background areas. More detailed maps of each area can be found on Figures 5-1, 5-2, and 5-3.

4.2.2.1 Background Area 1

Background Area 1 (BA1) is in the southwest quadrant of the NSWC Crane facility (Figure 4-1). Figure 5-1 is a more detailed map of BA1. The north boundary of BA1 is to the south of the Sanitary Waste Landfill (SWMU 14/00) and the Sludge Application Area. The western and southern NSWC Crane boundaries of BA1 are the western and southern facility boundaries, respectively. The eastern boundary of BA1 is an arbitrary north-south line to the west of the Pyrotechnic Test Area, Annex, and Rocket Range (PTA; SWMU 19/00). The eastern boundary was located in order to minimize any airborne contamination that may have been emitted from the PTA.

This background area characterizes the soil DEs classified as loess, alluvium, and residual soil derived from Pennsylvanian bedrock/colluvium. Additional information regarding the soil that is to be characterized from this background area can be found in Section 2.7.

4.2.2.2 Background Area 2

Background Area 2 (BA2) is in the northwest corner of the of the NSWC Crane facility. This background area characterizes the soil within the glacial outwash DE at the facility which is localized in the northwest corner of the facility. BA2 is very localized and is limited to non-impacted areas in this portion of the NSWC Crane facility. The extent of BA2 is defined by the boundaries of the glacial deposits as mapped by McElrath (1988) and Kvale (1992) and the proximity of two SWMUs. Due to the historical and on-going activities in the vicinity of BA2 and the interpretations of the spatial distribution of glacial outwash deposits in this area (McElrath, 1988 and Kvale, 1992), BA2 has been divided into two subsections, BA2a and BA2b.

Background Area 2a

BA2a is south of Highway 5 on the elevated area to the southwest of the Sludge Drying Beds B (SWMU 24/00) and Culpepper Branch (Figures 4-1 and 5-2). Culpepper Branch separates SWMU 24/00 from BA2a. The boundaries of BA2a (Figure 5-2) are defined by the boundaries of the glacial outwash deposits as mapped by McElrath (1988; Parke Soil series) and Kvale (1992). Please refer to section 2.7.2.2 for a more thorough description of the glacial outwash at NSWC Crane. BA2a does not include the soil deposits outside of the specified boundary shown on Figure 5-2 because of potential impacts identified by hummocky terrain and evidence of logging noted during site reconnaissance.

Background Area 2b

BA2b is in the glacial deposits north of Highway 5 and west of the NSWC Crane security fence (Figure 4-1). Figure 5-2 is a more detailed map of the BA2b which also shows the security fence. Although outside the security fence this area is still on the Navy property. The boundaries of BA2b are defined by the boundaries of the Negley soil series as mapped by McElrath (1988). It is noted that the spatial distribution of glacial outwash as mapped by McElrath (1988) is not shown on Figure 5-2. Maps of this interpretation are depicted in Appendix D. Please refer to Section 2.7.2.2 for a more thorough description of the glacial outwash at NSWC Crane. The southern boundary of BA2b is approximately 200 feet north of Highway 5 and the western boundary is the unnamed stream channel along the western edge of the Negley soil unit. The northern and eastern boundaries are the NSWC Crane facility fence.

4.2.2.3 Background Area 3

Background Area 3 (BA3) is in the northeast corner of the NSWC Crane facility (Figure 4-1). Figure 5-3 is a more detailed map of BA3. This background area characterizes the soil within the alluvium DE and residual soil derived from Mississippian bedrock/colluvium DE at the facility. This area was selected to characterize these soil types, because, within the facility boundaries, it is the area least likely to receive airborne emissions from the open burning/open detonation areas (OB/OD; e.g., Ammunition Burning Grounds [ABG]). Sections 2.5 and 2.9.2.1 provide greater detail on the predominant wind direction and airborne releases at the Crane facility.

The extent of BA3 is defined by the boundaries of the Mississippian bedrock in this area as mapped by Kvale (1992), the facility boundaries, and the area least likely affected by airborne emissions as defined above. The southern boundary of BA3 is to the south of Highway 162 (on the western portion), is approximately north of Highway 169 (in the central portion), and the northwest-southeast trending Boone Hollow (on the eastern portion). This boundary ranges between 3.5 and 4.25 miles north and northwest of the ABG. The northern and eastern extent is NSWC Crane's northern and eastern boundaries, respectively. The western boundary is defined by the surface exposure of Mississippian bedrock (Kvale, 1992). Rockeye is located approximately 1.2 miles to the west of the BA3 western boundary. However, Rockeye has no known airborne releases of metals.

4.2.3 Determination of Minimum Number of Background Samples

The background data set is the baseline condition to which contaminants at a SWMU may be added through site operations or otherwise. The addition of contaminants to the baseline condition is expected to cause a spreading of the concentration distributions and, by definition, will increase the mean value. As a site begins to appear more as background, it is logical to believe that its analyte concentration distributions converge with those of the background population. Hence the variances of the two data sets are approximately equal for each analyte when the site and background concentrations are similar. If the site population differs greatly from the background population, this assumption will not necessarily hold. However, the adverse effect of violating this assumption is offset by the population means being more disparate, thus facilitating the detection of a difference between data sets.

A definitive determination of the number of samples required for this investigation requires knowledge of five factors: (1) the shapes of the data distributions to be compared, (2) the variances of the distributions to be compared, (3) the difference between mean concentrations of the distributions to be compared, (4) the type of test used to discriminate between background and investigative data, and (5) the degree of confidence (or statistical significance) required for a data set comparison.

None of these five factors is known, in large part because the data required to estimate the "values" of those factors have not yet been collected, and because investigative decision criteria will be particular to each SWMU investigation. Given that the "values" of the factors are unknown, the minimum number of samples required for this background study was based on some assumptions. Those assumptions are: (1) normally distributed data sets, (2) equal variances for the data sets being compared, (3) the ability to detect a difference of less than or equal to two standard deviations between data set means, (4) use of a one-sided Student's *t*-test for discriminating between data sets, (5) a 5% significance level.

Assumption 3 is actually the primary project objective (See QAPP Section 1.1.1) described in quantitative terms. It corresponds to a 95% statistical confidence level, meaning that a difference between data set means that is equal to two standard deviations would be detectable in 95% of all comparisons.

Some of the stated assumptions may not always be valid. In particular, environmental contaminants frequently exhibit non-normal data distributions, and an assumption of equal variances for different data sets is not always valid. The cumulative effect of the assumptions not holding is difficult to predict because violation of some assumptions may drive the required number of samples higher while violation of other assumptions may drive the number of samples lower. Despite these limitations, the assumptions are useful because they provide an objective basis for modeling the discriminatory power achievable through various combinations of background samples and SWMU investigation samples.

The model, which relates discriminatory power to numbers of background samples and SMWU investigation samples, is:

$$\frac{\Delta\bar{x}}{s} = t_{(0.05,df)}\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}\,.$$

In this model, $\Delta\bar{x}/s$ represents the discriminatory power achievable when comparing data sets. The difference, $\Delta\bar{x}$, between arithmetic means of the data sets is divided by the standard deviation, *s*, of the data sets to normalize the results for tabulation. Values of $\Delta\bar{x}/s$ are presented in the Table 4-1a, where large values represent lesser discriminatory power and small values represent greater discriminatory power. Moving down and to the right in the table represents increasing power, and moving up and to the left represents decreasing power. The minimum numbers of samples in the background and SWMU data sets required to achieve each $\Delta\bar{x}/s$ value are given by n_1 and n_2, respectively; $t_{(0.05,df)}$ is the one-sided Student's *t*-value at a statistical significance level of 0.05 for each $\Delta\bar{x}/s$ value; and *df* is the number of degrees of freedom which is given by "$n_1 + n_2 - 2$" for each $\Delta\bar{x}/s$ value. In general terms, Table 4-1a shows that increasing power requires increasing numbers of samples. Thus, increasing power results in greater investigative costs.

The trade-off between numbers of samples and associated discriminatory power can be illustrated briefly in more quantitative terms. For example, if three samples are collected for this background study (Data set 1) and three samples are collected for a future SWMU investigation (Data Set 2), a difference greater than or equal to 1.74 standard deviations ("1.74" in the Table 4-1a at the intersection of *n*1 = 3 and *n*2 = 3) could be detected. Three samples for each data set yields six samples total. If six background samples (n1 = 6) and seven SWMU investigation samples (n2 = 7; 13 samples total), were collected a difference as small as 1.00 standard deviations between data set means could be detected. This is roughly a 70% "improvement" in performance for approximately a 100% "cost" increase. With 10 background samples, seven SWMU investigation samples will permit the detection of a difference of 0.86 standard deviations. This is a 14% "improvement" in performance at a 70% "cost" increase in the background study, and does not appear to be very cost-effective.

Striking a compromise, three to six samples is viewed as a reasonable number of samples needed for the background data set. Collecting three samples satisfies assumption three, and collecting more than six samples increases the discriminatory power but at increasingly disproportionate costs.

Using the one-sided Student's *t*-test as was done here, the statistical significance level, α, is the probability of concluding from the collected data that a site is not contaminated when in fact, it is contaminated. If the data show that a contaminated site is not greater than background, the site that is contaminated will not usually be investigated further and this consequence is considered to be relatively serious. This serious consequence is tempered somewhat by the fact that contaminant concentrations may exceed background levels but pose no increased threat to the environment and human health.

There is also a potential for making the converse error, i.e., concluding from the collected data that the site concentrations are greater than background concentrations when they are actually not greater. The consequence of this error is to spend resources to investigate the site further when such an investigation is not really necessary. This consequence is not so serious in terms of human or ecological health, but a waste of resources investigating sites that should not be investigated is undesirable.

The first type of error is considered to be more serious than the second type of error. In accord with standard DQO guidance (U.S. EPA, 1994), this establishes the null hypothesis to be that the site is greater than the background concentration. Accordingly, the onus is on the site data to demonstrate otherwise.

The two decision errors can be accounted for in a single computation that, again, yields the number of samples required to achieve a desired level of decision performance. The significance level for the more egregious error is maintained at 0.05 (i.e., 5%). For this exercise, tolerance (i.e., probability) for committing the lesser of the two errors was specified to be 0.3 (i.e., 30%). The equation forming the basis of the computation is (U.S. EPA, 1994):

$$m = n = \frac{2s^2\left(z_{1\text{-}\alpha} + z_{1\text{-}\beta}\right)^2}{\left(\delta_1 - \delta_0\right)^2} + \frac{z_{1\text{-}\alpha}^2}{4}$$

Where *m* and *n* are the numbers of samples in the two data sets being compared, *s* is the standard deviation of each sample, the *z*'s represent statistical *z*-scores, δ_1 is the minimum detectable difference between data set means, and $\delta_0 = 0$. For this project $\delta_1 = 2s$ and the equation reduces to:

$$m = n = \frac{\left(z_{1-\alpha} + z_{1-\beta}\right)^2}{2} + \frac{z_{1-\alpha}^2}{4}$$

Table 4-1b is a presentation of the number of samples from each data set that are required to provide a given level of α and β as computed using the above equation. This table reveals that 4 samples from each data set will satisfy the specification of an α = 5% chance of making the more serious error (i.e., of concluding that the site is not greater than background when it actually is greater), and a β = 30% chance of making the opposite error. The calculation without rounding shows that 4 samples at α = 5% and β = 30% actually corresponds to 3.03 samples. However, the number of samples is always rounded to the next highest integer because fractional samples cannot be collected. This rounding causes 3.03 samples to be interpreted as 4 samples. Table 4-1b also reveals that collecting *five* samples will limit the tolerance for the second type of error (β = 10%) to much less than the specification of β = 30%.

In conclusion, with α = 5%, collecting three to five samples from each population limits the tolerance for the more egregious error to 5% and the less egregious error from 10% to 30%. These computations are consistent with, and validate, the previous computations in which at least three samples was specified to obtain a minimum detectable difference of two-sigma and in which a target of five samples was established. They also identify the range of probabilities for making the less serious error when the specified numbers of samples are collected from each data set.

The greatest discriminatory power is achieved for a given cost when the number of samples in each data set is equal. This implies, for example, that three background samples is most efficiently complemented with three SWMU investigation samples. However, collecting only three background samples and three SWMU samples provides no protection against the loss of a sample which would then render the discriminatory power unacceptable (Table 4-1a, $\Delta \bar{x} / s$ = 2.15 for $n1$ = 2 and $n2$ = 3). Thus, five was selected as a reasonable number of samples to be collected for each soil type in the background data set. With five background samples, five SWMU investigation samples will yield a discriminatory power of 1.18*s*. This is well within the original goal of detecting a 2*s* difference, and it provides protection against loss of samples and the fact that the estimated sample sizes are minima.

4.2.4 Selection of Specific Background Sample Locations

Using the criteria listed in Section 4.2.1 specific background sample locations were selected. Ten sample locations (i.e., boreholes) within each depositional environment will be collected. At each of these sample locations surface and subsurface soil samples will be taken. Because the alluvium and the loess/glacial outwash DE span two background areas (BG1 and BG3, and BG1 and BG2, respectively) the number of sample locations in each background area is as follows:

- BG Area 1: 20 sampling locations
- BG Area 2: 5 sampling locations
- BG Area 3: 15 sampling locations

Ideally, samples would be collected at randomly selected locations but consideration was given to the reality that not all future sampling schemes are likely to follow a simple random sampling design and that irregular topography and operation areas could prevent the implementation of such a sampling design. Sampling locations were selected to provide good spatial coverage of each DE while considering access to the sampling locations. No attempts were made to bias sampling locations for any reason. When selecting the background sampling locations within each DE, an attempt was made to select a representative number of soil classifications as defined by the USDA/SCS (see Table 2-1) and at various topographic locations (i.e., lowlands, valleys, sideslopes, and ridgetops).

Tables 4-2, 4-3, and 4-4 list the sample tracking numbers, coordinate location, and a general description according to McElrath (1988) of each location. Using maps provided and the coordinate location of each point, sampling locations will be identified in the field (see Section 5.2.1). The sampling locations in the field shall be within a 30 foot radius of the designated location on the sample location maps and/or the coordinates. This range is reasonable considering the extent of the soil type (i.e., USDA soil series) according to soil maps of the site (McElrath, 1988).

4.2.5 Selection of Background Samples for Chemical Analysis

Figure 4-2 is a schematic diagram of the sampling strategy for chemical analysis. The circle represents a given DE from which samples will be collected. Within the DE, five surface samples will be collected, as represented by the top rectangle. Within the same DE, five samples will be collected for each gross soil grain size classification (e.g., clay, silt, and sand) from the subsurface, represented by the remaining rectangles. This leads to 20 samples within each DE, assuming that all grain sizes are encountered in the subsurface in each of the 10 boreholes in a DE. If all of the grain sizes are not encountered in the subsurface, fewer than five samples of the given grain size will be collected in the subsurface. Consequently, the minimum number of samples that could be collected within a DE is 10 (i.e., five surface samples and five subsurface samples of a single grain size). In order to eliminate biasing the number of samples for a given grain size at a specific location only one subsurface soil sample per grain size per sample location will be selected.

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TABLE 4-1A

SMALLEST DETECTABLE DATA SET DIFFERENCES (NORMALIZED TO UNITS OF STANDARD DEVIATION) NAVAL SURFACE WARFARE CENTER CRANE, INDIANA

No. of Samples in Data Set 2 (n2); No. of Samples in Data Set 1 (n1)

n1 \ n2	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	7.73	3.37	2.63	2.34	2.18	2.08	2.01	1.96	1.92	1.89	1.87	1.85	1.83	1.82
2	2.92	2.15	1.85	1.69	1.59	1.52	1.47	1.43	1.40	1.38	1.36	1.35	1.33	1.32
3	2.15	1.74	1.54	1.42	1.34	1.28	1.24	1.21	1.18	1.16	1.14	1.13	1.12	1.10
4	1.85	1.54	1.37	1.27	1.20	1.15	1.11	1.08	1.05	1.03	1.02	1.00	0.99	0.98
5	1.69	1.42	1.27	1.18	1.11	1.06	1.02	0.99	0.97	0.95	0.93	0.92	0.91	0.90
6	1.59	1.34	1.20	1.11	1.05	1.00	0.96	0.93	0.91	0.89	0.87	0.86	0.85	0.84
7	1.52	1.28	1.15	1.06	1.00	0.95	0.92	0.89	0.86	0.84	0.83	0.81	0.80	0.79
8	1.47	1.24	1.11	1.02	0.96	0.92	0.88	0.85	0.83	0.81	0.79	0.78	0.76	0.75
9	1.43	1.21	1.08	0.99	0.93	0.89	0.85	0.82	0.80	0.78	0.76	0.75	0.74	0.72
10	1.40	1.18	1.05	0.97	0.91	0.86	0.83	0.80	0.78	0.76	0.74	0.72	0.71	0.70
11	1.38	1.16	1.03	0.95	0.89	0.84	0.81	0.78	0.76	0.74	0.72	0.70	0.69	0.68
12	1.36	1.14	1.02	0.93	0.87	0.83	0.79	0.76	0.74	0.72	0.70	0.69	0.67	0.66
13	1.35	1.13	1.00	0.92	0.86	0.81	0.78	0.75	0.72	0.70	0.69	0.67	0.66	0.65
14	1.33	1.12	0.99	0.91	0.85	0.80	0.76	0.74	0.71	0.69	0.67	0.66	0.64	0.63
15	1.32	1.10	0.98	0.90	0.84	0.79	0.75	0.72	0.70	0.68	0.66	0.65	0.63	0.62

TABLE 4-1b

NUMBERS OF BACKGROUND AND SITE SAMPLES NECESSARY TO DETECT A TWO-SIGMA DIFFERENCE BETWEEN DATA SET MEAN VALUES FOR VARIOUS ERROR TOLERANCES (α AND β) NAVAL SURFACE WARFARE CENTER CRANE, INDIANA

	β (Probability of Type II Error)								
α (Probability of Type I Error)	**0.01**	**0.02**	**0.05**	**0.1**	**0.2**	**0.25**	**0.3**	**0.4**	**0.5**
0.005	14	13	11	10	8	7	7	6	5
0.01	13	11	10	8	7	6	6	5	5
0.02	11	10	8	7	6	5	5	4	4
0.025	11	10	8	7	5	5	5	4	3
0.05	9	8	7	5	4	4	4	3	3
0.075	8	7	6	5	4	3	3	2	2
0.1	7	6	5	4	3	3	3	2	2
0.15	6	6	4	3	3	2	2	2	1
0.2	6	5	4	3	2	2	2	1	1
0.25	5	4	3	3	2	2	1	1	1
0.3	5	4	3	2	2	1	1	1	1
0.35	4	4	3	2	1	1	1	1	1
0.4	4	3	2	2	1	1	1	1	1
0.45	4	3	2	1	1	1	1	1	1
0.5	3	3	2	1	1	1	1	1	1

TABLE 4-2

BACKGROUND SOIL SAMPLE LOCATIONS
BACKGROUND AREA 1
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

Sample Tracking Number	Coordinates: Northing	Coordinates: Easting	Depositional Environment[1]	Topographic Location	General Location	Crane Development Map #	Soil Survey of Martin County[2] Map #	Soil Series[1,3]	Soil Map Units[1,3]	Present at # of SWMUs	Soil Classification[1,3]: Surface Soil[4]	Soil Classification[1,3]: Subsurface Soil[5]
Loess/Glacial Outwash												
BG1SBL01	475333	552357	Loess deposits	uplands & ridgetops	west-southwest of Landfill	28	12	Hosmer	HoB	2	silt loam	silt loam to silty clay loam
BG1SBL02	473338	556120	Loess deposits	uplands & ridgetops	south of Landfill	28	12	Hosmer	HoB	2	silt loam	silt loam to silty clay loam
BG1SBL03	471916	556468	Loess deposits	uplands & ridgetops	southwest corner of base	28	20	Hosmer	HoB	2	silt loam	silt loam to silty clay loam
BG1SBL04	472420	557170	Loess deposits	uplands & ridgetops	southwest corner of base	12	20	Hosmer	HoB	2	silt loam	silt loam to silty clay loam
BG1SBL05	471726	557804	Loess deposits	uplands & ridgetops	south of Landfarm	28	12	Hosmer	HoB	2	silt loam	silt loam to silty clay loam
Alluvium												
BG1SBA01	467116	561809	Alluvium	lowlands	southwest of Pyrotechnic Test Areal	34	17	Haymond	Hd	3	silt loam	silt loam
BG1SBA02	465186	565000	Alluvium	floodplains & lowlands	southwest of Pyrotechnic Test Areal	34	17	Wilbur	Wr	0	silt loam	silt loam
BG1SBA03	465736	556035	Alluvium derived from sandstone, siltstone, and shale	floodplains & lowlands	south of Landfill	33	16	Burnside	Bu	4	loam	loam to channery loam
BG1SBA04	459291	558312	Silty alluvium derived from loess uplands	floodplains & lowlands	south of Landfill	37	16	Wakeland	Wa	4	silt loam	silt loam
BG1SBA05	460142	564374	Alluvium	lowlands	West of Rocket Range	34	17	Wakeland	Wa	4	silt loam	silt loam
Residual Soil from Pennsylvanian Bedrock/Colluvium												
BG1SBP01	473448	554603	material weathered fromss, siltstone, shale.	sideslopes	south of Landfill	28	12	Wellston-Gilpin complex	WnE	16	silt loam to channery silt loam	silt loam, silty clay loam, to channery loam
BG1SBP02	474801	562282	Loess and material weathered fromss, siltstone, shale.	ridgetop in uplands	East of Landfill	29	13	Zanesville	ZaB	6	silt loam to silty clay loam	silty loam, to sandy clay loam
BG1SBP03	475231	564089	material weathered from ss, siltstone, shale.	toe of slope	east of Landfill	29	13	Wellston	WeD2	8	silt loam	silt loam, silty clay loam, to channery loam
BG1SBP04	470853	561177	Loess and material weathered fromss, siltstone, shale.	sideslope in uplands	southeast of Landfill	29	13	Wellston	WeD2	8	silt loam	silt loam, silty clay loam, to channery loam
BG1SBP05	468455	560023	Loess and material weathered fromss, siltstone, shale.	ridgetop in uplands	southeast of Landfill	33	17	Zanesville	ZaB	6	silt loam to silty clay loam	silty loam, to sandy clay loam
BG1SBP06	466524	556306	Loess and material weathered fromss, siltstone, shale.	ridgetop in uplands	south of Landfill	33	16	Zanesville-Udorthents complex	ZnC	17	silt loam to silty clay loam	silt loam, silty clay loam to loam
BG1SBP07	465056	562910	material weathered from ss, siltstone, shale.	sideslope	southwest of Annex	34	17	Wellston-Gilpin complex	WnE	16	silt loam to channery silt loam	silt loam, silty clay loam, to channery loam
BG1SBP08	463375	560162	material weathered from ss, siltstone, shale.	sideslope near ridgetop	Northwest of Rocket Range	34	16	Wellston	WeC2	5	silt loam	silt loam, silty clay loam, to channery loam
BG1SBP09	457611	555750	material weathered from ss, siltstone, shale.	toe of slope	West of Rocket Range	37	20	Wellston-Gilpin complex	WnE	16	silt loam to channery silt loam	silt loam, silty clay loam, to channery loam
BG1SBP10	458358	557931	material weathered from ss, siltstone, shale.	toe of slope	West of Rocket Range	37	20	Zanesville	ZaC2	7	silt loam to silty clay loam	silty loam, to sandy clay loam

Notes:
NA
1 Information taken from (McElrath, G., Jr., 1998, Soil Survey of Martin County, Indiana, Soil Conservation Service, United States Department of Aqriculture.
2 No depth specified for surface soil samples
3 United States Department of Agriculture (USDA) classification system
4 Surface soil is from 0 to 12 inches below ground surface (bgs).
5 Subsurface soil is between 12 to 70 inches bgs or to the top of bedrock.

TABLE 4-3

BACKGROUND SOIL SAMPLE LOCATIONS
BACKGROUND AREA 2
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

Sample Tracking Number	Coordinates		Depositional Environment[1]	Topographic Location	General Location	Crane Development Map #	Soil Survey of Martin County[2] Map #	Soil Series[1,3]	Soil Map Units[1,3]	Present at # of SWMUs	Soil Classification[1,3]	
	Northing	Easting									Surface Soil[4]	Subsurface Soil[5]
Background Area 2a												
BG2SBG1	505679.5	553711.1	Glacial outwash deposits	sideslopes	south of Hwy 5, West Gate	8	4	Parke	PaC2	1	silt loam	silty clay loam to sandy clay loam
BG2SBG2	505880	553569	Glacial outwash deposits	sideslopes	south of Hwy 5, West Gate	8	4	Parke	PaC2	2	silt loam	silty clay loam to sandy clay loam
BG2SBG3	505905	554153	Glacial outwash deposits	sideslopes	south of Hwy 5, West Gate	8	4	Parke	PaC2	3	silt loam	silty clay loam to sandy clay loam
Background Area 2b												
BG2SBG4	507638	555136	Glacial outwash deposits	sideslopes	north of Hwy 5, West Gate	8	4	Negley	NeE	2	silt loam to loam	loam, clay loam, gravely loam
BG2SBG5	507355	555578	Glacial outwash deposits	sideslopes	north of Hwy 5, West Gate	8	4	Negley	NeE	2	silt loam to loam	loam, clay loam, gravely loam

Notes:
NA Information not available.
1 Information taken from (McElrath, G., Jr., 1998, Soil Survey of Martin County, Indiana, Soil Conservation Service, United States Department of Aqriculture.
2 No depth specified for surface soil samples
3 United States Department of Agriculture (USDA) classification system
4 Surface soil is from 0 to 12 inches below ground surface (bgs).
5 Subsurface soil is between 12 to 70 inches bgs or to the top of bedrock.

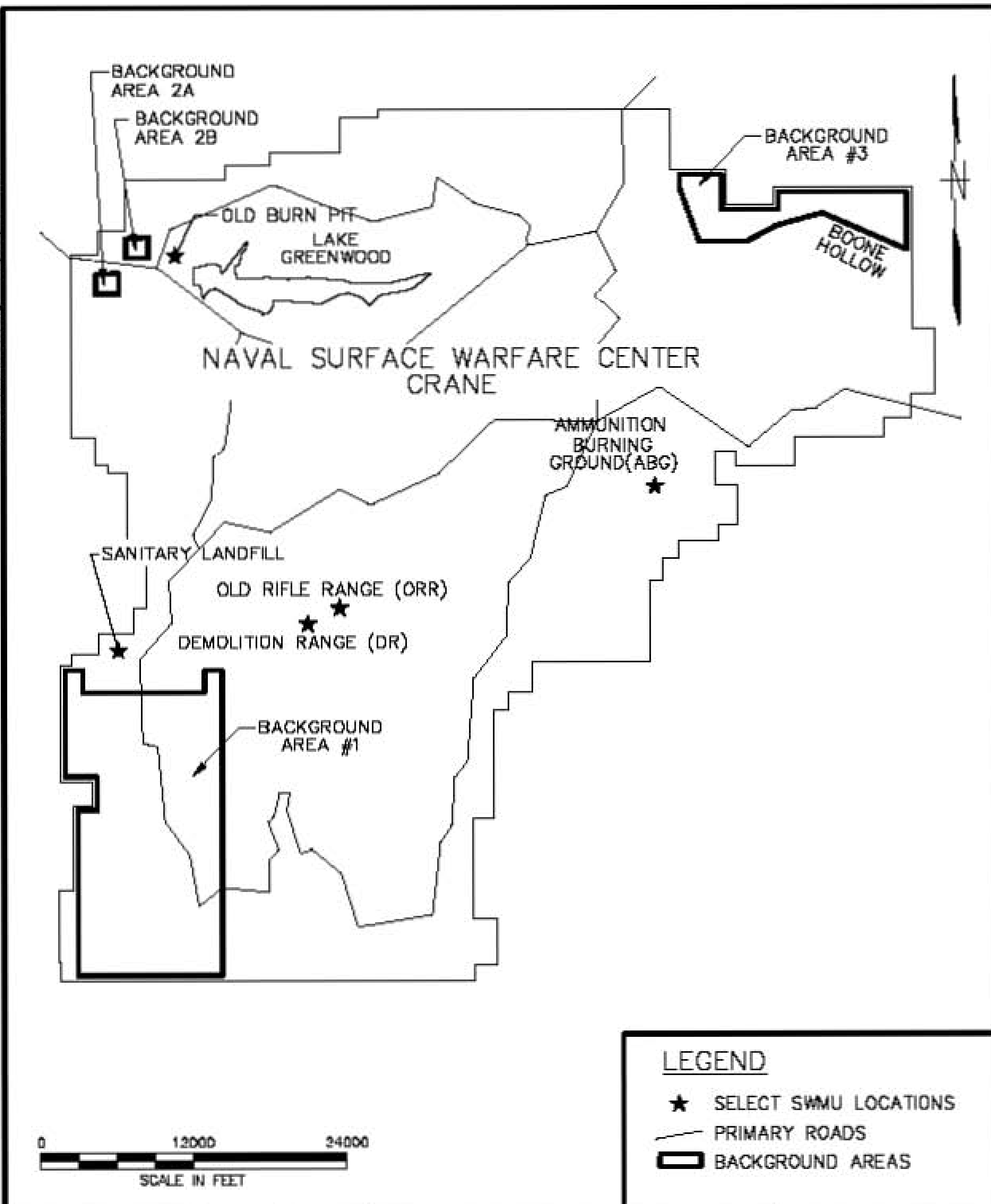
TABLE 4-4

BACKGROUND SOIL SAMPLE LOCATIONS
BACKGROUND AREA 3
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

Sample Tracking Number	Coordinates: Northing	Coordinates: Easting	Depositional Environment[1]	Topographic Location	General Location	Crane Development Map #	Soil Survey of Martin County[2] Map #	Soil Series[1,3]	Soil Map Units[4,5]	Present at # of SWMUs	Soil Classification[1,3]: Surface Soil[4]	Soil Classification[1,3]: Subsurface Soil[5]
Alluvium												
BG3SBA01	508414	599372	Alluvium derived fromsandstone, siltstone, and shale	floodplain & lowlands	Upper Sulphur Creek; northwest of intersection btwn JT-9 & H-162	12	3	Burnside	Bu	4	loam	loam to channery loam
BG3SBA02	507577	599827	Alluvium derived fromsandstone, siltstone, and shale	floodplain & lowlands	Upper Sulphur Creek; northwest of intersection btwn JT-9 & H-163	12	3	Burnside	Bu	4	loam	loam to channery loam
BG3SBA03	511031	604730	Alluvium derived fromsandstone, siltstone, and shale	floodplain & lowlands	southwest of PT-9	6	3	Burnside	Bu	4	loam	loam to channery loam
BG3SBA04	505375	612763	Alluvium derived fromsandstone, siltstone, and shale	floodplain & lowlands	Boone Hollow; west of PT-10A	14	3	Burnside	Bu	4	loam	loam to channery loam
BG3SBA05	505034.5	613232.1	Alluvium derived fromsandstone, siltstone, and shale	floodplain & lowlands	Boone Hollow; west of PT-10A	14	3	Burnside	Bu	4	loam	loam to channery loam
Residual Soils from Mississippian Bedrock/Colluvium												
BG3SBM01	510864	596982	material weathered from (M6) ss, siltstone, shale.	sideslope	East of Roberts Cemetary, along PT-8	5	3	Wellston-Ebal	WID	NP	silt loam	silt loam, silty clay loam, to channery loam
BG3SBM02	510791	598828	material weathered from (M6) ss, siltstone, shale.	sideslope	East of Roberts Cemetary, along PT-8	5	3	Zanesville	ZaC3	2	silt loam to silty clay loam	silty loam, to sandy clay loam
BG3SBM03	508028	600219	material weathered from (M5) ss, siltstone, shale.	sideslope	West of JT-9; Northeast of Bunker #1583	13	3	Wellston-Berks-Gilpin complex	WgG	6	silt loam to channery silt loam	silt loam, silty clay loam, to channery loam
BG3SBM04	511170	608891	material weathered from (M5) ss, siltstone, shale.	sideslope	N.east of JT-10 & JT-10A intersection	6	3	Zanesville	ZaC2	7	silt loam to silty clay loam	silty loam, to sandy clay loam
BG3SBM05	509751	610435	material weathered from (M5) ss, siltstone, shale.	ridgetop	North of JT-10A	14	3	Johnsburg	Jo	NP	silt loam	silty clay loam, silt loam, to sandy loam
BG3SBM06	508468	601500	material weathered from (M4) ss, siltstone, shale.	sideslope/lowland	East of JT-9; north of intersection btwn JT-9 & H-162	13	3	Wellston-Berks-Gilpin complex	WgG	5	silt loam to channery silt loam	silt loam, silty clay loam, to channery loam
BG3SBM07	508693	611899	material weathered from (M5) ss, siltstone, shale.	ridgetop	South of JT-10A	14	3	Zanesville	ZaB	6	silt loam to silty clay loam	silty loam, to sandy clay loam
BG3SBM08	510940	606117	material weathered from (M3) ss, siltstone, shale.	sideslope/lowland	400 feet south of PT-9	6	3	Wellston-Ebal	WID	NP	silt loam	silt loam, silty clay loam, to channery loam
BG3SBM09	508563	610090	material weathered from (M3) ss, siltstone, shale.	sideslope	800 feet South of JT-10A	13	3	Wellston-Berks-Gilpin complex	WgG	5	silt loam to channery silt loam	silt loam, silty clay loam, to channery loam
BG3SBM10	505544.7	613328.1	material weathered from (M2) ss, siltstone, shale.	sideslope/lowland	400 feet West of PT-10A	14	3	Wellston-Berks-Gilpin complex	WgG	5	silt loam to channery silt loam	silt loam, silty clay loam, to channery loam

Notes:
NA
1 Information taken from (McElrath, G., Jr., 1998, Soil Survey of Martin County, Indiana, Soil Conservation Service, United States Department of Aqriculture.
2 No depth specified for surface soil samples
3 United States Department of Agriculture (USDA) classification system
4 Surface soil is from 0 to 12 inches below ground surface (bgs).
5 Subsurface soil is between 12 to 70 inches bgs or to the top of bedrock.

ACAD: 0087GM01.dwg 04/26/01 HJP



DRAWN BY MF DATE 2/23/99		LOCATION OF NAVAL SURFACE WARFARE CENTER CRANE DIVISION AND BACKGROUND AREAS NSWC CRANE, CRANE, INDIANA	CONTRACT NO. 0087
CHECKED BY DATE			APPROVED BY K. HENN DATE 3/9/00
COST/SCHED-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 4-1 REV. 1

FORM CADD NO. SDIV_AV.DWG - REV 0 - 1/20/98

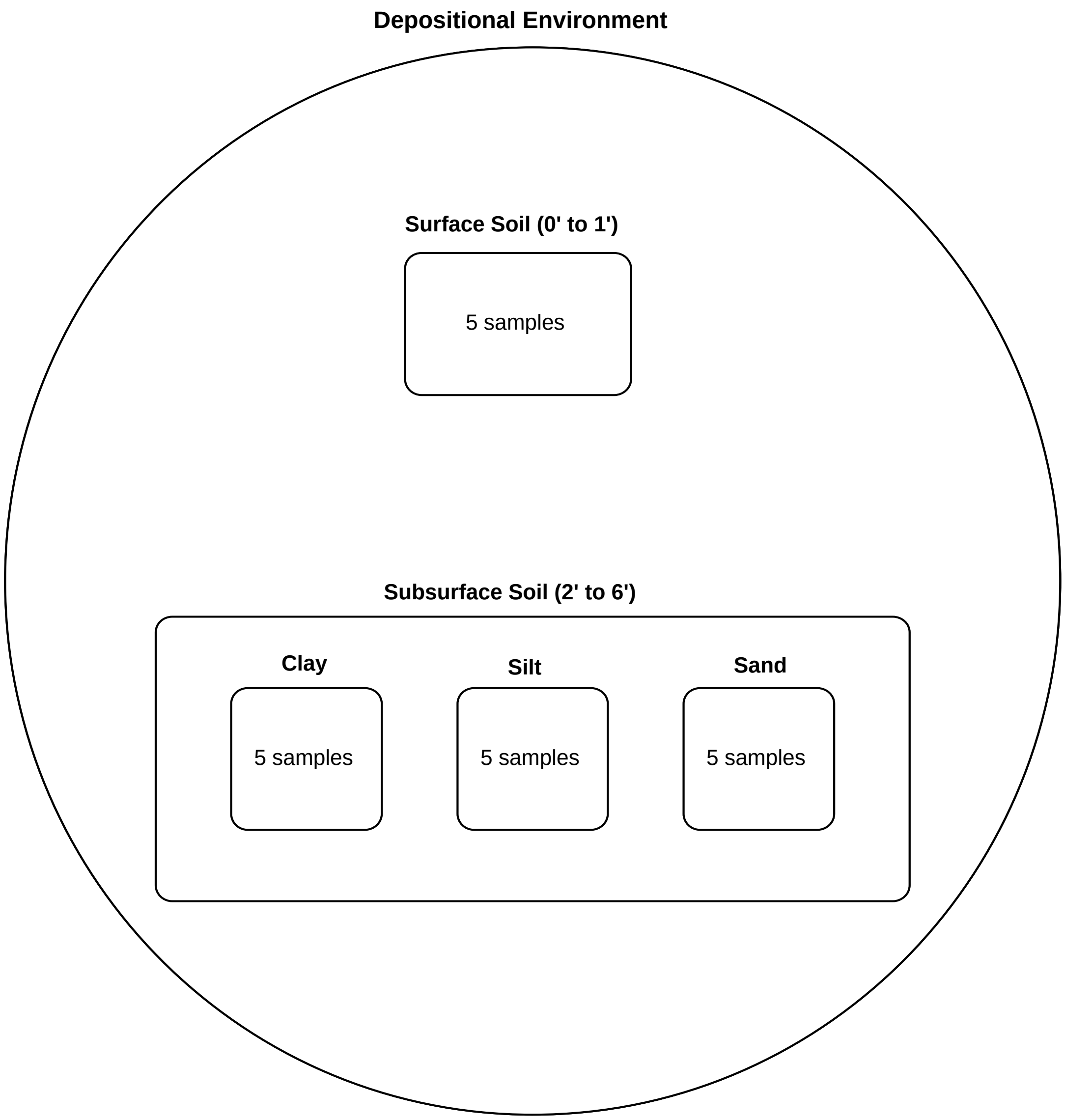


Figure 4-2

SELECTION OF SAMPLES FOR CHEMICAL ANALYSIS
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

Note: This schematic diagram illustrates the maximum number of samples to be submitted for chemical analysis within a depositional environment, depth, and grain size.

5.0 SOIL SAMPLING, ANALYSIS AND FIELD OPERATIONS

This section contains the Field Sampling Plan (FSP). It describes the proposed sampling locations, sampling, analysis, and the field operations, which are to be followed in conjunction with information in the QAPP and the WP.

5.1 BACKGROUND SAMPLING LOCATIONS

This section describes the locations proposed for background sampling. Both surface soil and subsurface soil will be sampled as a part of this FSP. Three specific areas, Background Areas 1, 2 and 3, have been defined for background sampling (see Section 4.2.2). The general locations of each of the background areas are shown on Figure 4-1. Figures 5-1, 5-2, and 5-3 illustrate the location of the sampling points for Background Area 1, Background Area 2, and Background Area 3, respectively.

5.1.1 Access/Location of Background Sampling Locations

Although accessibility of sampling locations was considered during planning, access to some of the sampling locations may be difficult due to their remote nature. In order to assist in the location of the sampling points, field personnel (at the discretion of the FOL) may use a hand held global positioning system (GPS) to locate the sampling points. The northing and easting coordinates for each of the sampling locations are listed in Tables 4-2, 4-3, and 4-4 for Background Areas 1, 2, and 3, respectively. The sample location maps also will be used to determine the appropriate access and location of the points. The actual point of sampling in the field may be within a 30 foot radius of the location designated on the sample location maps Figures 5-1, 5-2, and 5-3 and/or the coordinates on Tables 4-2, 4-3, and 4-4 (see Section 4.2.4). The sample location(s) may be moved within this distance at the discretion of the TetraTech NUS Field Operations Leader if undesirable features are encountered at the original sampling point (e.g., bedrock exposed on the surface, surface drainage patterns, logging roads, etc.).

5.2 SAMPLING AND ANALYSIS PROCEDURES

This section discusses the soil sampling methodology which will be used for the base-wide background investigation at NSWC Crane. Field investigation sampling summaries for Background Areas 1, 2, and 3 are shown in Tables 5-1, 5-2, and 5-3, respectively. The summary of sample analysis, bottle requirements, preservation requirements, and holding times are in Table 5-4. The field sample summary for fixed-base laboratory analysis is summarized in Table 5-5.

5.2.1 Sampling Equipment

Soil borings will be advanced using a hand auger. The hand auger consists of a stainless steel auger bucket and steel rods (each typically 3 feet in length). Commonly referred to as an Iwan sampler, the auger is advanced by turning a "T" handle in a clockwise motion. Samples will be taken continuously from the ground surface to a maximum depth of 6 feet below ground surface or until one of the following conditions are met:

- saturated zone is encountered;
- bedrock or weathered bedrock is encountered; or
- advancement refusal is met by the hand auger.

If condition 3 is encountered, an additional attempt will be made at another location nearby at the discretion of the FOL. Samples will be extracted from the auger bucket using a disposable polyethelyene (or stainless-steel) trowel and a stainless-steel mixing bowl. SOP CTO83-1 in Appendix B has additional information on borehole advancement and sample collection using a hand auger.

Once the borings have been advanced to the desired depth and sufficient sample volume has been collected, the boreholes will be abandoned by backfilling the hole with remaining soil cuttings.

5.2.2 Surface Sampling

Surface soil samples will be collected from the ground surface to a maximum depth of 2 feet (i.e., 0 to 2 feet) during advancement of soil borings using a stainless-steel hand auger. Upon retrieval, all samples obtained will be monitored for volatile organic compounds (VOCs) with a photo-ionization detector (PID) and then collected for visual lithologic classification. The 0 to 1 foot depth interval will be collected and placed in sample bottles as defined on Tables 5-1, 5-2, and 5-3. Soil from the 1 to 2 foot depth interval will be discarded after visual lithologic classification. SOP CTO83-2 (Appendix B) describes the selection of soil samples for chemical analysis. All samples will be placed in a cooler of ice immediately after collection. SOP CT083-3 provides additional information for handling soil samples. Before samples are collected, all pertinent ambient conditions and field data will be recorded in the field logbook and on the soil sample log sheet (included in Appendix A).

5.2.3 Subsurface Sampling

Subsurface soil samples will be collected from a depth of 2 feet to a maximum depth of 6 feet below ground surface using a stainless-steel hand auger. Upon retrieval, all samples will be monitored for

VOCs with a PID and then collected for visual classification of the lithology. Sample intervals are defined in Tables 5-1, 5-2, and 5-3. Refer to SOP CTO83-2 for the procedure on selection of soil samples for chemical analysis. All samples will be placed in a cooler of ice immediately after collection. SOP CT083-3 provides additional information on handling of soil samples. Before samples are taken, all pertinent ambient conditions and field data are recorded in the field logbook and on the soil sample log sheet (example included in Appendix A).

5.2.4 Borehole and Sample Logging

A lithologic description of each soil sample and a complete log of each boring will be maintained by the TetraTech NUS geologist in accordance with CTO83-4 (Appendix B). At a minimum, the boring log will contain the following information:

- Boring identification
- Name of geologist logging the boring
- Sample numbers and types
- Sample depths
- Soil density or cohesiveness
- Soil color
- USCS material description
- Location of boring
- Drilling problems/deviations from project specific FSP

In addition, depths of changes in lithology, sample moisture observations, depth to water, organic vapor (i.e., PID) readings, drilling methods, and total depth of each borehole will be included on each log, as well as any other pertinent observations. An example of the boring log form is attached in Appendix A.

5.2.5 Sample Identification System

All samples will be properly labeled with a sample label affixed on the sample container and a sample tag secured around the neck of the sample container.

The sample labels and sample tags will include the following information: project name, sample tracking number, sampling date, type of analysis, matrix type, preservative, and gross grain size classification.

Each sample collected will be assigned a unique sample tracking number. The sample tracking number is a four-segment, alpha-numeric code that identifies the site, type of sample, sample location, and depth of sample. Any other pertinent information regarding sample identification will be recorded in the field logbooks and/or sample logsheets (see Section 5.2.7 for additional details).

The alpha-numeric coding to be used in the sample system is explained in the diagram and the subsequent definitions:

(AAN)	**-**	**(AA)**	**-**	**(ANN)**	**-**	**(NN)**
(Site ID)		(Type)		(Location)		(Depth)

Character:

A = Alpha
N = Numeric

Site ID:

BG1 = Background Area 1
BG2 = Background Area 2
BG3 = Background Area 3

Type:

SB = Soil Boring

Sample Location:

A # # = alluvial soil and the sample location number
G # # = glacial outwash soil and the sample location number
L # # = loess soil and the sample location number
M # # = Residual soil from Mississippian bedrock/colluvium and the sample location number
P # # = Residual soil from Pennsylvanian bedrock/colluvium and the sample location number

Depth:

01 = soil collected from 0 to 1 foot bgs
03 = soil collected from 2 to 3 feet bgs
04 = soil collected from 3 to 4 feet bgs, etc.

For example, a soil sample collected from 0 to 1 foot at sampling location P04 in background area 1 will be designated as BG1SBP0401, or a soil sample collected from 4 to 5 foot at sampling location M10 in background area 3 will be designated as BG3SBM1005.

Field quality assurance/ quality control (QA/QC) samples are described in Section 5.3. They will be designated with a different coding system. The QC code will consist of a two-segment, alpha-numeric code that identifies the sample medium (for duplicates only), QC type, and date. The QC types are identified as:

- SW = Source Water
- RB = Rinsate Blanks
- FB = Field Blanks
- FD = Field Duplicates

For example, a field duplicate of sample BG1SBL0401 obtained on October 3, 1999 would be designated as: BGFD-100399. This allows duplicates to be submitted as "blind" samples to the analytical laboratory. Sample log sheets, not received by the analytical laboratory, will document duplicate sample locations.

Matrix spike and laboratory duplicate (MS) samples will be designated on the field documentation forms and sample labels.

5.2.6 Sample Preservation, Shipping, and Handling

Soil samples are unstable and therefore require preservation to prevent changes in either the concentration or the physical condition of the constituent(s) requiring analysis. The sample preservatives required for each of the chemicals of interest are provided in Table 5-4.

Sample handling includes the field-related considerations connected with the selection of sample containers, preservatives, allowable holding times, and analyses requested. Table 5-4 provides a summary of sample handling considerations for the various analytical fractions. SOP CTO83-3 (Appendix

B), provides a detailed description of sample handling, packaging, and shipping procedures and requirements required for this sampling plan.

Sample Shipment Procedures

The following procedures will be followed when shipping samples for laboratory analysis:

- All samples require cooling to 4°C ± 2°C and will be promptly chilled with ice and packaged in an insulated cooler for transport. Each cooler shipped to the laboratory will include a temperature blank. Ice will be sealed in containers to prevent water leakage. Samples will not be frozen. Each sample container will be placed in a zip-lock bag to prevent contamination. The zip-lock bag will be placed in a bubble-wrap sleeve to protect from breakage. The temperature of the cooler will be measured using the temperature blank and then recorded in the appropriate section of the chain-of-custody form.

- Only shipping containers that meet all applicable state and Federal standards for safe shipment will be used.

- Shipping containers will be sealed with nylon strapping tape, and custody seals will be signed, dated, and affixed in a manner that will allow the receiver to quickly identify any tampering that may have occurred during transport to the laboratory.

- The field chain-of-custody document will be taped to the top inside cover of the shipping container in a sealed plastic envelope.

- Shipment will be made by a public courier. After all samples for a given depositional environment have been collected, they will be sent to the laboratory within 24 hours.

5.2.7 Chain-of-Custody/Documentation

Sample custody procedures (See also, QAPP Section 5) are designed to provide documentation of preparation, handling, storage, and shipping of all samples collected. Integrity of the samples collected during the investigation will be the responsibility of identified persons from the time they are collected until they, or their derived data, are incorporated into the final report. Stringent chain-of-custody procedures described in the following sections will be followed to document sample possession. An example of the chain-of-custody form, which will be used to document this procedure, is included in Appendix A. The chain-of-custody procedure will be followed in accordance with SOP CTO83-5 (Appendix B).

Field Custody

- The Field Operations Leader (FOL) is responsible for the care and custody of the samples from the time they are collected until they are delivered to the analyzing laboratory or entrusted to a courier.

- Soil Sample Log Sheets (see attached form in Appendix A) and/or other records, such as field notebooks, will be signed and dated in accordance with SOP CTO83-5. Chain-of-custody sample forms will be completed to the fullest extent possible prior to sample shipment. They will include the following information: project name, sample number, time collected, source of sample and location, description of sample location, matrix, designated analysis, type of sample, preservative, and name of sampler (see form in Appendix A).

- All forms, logsheets, and records will be filled out in a legible manner, using waterproof ink, and will be signed by the sampler. Similar information will be provided on the sample label and tag, which will be securely attached to the sample bottle. The label will include the general analyses to be conducted. In addition, sampling forms will be used to document collection and preparation procedures. Copies of all forms used during field activities are provided in Appendix A.

Transfer of Custody and Shipment

The following procedures will be used when transferring custody of samples:

- Samples will be accompanied by a chain-of-custody record. When transferring samples, the individuals relinquishing and receiving them will sign, date, and note the time on the chain-of-custody record. This record documents the sample custody transfer from the sampler to the laboratory, often through another person or agency (common courier). Upon arrival at the laboratory, internal sample custody procedures will be followed.

- Prior to shipment to the laboratory for analysis, samples will be properly packaged. Individual custody records will accompany each shipment. Shipping containers will be sealed for shipment to the laboratory. The methods of shipment, courier name, and other pertinent information will be entered in the remarks section of the custody record.

- All shipments will be accompanied by the chain-of-custody record identifying the contents. The original record will accompany the shipment and a copy will be retained by the field sampler.

- Proper documentation will be maintained for shipments by common courier.

Laboratory Sample Custody

To ensure the integrity of a sample from collection through analysis, it is necessary to have an accurate written record that traces the possession and handling of the sample. This documentation is referred to as the sample chain-of-custody.

A sample is under custody if:

- The sample is in the physical possession of an authorized person.
- The sample is in view of an authorized person after being in his/her possession.
- The sample is placed in a secure area by an authorized person after being in his/her possession.
- The sample is in a secure area, restricted to authorized personnel only.

Sample custody during collection and shipping is discussed in SOP CTO83-5, attached in Appendix B. Laboratory sample custody is discussed below:

When samples are received at the laboratory, the shipping manifest will be signed and dated to acknowledge sample receipt. The sample custodian must examine the shipping containers and verify that the correct number of containers were received. The shipping containers will be opened. The temperature of the temperature blank will be measured and recorded on the COC accompanying the sample shipment. As samples are removed from the shipping containers the bottle condition shall be noted. The information on the chain-of-custody, the airbill, the containers, and the laboratory request is reviewed to note any discrepancies.

Laboratory holding times are specified by the contract and are presented in Table 5-4.

Field Recordkeeping

Various hard cover, bound, record books are maintained for each field activity in accordance with SOP CTO83-5, contained in Appendix B. The Master Site Logbook serves as the overall record of field activities. Information included daily in the Master Site Logbook includes daily field activities; weather conditions; identity, arrival times, and departure times of personnel; and management issues. Information collected during soil sampling will be recorded on sample forms (Appendix A), and will be referenced in the Master Site Logbook.

Field Documentation Responsibilities

The FOL is responsible for the maintenance and security of all field records (e.g., sampling logs, Master Site Logbook) at the end of each work day. A copy of all forms used during field activities is included in Appendix A.

At the completion of field activities, the FOL will send the TtNUS Task Order Manager (TOM) all field records, data, field notebooks, logbooks, chain-of-custody receipts, sample log sheets, daily logs, etc. The TOM will ensure that the appropriate materials are included in the final background investigation report.

Changes in project operating procedures may be necessary as a result of changed field conditions or unanticipated events. A summary of the sequence of events associated with field changes is as follows (See also QAPP Section 13.1):

- The FOL notifies the TOM of the need for the change.
- If necessary, the TOM will discuss the change with the pertinent individuals (e.g., Navy Remedial Project Manager, TtNUS Quality Assurance Manager) and will provide a verbal approval or denial to the FOL for the proposed change. EPA and IDEM will be consulted if any scope changes occur while fieldwork is ongoing.
- The FOL will document the change on a Task Modification Request form and forward the form to the TOM at the earliest convenient time (e.g., end of the work week).
- The TOM will sign the form and distribute copies to the Navy Remedial Project Manager, Quality Assurance Manager, FOL, and project file.
- A copy of the completed Task Modification Request form will be attached to the field copy of the affected document.

The possession of all records will be documented; however, only the project FOL or designee may remove field data from the site for reduction and evaluation.

5.2.8 Decontamination of Field Sampling Equipment

All nondedicated reusable sampling equipment used for collecting samples will be decontaminated both prior to beginning field sampling and between samples. This equipment includes stainless-steel hand augers, stainless-steel trowels, mixing bowls, and hollow sample tubes. The following decontamination steps will be taken:

- Potable water rinse
- Liquinox detergent wash
- Potable water rinse
- Deionized water rinse
- Air dry
- Wrap in aluminum foil (if not to be used immediately)

Please see SOP CTO83-6 which contains additional details regarding decontamination of field sampling equipment.

5.2.9 Investigation Derived Waste Management

Two types of potentially contaminated investigation derived wastes (IDW) will be generated during the field investigation, namely, personal protective equipment (PPE) and decontamination water. Excess soil cuttings will be returned to the borehole or scattered near the borehole. Based on the activities and types of contaminants present, none of these residues are expected to represent a significant risk to human health or the environment if properly managed. Planned management of each of these residues is provided below:

PPE - All PPE will be placed in single plastic garbage bags and then in the trash receptacles at the facility.

Decontamination Water – Because the background areas are not expected to have any contamination and are not located near any SWMUs the containerized decontamination fluids shall be discharged directly to a sanitary sewer at NSWC Crane.

5.3 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

The purpose of this section is to address the data quality objectives of field quality, quality assurance/control (QA/QC) samples such as field blanks, field duplicates, rinsate blanks, trip blanks, ambient blanks, and matrix spikes and laboratory duplicates. Table 5-5 contains a summary of the soil sample analysis and field quality control samples selected for this investigation. The following sections describe the purpose and a description of each of the quality control samples selected. Please see Section 8.0 of the QAPP for additional information regarding quality control/quality assurance samples and analyses.

5.3.1 Source Water Blanks

Source water blanks are obtained by sampling the analyte-free water and/or potable water source(s) used for decontamination of sampling equipment. Source water blanks are used to determine whether the analyte-free water or the potable water (used for sampling equipment decontamination procedures) may be contributing to sample contamination. One source water blank will be collected from each source of water used for decontamination.

5.3.2 Field Duplicates

Field duplicates are collected by splitting a single sample into two portions (in the case of soil or sediment sampling only) collected in the same order as the procedure outlined in CTO 83-1. Field duplicates are obtained during a single act of sampling and are used to assess the overall precision of the sampling and analysis methods employed. Field duplicates will be collected at a minimum frequency of 1 per every 10 samples. Field duplicates are not applicable for field analyses. Field duplicates will be analyzed for the same parameters in the laboratory and will be labeled in order to make the identity of the duplicate unknown to the laboratory (see Section 5.2.5 for sample nomenclature).

5.3.3 Rinsate Blanks

Equipment rinsate blanks are obtained under representative field conditions by running analyte-free water through sample collection equipment (e.g., hand auger, etc.) after decontamination and then placing it in the appropriate sample containers for analysis. Equipment rinsate blanks will be used to assess the effectiveness of decontamination procedures. Equipment rinsate blanks will be collected at a frequency of 1 per every 10 samples, with a minimum of one per day of sampling, per sampling device/instrument. For pre-cleaned, dedicated, and/or disposable equipment (i.e., disposable plastic trowels, etc.), one rinsate blank will be collected and analyzed at a frequency of one per lot or “batch blank” for a specific equipment type. In this case, equipment rinsate blanks will be used to assess the cleanliness of pre-cleaned, dedicated, and/or disposable equipment. In light of not knowing the exact number or rinsate blanks needed in the field, totals are to be determined in the field. Rinsate blanks are not applicable for field analyses.

5.3.4 Trip Blanks

Because only inorganics will be analyzed in this investigation, the collection of trip blanks is not anticipated for this investigation. Trip blanks are used to assess the potential for contamination resulting from contaminant migration into sample bottles/jars during sample shipment and storage. Trip blanks pertain to VOCs only. Trip blanks are prepared by the laboratory prior to the sampling event, shipped to the site with the sample containers, and kept with the investigative samples throughout the sampling event. They are packaged for shipment with other VOC samples and sent for analysis.

5.3.5 Ambient Condition Blanks

Ambient condition blank samples, consisting of deionized water, are collected in the field to provide a means to assess the quality of the data resulting from the field sampling program. Ambient blanks are analyzed to check for interfering contaminants that potentially could be present in ambient air at the sampling site (e.g., particulates). Ambient condition blanks will be collected based on conditions at the time of sampling, at the discretion of the FOL, to characterize site conditions. Because site conditions vary, the collected will be determined in the field. Ambient condition blanks are not applicable for field analyses.

5.3.6 Matrix Spikes/Laboratory Duplicates

Matrix spikes are investigative samples analyzed to provide information about the effect of the sample matrix on the digestion and measurement methodology. Only inorganics will be analyzed as a part of this investigation, thus only matrix spike and lab duplicates will be collected. Matrix spike (MS) and duplicate samples will be collected at a frequency of 1 per 20 samples. No additional sample volume will be required for analysis of the matrix spike/lab duplicate. MS and lab duplicates are not applicable for field analyses.

5.4 SURVEYING

The horizontal location of all background samples locations will be surveyed. A global positioning unit (GPS) will be used to identify horizontal locations of each of the background samples. The horizontal location will be surveyed to the Indiana State Plane Coordinates within the nearest 0.10 foot and referenced to the 1983 North American Datum (NAD83). Identification of the vertical locations of the background samples will not be performed.

5.5 CALIBRATION PROCEDURES AND FREQUENCY

Instruments used in the field (PID only) will be calibrated according to the procedures described in the SOPs. Calibration will be documented on an Equipment Calibration Log (Appendix A). During calibration, an appropriate maintenance check will be performed on each piece of equipment. If damaged or defective parts are identified during the maintenance check and it is determined that the damage could have an impact on the instrument's performance, the instrument will be removed from service until the defective parts are repaired or replaced.

5.6 PERFORMANCE AND SYSTEM AUDITS

System audits will be performed, as appropriate, to ensure that the work is being implemented in accordance with the approved project SOPs and in an overall satisfactory manner.

- The FOL will supervise, and check on a daily basis, that field measurements are made accurately, equipment is thoroughly decontaminated, samples are collected and handled property, and the field work is accurately and neatly documented.
- A formal audit of the field sampling procedures may also be conducted.
- U.S. EPA, IDEM, and the Navy may perform an audit of field procedures at any time.

5.7 PREVENTIVE MAINTENANCE

The PID is calibrated before use in the field in accordance with the equipment manual. As described in Secton 5.5, an appropriate maintenance check will be performed for each piece of equipment during calibration. Any equipment that does not calibrate properly is not used and will be returned to the vendor for replacement. Therefore, preventive maintenance of field equipment is not required while in the field.

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TABLE 5-1

FIELD INVESTIGATION SAMPLING SUMMARY
BACKGROUND AREA 1
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

Background Sample Location	Background Sample Name	Depth[1] (feet-bgs)	Collection of Sample[2]
Loess/Glacial Outwash			
BG1SBL01	BG1SBL0101	0-1	X
	BG1SBL0103	2-3	X
	BG1SBL0104	3-4	X
	BG1SBL0105	4-5	X
	BG1SBL0106	5-6	X
BG1SBL02	BG1SBL0201	0-1	X
	BG1SBL0203	2-3	X
	BG1SBL0204	3-4	X
	BG1SBL0205	4-5	X
	BG1SBL0206	5-6	X
BG1SBL03	BG1SBL0301	0-1	X
	BG2SBG0303	2-3	X
	BG2SBG0304	3-4	X
	BG2SBG0305	4-5	X
	BG2SBG0306	5-6	X
BG1SBL04	BG1SBL0401	0-1	X
	BG1SBL0403	2-3	X
	BG1SBL0404	3-4	X
	BG1SBL0405	4-5	X
	BG1SBL0406	5-6	X
BG1SBL05	BG1SBL0501	0-1	X
	BG1SBL0503	2-3	X
	BG1SBL0504	3-4	X
	BG1SBL0505	4-5	X
	BG1SBL0506	5-6	X
Alluvium			
BG1SBA01	BG1SBA0101	0-1	X
	BG1SBA0103	2-3	X
	BG1SBA0104	3-4	X
	BG1SBA0105	4-5	X
	BG1SBA0106	5-6	X
BG1SBA02	BG1SBA0201	0-1	X
	BG1SBA0203	2-3	X
	BG1SBA0204	3-4	X
	BG1SBA0205	4-5	X
	BG1SBA0206	5-6	X
BG1SBA03	BG1SBA0301	0-1	X
	BG1SBA0303	2-3	X
	BG1SBA0304	3-4	X
	BG1SBA0305	4-5	X
	BG1SBA0306	5-6	X
BG1SBA04	BG1SBA0401	0-1	X
	BG1SBA0403	2-3	X
	BG1SBA0404	3-4	X
	BG1SBA0405	4-5	X
	BG1SBA0406	5-6	X
BG1SBA05	BG1SBA0501	0-1	X
	BG1SBA0503	2-3	X
	BG1SBA0504	3-4	X
	BG1SBA0505	4-5	X
	BG1SBA0506	5-6	X
Residual Soils from Pennsylvanian Bedrock/Colluvium			
BG1SBP01	BG2SBP0101	0-1	X
	BG1SBP0103	2-3	X
	BG1SBP0104	3-4	X
	BG1SBP0105	4-5	X

TABLE 5-1

FIELD INVESTIGATION SAMPLING SUMMARY
BACKGROUND AREA 1
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

Background Sample Location	Background Sample Name	Depth[(1)] (feet-bgs)	Collection of Sample[(2)]
	BG1SBP0106	5-6	X
BG1SBP02	BG1SBP0201	0-1	X
	BG1SBP0203	2-3	X
	BG1SBP0204	3-4	X
	BG1SBP0205	4-5	X
	BG1SBP0206	5-6	X
BG1SBP03	BG1SBP0301	0-1	X
	BG1SBP0303	2-3	X
	BG1SBP0304	3-4	X
	BG1SBP0305	4-5	X
	BG1SBP0306	5-6	X
BG1SBP04	BG1SBP0401	0-1	X
	BG1SBP0403	2-3	X
	BG1SBP0404	3-4	X
	BG1SBP0405	4-5	X
	BG1SBP0406	5-6	X
BG1SBP05	BG1SBP0501	0-1	X
	BG1SBP0503	2-3	X
	BG1SBP0504	3-4	X
	BG1SBP0505	4-5	X
	BG1SBP0506	5-6	X
BG1SBP06	BG1SBP0601	0-1	X
	BG1SBP0603	2-3	X
	BG1SBP0604	3-4	X
	BG1SBP0605	4-5	X
	BG1SBP0606	5-6	X
BG1SBP07	BG1SBP0701	0-1	X
	BG1SBP0703	2-3	X
	BG1SBP0704	3-4	X
	BG1SBP0705	4-5	X
	BG1SBP0706	5-6	X
BG1SBP08	BG1SBP0801	0-1	X
	BG1SBP0803	2-3	X
	BG1SBP0804	3-4	X
	BG1SBP0805	4-5	X
	BG1SBP0806	5-6	X
BG1SBP09	BG1SBP0901	0-1	X
	BG1SBP0903	2-3	X
	BG1SBP0904	3-4	X
	BG1SBP0905	4-5	X
	BG1SBP0906	5-6	X
BG1SBP10	BG1SBP1001	0-1	X
	BG1SBP1003	2-3	X
	BG1SBP1004	3-4	X
	BG1SBP1005	4-5	X
	BG1SBP1006	5-6	X

Notes:
NA
1 Maximum depth of boring may be limited due to one of the conditions specified in Section 5.2.1. No sampleswill be collected beyond a given point where one of these conditons are present.
2 See Section 5.2 and SOP CTO 83-2 to determine the process of selecting samples for fixed-based chemical analysis.

TABLE 5-2

FIELD INVESTIGATION SAMPLING SUMMARY
BACKGROUND AREA 2
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

Background Sample Location	Background Sample Name	Depth(1) (feet-bgs)	Collection of Sample(2)
Loess/Glacial Outwash			
BG2SBG01	BG2SBG0101	0-1	X
	BG2SBG0103	2-3	X
	BG2SBG0104	3-4	X
	BG2SBG0105	4-5	X
	BG2SBG0106	5-6	X
BG2SBG02	BG2SBG0201	0-1	X
	BG2SBG0203	2-3	X
	BG2SBG0204	3-4	X
	BG2SBG0205	4-5	X
	BG2SBG0206	5-6	X
BG2SBG03	BG2SBG0301	0-1	X
	BG2SBG0303	2-3	X
	BG2SBG0304	3-4	X
	BG2SBG0305	4-5	X
	BG2SBG0306	5-6	X
BG2SBG04	BG2SBG0401	0-1	X
	BG2SBG0403	2-3	X
	BG2SBG0404	3-4	X
	BG2SBG0405	4-5	X
	BG2SBG0406	5-6	X
BG2SBG05	BG2SBG0501	0-1	X
	BG2SBG0503	2-3	X
	BG2SBG0504	3-4	X
	BG2SBG0505	4-5	X
	BG2SBG0506	5-6	X

Notes:
NA
1 Maximum depth of boring may be limited due to one of conditions specified in Section 5.2.1. No samples will be collected beyond a given point where one of these conditions are present.
2 See Section 5.2 and SOP CTO 83-2 to determine the process of selecting samples for fixed-based chemical analysis.

TABLE 5-3

FIELD INVESTIGATION SAMPLING SUMMARY
BACKGROUND AREA 3
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

Background Sample Location	Background Sample Name	Depth[1] (feet-bgs)	Collection of Sample[2]
Alluvium			
BG3SBA01	BG3SBA0101	0-1	X
	BG3SBA0103	2-3	X
	BG3SBA0104	3-4	X
	BG3SBA0105	4-5	X
	BG3SBA0106	5-6	X
BG3SBA02	BG3SBA0201	0-1	X
	BG3SBA0203	2-3	X
	BG3SBA0204	3-4	X
	BG3SBA0205	4-5	X
	BG3SBA0206	5-6	X
BG3SBA03	BG3SBA0301	0-1	X
	BG3SBA0303	2-3	X
	BG3SBA0304	3-4	X
	BG3SBA0305	4-5	X
	BG3SBA0306	5-6	X
BG3SBA04	BG3SBA0401	0-1	X
	BG3SBA0403	2-3	X
	BG3SBA0404	3-4	X
	BG3SBA0405	4-5	X
	BG3SBA0406	5-6	X
BG3SBA05	BG3SBA0501	0-1	X
	BG3SBA0503	2-3	X
	BG3SBA0504	3-4	X
	BG3SBA0505	4-5	X
	BG3SBA0506	5-6	X
Residual Soils from Mississippian Bedrock/Colluvium			
BG3SBM01	BG3SBM0101	0-1	X
	BG3SBM0103	2-3	X
	BG3SBM0104	3-4	X
	BG3SBM0105	4-5	X
	BG3SBM0106	5-6	X
BG3SBM02	BG3SBM0201	0-1	X
	BG3SBM0203	2-3	X
	BG3SBM0204	3-4	X
	BG3SBM0205	4-5	X
	BG3SBM0206	5-6	X
BG3SBM03	BG3SBM0301	0-1	X
	BG3SBM0303	2-3	X
	BG3SBM0304	3-4	X
	BG3SBM0305	4-5	X
	BG3SBM0306	5-6	X
BG3SBM04	BG3SBM0401	0-1	X
	BG3SBM0403	2-3	X
	BG3SBM0404	3-4	X
	BG3SBM0405	4-5	X

TABLE 5-3

FIELD INVESTIGATION SAMPLING SUMMARY
BACKGROUND AREA 3
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

Background Sample Location	Background Sample Name	Depth[1] (feet-bgs)	Collection of Sample[2]
	BG3SBM0406	5-6	X
BG3SBM05	BG3SBM0501	0-1	X
	BG3SBM0503	2-3	X
	BG3SBM0504	3-4	X
	BG3SBM0505	4-5	X
	BG3SBM0506	5-6	X
BG3SBM06	BG3SBM0601	0-1	X
	BG3SBM0603	2-3	X
	BG3SBM0604	3-4	X
	BG3SBM0605	4-5	X
	BG3SBM0606	5-6	X
BG3SBM07	BG3SBM0701	0-1	X
	BG3SBM0703	2-3	X
	BG3SBM0704	3-4	X
	BG3SBM0705	4-5	X
	BG3SBM0706	5-6	X
BG3SBM08	BG3SBM0801	0-1	X
	BG3SBM0803	2-3	X
	BG3SBM0804	3-4	X
	BG3SBM0805	4-5	X
	BG3SBM0806	5-6	X
BG3SBM09	BG3SBM0901	0-1	X
	BG3SBM0903	2-3	X
	BG3SBM0904	3-4	X
	BG3SBM0905	4-5	X
	BG3SBM0906	5-6	X
BG3SBM10	BG3SBM1001	0-1	X
	BG3SBM1003	2-3	X
	BG3SBM1004	3-4	X
	BG3SBM1005	4-5	X
	BG3SBM1006	5-6	X

Notes:
NA
1 Maximum depth of boring may be limited due to one of the conditions specified in Section 5.2.1. No samples will be collected beyond a given point where one of these conditions are present.
2 See Section 5.2 and SOP CTO 83-2 to determine the process of selecting samples for fixed-based chemical analysis.

TABLE 5-4

SUMMARY OF SAMPLE ANALYSIS, BOTTLE REQUIREMENTS, PRESERVATION REQUIREMENTS, AND HOLDING TIMES
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

Parameter	Sample Container	Container Volume	Preservation	Maximum Holding Time[2]	Analytical Methodology
SOIL					
TAL Metals + Lithium, Strontium, Thorium, and Tin[1]	Glass, Teflon-lined cap	4 ounce	Cool to 4°C ± 2°C	Mercury: analysis within 28 days Other Metals: analysis within 180 days	See Table 1-1 in the QAPP

Notes:

1 See Section 1.0 and Table 1-1 in the QAPP for a complete list of metals to be analyzed.

2 All holding times are determined from date of collection.

TABLE 5-5

FIELD SAMPLE SUMMARY FOR FIXED-BASED LABORATORY ANALYSIS
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

Analysis	Methodology	Samples	Field Duplicates	Rinsate Blanks[3]	Trip Blanks	Ambient Condition Blanks	Matrix Spike/ Lab Duplicate	Total[2]
Soil								
TAL Metals + Lithium, Strontium, Thorium, and Tin[1]	see note 1	80	8	9	NA	TBD	4	101

Notes:

NA = not applicable

TBD = Number of samples will be determined on site depending on conditions during sampling.

1 See Section 3.0 and 3.1 and Table 1-1 in the QAPP for a list of metals to be analyzed and the sample analysis methodology.

2 Rinsate blanks include 1 rinsate per 10 samples (e.g., hand auger) and 1 rinsate as a "batch blank" for the disposable sampling equipement (see text for additional details).

3 Totals do not include the number of Ambient Blanks. Number of ambient conditon blanks to be determined in the field based on field conditions.

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES	NO.	RELEASED FOR	BY	DATE

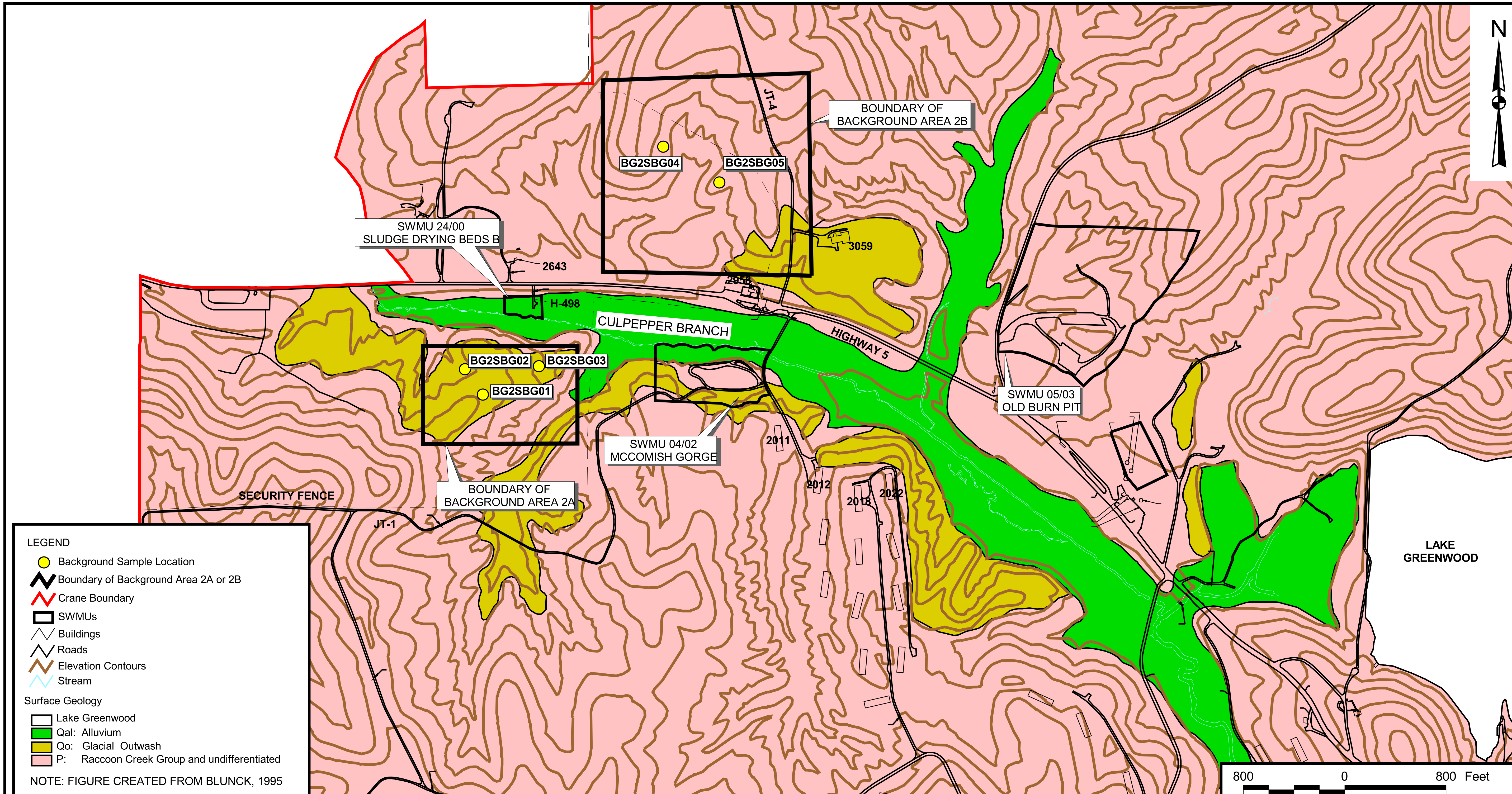
DRAWN BY: D. PERRY — DATE: 8-MAR-99
CHECKED BY — DATE
COST/SCHEDULE-AREA
SCALE: AS NOTED

Tetra Tech NUS, Inc.

SAMPLING LOCATION MAP
BACKGROUND AREA 1
NAVAL SURFACE WARFARE CENTER CRANE
CRANE, INDIANA

CONTRACT NO. | OWNER NO.
APPROVED BY | DATE
APPROVED BY | DATE
DRAWING NO.: FIGURE 5-1 | REV.: 0

P:\GIS\NSWC_CRANE\0087.APR 5/25/99 JAL NORTHWEST BH LAYOUT



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY: D. PERRY DATE: 5-MAR-99
CHECKED BY: — DATE: —
COST/SCHEDULE-AREA
SCALE: AS NOTED

Tetra Tech NUS, Inc.

BACKGROUND SAMPLE LOCATION MAP
BACKGROUND AREA 2
NAVAL SURFACE WARFARE CENTER CRANE
CRANE, INDIANA

CONTRACT NUMBER: —
OWNER NUMBER: —
APPROVED BY: — DATE: —
APPROVED BY: — DATE: —
DRAWING NO.: FIGURE 5-2
REV: 0

LEGEND

- Background Sample Location
- Crane Boundary
- Boundary of Background Area 3
- Buildings
- Roads
- Elevation Contours (20 Foot Contour Interval)

Surface Geology

- Qal: Alluvium
- P: Raccoon Creek Group and undifferentiated
- M6: Glenn Dean Ls, Hardinsburg Fm, Haney Ls, Indian Springs Shale Mbr, and undifferentiated
- M5: Sandstone Mbr of the Big Clifty Fm
- M4: Beech Creek Ls
- M3: Elwren Fm, Reelsville Ls, upper Sample Fm, and undifferentiated
- M2: Lower part of Sample Fm, Beaver Bend Ls, Bethel Fm, and undifferentiated
- M1: Paoli Ls, Ste Genevieve, and undifferentiated

NOTE: FIGURE CREATED FROM BLUNCK, 1995

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES	NO.	RELEASED FOR	BY	DATE

DRAWN BY D. PERRY — DATE 5-MAR-99
CHECKED BY — DATE
COST/SCHEDULE-AREA
SCALE AS NOTED

Tetra Tech NUS, Inc.

SAMPLE LOCATION MAP
BACKGROUND AREA 3
NAVAL SURFACE WARFARE CENTER CRANE
CRANE, INDIANA

CONTRACT NO. — OWNER NO.
APPROVED BY — DATE
APPROVED BY — DATE
DRAWING NO. FIGURE 5-3 — REV. 0

6.0 PROCEDURE FOR DETERMINING BACKGROUND VALUES

6.1 INTRODUCTION

The evaluation of the background data will culminate in data sets that are characterized with respect to several attributes. Those attributes and the manner in which the data will be characterized are the subject of this section.

6.1.1 Guidance Documents

The following guidance documents were used to determine which data analyses would be useful in characterizing the background data and which statistical parameters might provide useful benchmarks for comparing SWMU data to the background data:

- U.S. EPA 1992. Preparation of Soil Sampling Protocols: Sampling Techniques and Strategies. EPA 600/R-92/128 (EPA, 1992).

- SWDIV and EFA WEST of Naval Facilities Engineering Command 1998. Procedural Guidance for Statistically Analyzing Environmental Background Data. (SWDIV and EFA WEST, 1998)

Other important references which were useful in verifying suitability of the statistical tests selected for use in this project:

- Gilbert, Richard O., 1987. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold Company, New York, New York (Gilbert, 1987)

- Snedcor, George W. and William G. Cochran, 1980. Statistical Methods. The Iowa State University Press (Snedcor and Cochran, 1980).

6.1.2 Variations from Guidance Documents

No significant deviations were made from the guidance documents cited above.

6.2 STATISTICAL APPROACH

After data validation, the data will be treated in the following manner. Background soil metals results will be compiled into data sets by depositional environment and depth (surface soil [0' – 1'] or subsurface soil [2' - 6']) for each analyte. The depositional environments are as follows:

1. Residual soil from Mississippian bedrock/colluvium (referred hereafter as Mississippian soil)
2. Residual soil from Pennsylvanian bedrock/colluvium (referred hereafter as Pennsylvanian soil)
3. Alluvium deposits (referred hereafter as Alluvium)
4. Loess/Glacial outwash deposits (referred hereafter as Loess/Glacial)

The data sets will be further differentiated by gross grain size classification (e.g., sand, silt, and clay) for subsurface soil. Using this scheme for generating data subsets, 16 subsets are possible:

1. Mississippian surface soil
2. Pennsylvanian surface soil
3. Alluvium surface soil
4. Loess/Glacial surface soil
5. Mississippian sand subsurface soil
6. Mississippian silt subsurface soil
7. Mississippian clay subsurface soil
8. Pennsylvanian sand subsurface soil
9. Pennsylvanian silt subsurface soil
10. Pennsylvanian clay subsurface soil
11. Alluvium sand subsurface soil
12. Alluvium silt subsurface soil
13. Alluvium clay subsurface soil
14. Loess/Glacial sand subsurface soil
15. Loess/Glacial silt subsurface soil
16. Loess/Glacial clay subsurface soil

The underlying data distributions will be evaluated (e.g., normal or lognormal) for each metal in each data subset using the standard Shapiro-Wilk W test. If the data adhere to a parametric distribution, statistical parameters of the distributions will be computed. For statistical comparisons and mathematical manipulations, analytes that are not detected at the applicable soil-adjusted, sample specific IDL will be represented by a concentration equal to one-half the soil-adjusted, sample specific IDL.

Summary statistics also will be computed, including the maximum concentration, minimum concentration, number of samples exhibiting no detectable metal, number of samples exhibiting detectable metal, and proportion of samples with detectable and undetectable metal.

Probability plots will be prepared for each metal in each data subset. If the underlying distribution is log-normal, a log transformation will be imposed on the data prior to generating the plots.

Potential outliers will be identified using a 95% confidence goodness-of-fit test on the plotted data. Consideration will be given to selecting a goodness-of-fit test suited to the number of data points in the data set.

Potential outliers will be removed if after a review of field and laboratory documents indicates that the results are true outliers. If no identifiable reason for the outlier can be identified, the datum will not be removed from the data set. Statistical tests for outlier validity will be based on "Procedural Guidance for Statistically Analyzing Environmental Background Data" (NFEC, 1998).

Levene's test for unequal variances will be performed to identify differences in variances among data subsets (e.g., among surficial and subsurface data sets).

A 95% Upper Tolerance Limit (UTL) will be computed for each metal in each data subset based on the underlying distribution. These UTLs will be provided as background benchmarks for subsequent comparisons to site data; they should not be viewed as definitive cutoff concentrations for classifying SWMU or other environmental investigation data as greater than background.

Using a Wilcoxon Rank-Sum test, comparisons will be made of depositional environment data sets across grain sizes for each metal. If the data sets for every metal in two or more depositional environments pass the analysis of variance (ANOVA) at a 95% confidence level it may be appropriate to discontinue differentiation between those depositional environments and combine their data sets into a larger background data set.

Using a Wilcoxon Rank-Sum test, comparisons will be made of grain size data sets across depositional environments for each metal. If the data sets for every metal in two or more grain sizes pass the ANOVA at a 95% confidence level it may be appropriate to discontinue differentiation between those grain sizes and combine their data sets into a larger background data set.

The consolidation of data sets would provide additional discriminatory power for future data comparisons. Consolidation would also reduce the number of data sets needed for future SWMU investigations. However, data sets will not be combined if the data analyses indicate that such consolidation is inappropriate at the 95% confidence level.

The non-parametric Wilcoxon Rank-Sum test has been selected in lieu of parametric tests. This selection was made consciously to simplify the many data analyses that will be performed on the background data, as parametric tests are not expected to add significantly to the statistical rigor nor to the benefit of the analyses. This is expected, in part, because the nearly 400 data sets are likely to exhibit a mixture of distributions and many paired data sets are likely not to exhibit similar distributions and variances.

Data sets also will be inspected for spatial variations that might qualify the suitability of the data sets for general use. For example, a general decreasing spatial trend of the concentration of one or more chemicals could indicate a spatially related geochemical difference in background concentrations that should be considered when using the background data set.

Professional judgment may play a significant role in these data interpretations because of the potential complexity of the data distributions. For example, analyte concentrations will be examined for consistency. If inconsistencies are identified, they will be investigated by checking calculations and reporting units. Experienced geologists and chemists may interpret the data in terms of fundamental chemical and geochemical principles. The overall objective of the data reviews will be to obtain an assessment of the reasonableness of the data sets and to evaluate whether project objectives have been achieved. If data analysis indicates that the objectives set forth have not been achieved, consideration will be given to qualifying the data, collecting additional data, and/or rethinking the background data generation problem. Objective statistical tests, as described above, will be used where possible to limit any biases that could be introduced through the use of professional judgment.

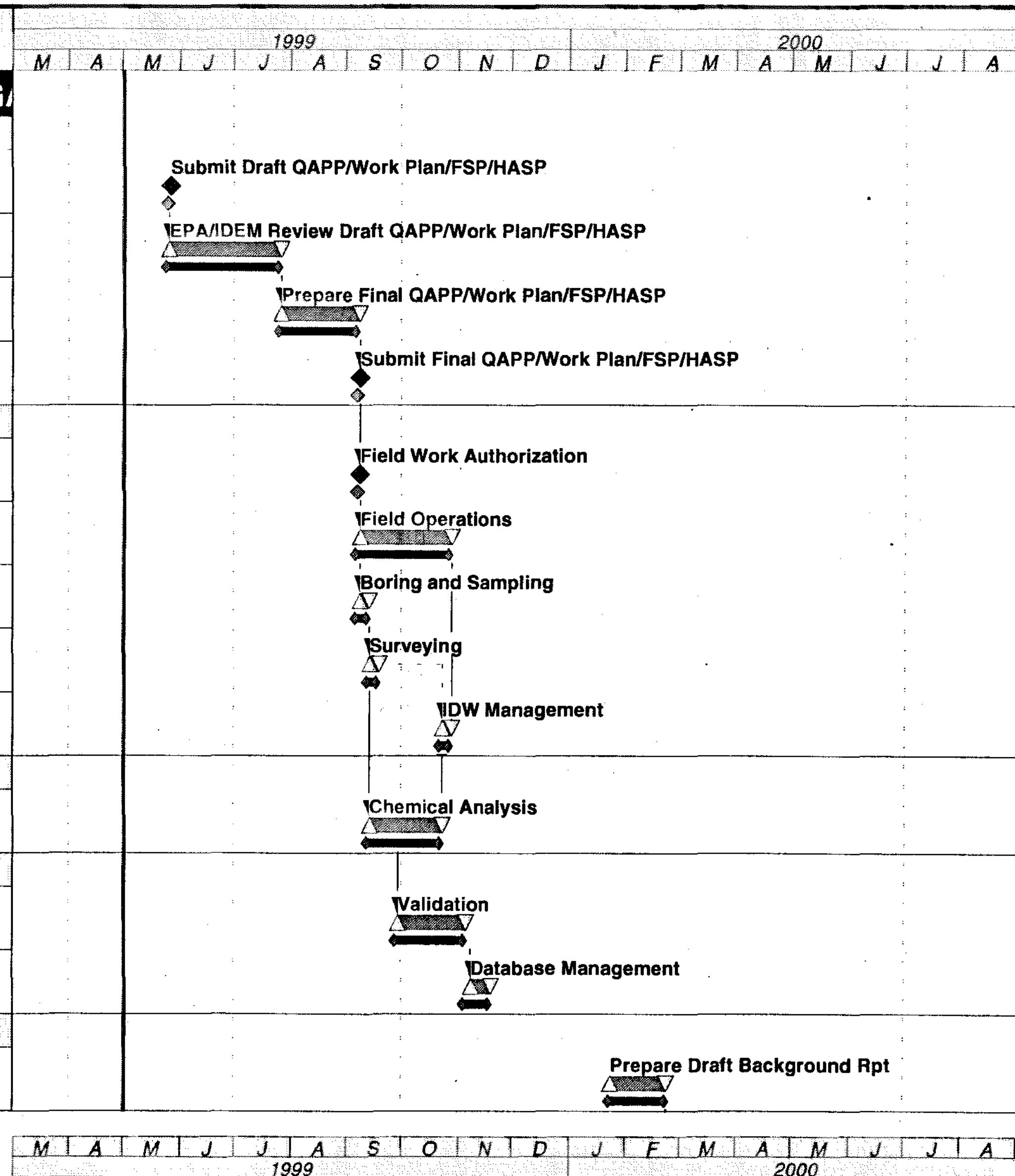
If any data indicate that a sample location has been the location of an actual or potential release as a result of Navy operations, the validity of the data for inclusion in the background data set will be re-evaluated. Any data found to be associated with such a release will be eliminated from consideration. If assignment to a release is inconclusive, the weight of the data in question relative to other data will be evaluated. Whether the data are included in the data compilations will be determined based on the effects of including and excluding the data from the compilations. All data rejected for use on this basis will be identified and documented.

The outcome of this investigation will be validated metals concentrations that represent background soil at NSWC Crane. This data will have been analyzed and summarized in a variety of ways to facilitate its use in background comparisons in on-going and future investigations performed at various SWMUs at NSWC Crane. A draft background data report presenting the data and related interpretations will be submitted to the U.S. EPA Region 5. The report will summarize the data and will identify any limitations that should be placed on its use. It also will present recommendations for additional sampling if that is indicated by the data. After the U.S. EPA review of the report, the need for additional data will be evaluated. All additional data collection activities will be discussed with, and approved by, the U.S. EPA prior to implementation.

7.0 PROJECT SCHEDULE

This section provides a project schedule for the implementation and completion of the Base-Wide Background Soil Investigation at the NSWC Crane, Indiana. It is anticipated that the background soil sample collection will occur in the fall of 1999. The laboratory analysis, data validation, data evaluation, and report writing will follow sample collection, occurring during the last quarter of 1999 and the first quarter of 2000. It is anticipated that the final report, which will be approved by the US EPA Region V and IDEM, will be completed in mid 2000. These milestones are illustrated in more detail on Table 7-1.

Activity description	Cal ID	Early Start	Early Finish
CTO 083 NSWC CRANE - BACKGRND INVESTIG/			
PLANNING DOCUMENTS			
Submit Draft QAPP/Work Plan/FSP/HASP	2		26MAY99
EPA/IDEM Review Draft QAPP/Work Plan/FSP/HASP	1	26MAY99	26JUL99
Prepare Final QAPP/Work Plan/FSP/HASP	2	27JUL99	07SEP99
Submit Final QAPP/Work Plan/FSP/HASP	2		07SEP99
FIELD INVESTIGATIONS			
Field Work Authorization	2	08SEP99	
Field Operations	1	08SEP99	28OCT99
Boring and Sampling	1	08SEP99	13SEP99
Surveying	1	14SEP99	18SEP99
IDW Management	1	24OCT99	28OCT99
LABORATORY ANALYSIS			
Chemical Analysis	1	14SEP99	23OCT99
DATA MANAGEMENT			
Validation	2	29SEP99	05NOV99
Database Management	2	08NOV99	19NOV99
DATA EVALUATION & REPORT			
Prepare Draft Background Rpt	2	24JAN00	22FEB00



Project Start	24NOV98	Early Bar
Project Finish	04AUG00	Target Bar
Data Date	02MAY99	Progress Bar
Run Date	20MAY99	Critical Activity

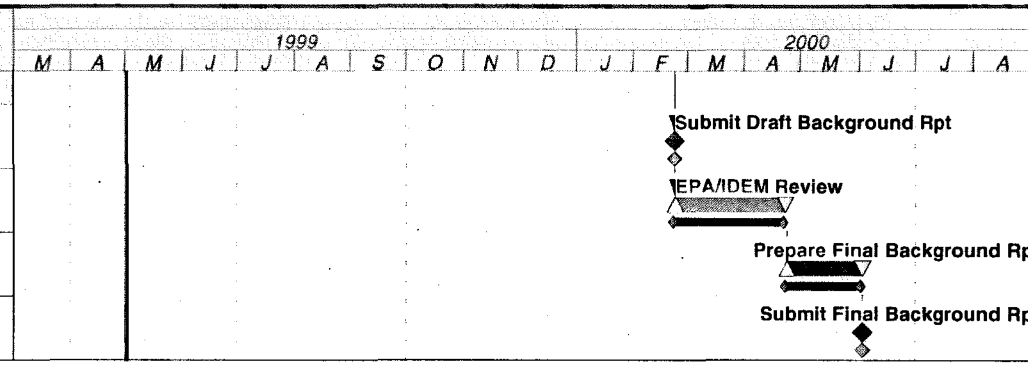
NAVA:CT83

Sheet 1 of 2

TETRA TECH NUS, INC.
NAVY CLEAN III - SDIV
TABLE 7 - 1

TetraTech NUS

Activity description	Cal ID	Early Start	Early Finish
DATA EVALUATION & REPORT			
Submit Draft Background Rpt	2		22FEB00
EPA/IDEM Review	1	23FEB00	22APR00
Prepare Final Background Rpt	2	24APR00	02JUN00
Submit Final Background Rpt	2		02JUN00



Project Start 24NOV98
Project Finish 04AUG00
Data Date 02MAY99
Run Date 20MAY99

Early Bar
Target Bar
Progress Bar
Critical Activity

NAVA:CT83

Sheet 2 of 2

TETRA TECH NUS, INC.
NAVY CLEAN III - SDIV
TABLE 7 - 1

TetraTech NUS

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APPENDIX A

FIELD FORMS

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Project Site Name: NSWC Crane
Project No.: 0087 CTO 083

[] Surface Soil
[] Subsurface Soil
[] Other: ____________
[] QA Sample Type: ____________

Sample ID No.: ____________
Sample Location: ____________
Sampled By: ____________
C.O.C. No.: ____________

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:			
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: NSWC Crane
BORING NUMBER: ____________
PROJECT NUMBER: 0087 CTO 083
DATE: ____________
DRILLING COMPANY: not applicable
GEOLOGIST: ____________
DRILLING METHOD: hand auger
DRILLER: ____________

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION			USCS *	Remarks	PID/FID Reading (ppm)			
					Soil Density/ Consistency or Rock Hardness	Color	Material Classification			Sample	Sampler BZ	Borehole**	Driller BZ**

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): ______

Remarks: ____

Converted to Well: Yes ______ No ______ Well I.D. #: ____________

EQUIPMENT CALIBRATION LOG

INSTRUMENT NAME/MODEL : ________________________________

SERIAL NUMBER: ______________________________________

MANUFACTURER : ______________________________________

PROJECT NAME : NSWC Crane

PROJECT NUMBER : __'0087_CTO 083___________

CALIBRATION DATE	INITIAL SETTINGS	STANDARDS USED	PROCEDURE	ADJUSTMENTS MADE	FINAL SETTINGS	SIGNATURE	COMMENTS

Instrument Rented From: ____

TETRA TECH NUS, INC.
661 Andersen Drive • Pittsburgh, PA 15220

NSWC CRANE, INDIANA

CHAIN OF CUSTODY RECORD

PROJECT NO.:

SAMPLERS (SIGNATURE): (1)

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS	VOLATILES	DISSOLVED GASES	SULFIDE	TOX	SEMIVOLATILES	EXPLOSIVES	METALS	CYANIDE	PESTICIDES/PCBS	HERBICIDES	DIOXINS/FURANS	TOC	SULFATE	AMMONIA	CHLORIDE	PHOSPHORUS	(8)	(8)	TAG NO.	REMARKS
(2)	(3)	(4)	(5)	(6)	(6)	(7)	(7)	(6)	(6)	(6)	(7)	(6)	(6)	(6)	(7)	(7)	(7)	(7)	(7)	(9)	(9)	(10)	(11)

RELINQUISHED BY (SIGNATURE):	DATE/TIME		RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE/TIME	
(12)	(13)	(14)	(15)	(12)	(13)	(14)

RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE/TIME		RECEIVED FOR LAB BY (SIGNATURE):	DATE/TIME	
(15)	(12)	(13)	(14)	(16)	(17)	(18)

AIR BILL NO.: (19)

TEMP. BLANK: AT SHIPMENT (20) °C AT LAB (21) °C

COOLER CUSTODY SEAL NOS: (22)

REMARKS:
(23)

APPENDIX B

STANDARD OPERATING PROCEDURES

APPENDIX B

STANDARD OPERATING PROCEDURES

SOP Number	Title
CTO 83-1	Borehole Advancement and Soil Sampling using a Hand Auger
CTO 83-2	Selection of Soil Samples for Chemical Analysis
CTO 83-3	Sample Handling, Preservation, Packaging, and Shipping
CTO 83-4	Borehole and Sample Logging
CTO 83-5	Sample Custody and Field Documentation
CTO 83-6	Decontamination of Field Equipment
CTO 83-7	Use of the Photoionization Detector

STANDARD OPERATING PROCEDURE
NUMBER CTO83-1

BOREHOLE ADVANCEMENT AND SOIL SAMPLING USING A HAND AUGER

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe the procedures for advancement and soil sampling using a hand auger for the background soil investigation at NSWC Crane.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Writing utensil
Non-Latex Gloves
Boring Log
Sample Logsheets
Complete hand auger assembly (stainless steel bucket bits, a series of extension rods (available in 2', 3', 4' and 5' lengths, and a "T" cross handle).
Stainless-steel mixing bowls
Disposable plastic trowel or Stainless-steel trowel
Required sample containers with appropriate preservative: All sample containers for analysis by fixed-base laboratories will be supplied and deemed certified clean by the laboratory.
Required Decontamination Materials

3.0 PROCEDURES FOR ADVANCEMENT OF BOREHOLE AND SOIL SAMPLING USING A BUCKET AUGER

3.1 Clear the area to be sampled of any surface debris (herbaceous vegetation, twigs, rocks, litter, etc.).

3.2 Attach a properly decontaminated bucket bit to a clean extension rod and further attach the cross handle to the extension rod.

3.3 Begin augering by turning the "T" handle in a clock-wise fashion, thus turning the auger bit until the bucket bit is advanced approximately 6 inches into the soil. Add additional rod extensions as necessary to reach the desired depth.

3.4 After reaching the desired depth, slowly and carefully withdraw the bucket from the borehole.

3.5 Discard the top of core (approximately 1"), which represents any loose material collected by the bucket bit before penetrating the desired sample depth.

3.6 Utilizing the hand trowel remove the sample material from bucket bit into a properly decontaminated stainless steel mixing bowl.

3.7 Log the recovered sample on the Boring Log sheet (provided in Appendix A) per SOP CT083-4.

3.8 Return the same bucket auger into the borehole and turn the auger as stated in step 3.3, advancing the auger bit an additional 6 inches into the soil (totaling 1 foot).

3.9 After reaching the desired depth, slowly and carefully withdraw the bucket from the borehole.

3.10 Discard the top of core (approximately 1"), which represents any loose material collected by the bucket bit before penetrating the desired sample depth.

3.11 Utilizing the hand trowel remove sample material from bucket bit into the same stainless steel mixing bowl mentioned in step 3.6.

3.12 Log the recovered sample on the Boring Log sheet (provided in Appendix A) per SOP CT083-4.

3.13 Carefully remove gravel, vegetation, roots, twigs, litter, etc. from the sample.

3.14 Using a disposable plastic trowel or decontaminated stainless-steel trowel, thoroughly mix (homogenize) the sample material (which now contains a 1-foot interval of sample) in the mixing bowl and fill the appropriate sample bottle(s).

3.15 Fill out a soil sample logsheet (found in Appendix A) and sample labels and tags (according to CTO83-3 and CTO83-5) making sure that the appropriate fields are filled out completely and legibly and affix them to the sample bottle.

3.16 Proceed with handling each sample container as outlined in CTO83-2 and CTO83-3.

3.17 Repeat step steps 3.2 through 3.16 for each 1-foot interval until one of the following conditions have been met. If one of these conditions holds true the borehole is complete and abondonment procedures outlined in Section 5.2.1 of the Work Plan can begin.

1) A depth of 6 feet below ground surface has been reached;
2) The saturated zone is encountered;
3) Bedrock or weathered bedrock is encountered; or
4) Advancement refusal is met by the hand auger.

STANDARD OPERATING PROCEDURE
NUMBER CTO83-2

SELECTION OF SOIL SAMPLES FOR CHEMICAL ANALYSIS

1.0 PURPOSE

This SOP governs the selection of soil samples for shipment to Laucks Testing Laboratories, Inc. for Target Analyte List (TAL) metal plus tin chemical analyses. The NSWC Crane facility has been divided into four areas related to the depositional environment (DE) of soils:

- Residual Soil from Mississippian bedrock/Colluvium;
- Residual Soil from Pennsylvanian bedrock/Colluvium;
- Alluvium; and
- Glacial till/loess.

Within each DE, surface and subsurface soils will be collected at ten soil boring locations to a maximum depth of 6’. The samples will be classified according to grain size (sand, silt and clay) and placed into bottle(s). This procedure is designed to result in the selection and shipment of bottled samples to an analytical laboratory according to the following scheme:

- five samples of surface soil from each DE (= 5 samples/DE x 4 DEs = 20 samples);
- five samples of subsurface soil from each DE/grain size classification (= 5 samples/DE x 3 grain sizes/DE x 4 DEs = 60 samples).

Note: A maximum of 240 samples will be classified according to grain size. All soil samples from the 1 to 2 ft. depth interval will be discarded after grain size classification and will *not* be bottled.

Note: The distribution of soil grain size within each DE is unknown. Consequently, after completing the ten soil borings in each DE, five subsurface soils of each DE/grain size combination may not be available.

2.0 REQUIRED EQUIPMENT

Pen

SOP CTO83-4

3.0 PROCEDURE

1. Complete the 10 boreholes from a given DE. Gather all samples from a single DE.
2. Physically segregate the bottles containing surface soil (0' to 1' depth) from the subsurface soil (2' to 6' depths).
3. For surface soils within the DE, arrange the sample bottles in the order in which they were collected and letter them sequentially beginning at "A" and ending with "J".
4. Ship samples B, C, E, F, and I to the laboratory and discard the remaining five samples.
5. For subsurface soil within the DE:

5.1 Physically segregate the bottles containing subsurface soils (2-3', 3-4', 4-5', and 5-6' depths) according to the following three gross grain size classifications using SOP CTO83-4:

- Clay
- Silt
- Sand

5.2 Select samples of a single grain size for consideration.

5.2.1 Identify all boreholes that yielded at least one sample of the selected grain size and assign letters to them sequentially beginning with "A."

5.2.2 For **each** borehole that yielded more than one sample of the selected grain size:

5.2.2.1 Sequentially assign numbers to the samples for that borehole, beginning with "1."

5.2.2.2 Select one sample according to the following table:

Number of samples of the selected grain size in the borehole	Sample to be selected
2	2
3	1
4	3

5.2.2.3 Remove and discard from consideration all samples not selected in Step 5.2.2.2 and retain the selected samples.

5.2.3 Add the samples retained in Step 5.2.2.3 to those that come from boreholes yielding only one sample of the selected grain size.

5.2.4 If five or fewer samples of the selected grain size remain, set them aside for shipment to the laboratory.

5.2.5 If more than five samples of the selected grain size remain:

5.2.5.1 Assign letters to the samples beginning with "M" and progressing sequentially through the alphabet.

5.2.5.2 Select samples for shipment to the laboratory according to Table 1.

Table 1. Sample Shipment Selection Criteria.

Number of samples remaining	Borehole letters from which samples will be selected for shipment
6	M, N, O, P, Q
7	N, O, P, Q, R
8	M, N,Q, S, T
9	N, Q, R, T, U
10	P, Q, R, S, V

5.2.5.3 Set the selected samples aside for shipment to the laboratory.

5.2.5.4 Discard the remaining samples from the selected grain size.

5.3 Select the next grain size and repeat steps 5.2.1 through 5.2.5.4 until each subsurface soil grain size has been addressed for the selected DE.

6. Select samples from the next DE for consideration and repeat steps 2 through 5.3 until each DE has been addressed for surface soils, and until each DE/grain size classification has been addressed for subsurface soils.

STANDARD OPERATING PROCEDURE
NUMBER CTO83-3

SAMPLE PRESERVATION, PACKAGING, AND SHIPPING

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe the procedures for sample preservation, packaging, and shipping to be used in handling soil samples obtained for chemical analysis at NSWC Crane.

The NSWC Crane Environmental Protection Department must approve any deviations from this procedure.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Shipping labels
Custody seals
Chain-of-custody (COC) forms
Sample containers with preservatives: All sample containers for analysis by fixed-base laboratories will be supplied and deemed certified clean by the laboratory.
Sample shipping containers (coolers): All sample shipping containers are supplied by the laboratory.
Packaging material: Bubble wrap, ZipLoc bags®, strapping tape, etc.

3.0 PROCEDURES FOR SAMPLE PRESERVATION, PACKAGING, AND SHIPPING

3.1 Table 5-4 of this Work Plan/Field Sampling Plan (WP/FSP) establishes requirements for sample preservation. The laboratory provides sample containers that are certified clean for the analytical parameter for which the sample is to be analyzed. All samples will be held, stored, and shipped at 4°C ±2°C. This will be accomplished through refrigeration (used to hold samples prior to shipment) and/or ice.

3.2 The sampler shall maintain custody of the samples until the samples are relinquished to another custodian or to the common carrier.

3.3 Check that the sample container is properly identified on the label and tag, the lid securely fastened, and the container sealed in a ZipLoc bag.

3.4 Place the sample container into a bubble-out shipping bag and seal the bag using the self-sealing, pressure sensitive tape supplied with the bag.

3.5 Inspect the insulated shipping cooler. Check for any cracks, holes, broken handles, etc. If the cooler has a drain plug, make certain it is sealed shut. If the cooler is questionable for shipping, the cooler must be discarded.

3.6 Place the sample container into a shipping cooler in an upright position (containers will be upright). Continue filling the cooler with samples and packing material until the cooler is full and the movement of the sample containers is limited.

3.7 Place a temperature blank in the cooler. Record the temperature of the temperature blank on the COC.

3.8 Fill the voids in between the bubble-out shipping bags with ice and continue filling the cooler with ice to the top, using a minimum of eight pounds of ice for a medium-size cooler.

3.9 Complete a Chain of custody form (COC) for each cooler. List on the COC each sample bottle contained in the cooler. Include the air bill number on the COC. Use a ballpoint pen and make sure that all of the carbon forms are legible. SOP CTO83-5 contains instructions for completing the COC.

3.10 Place the original (top) signed copy of the COC form, listing only those samples contained in that particular cooler, inside a large ZipLoc bag. Tape the bag to the inside of the lid of the shipping cooler.

3.11 Close the cooler and seal the cooler with approximately four wraps of strapping tape at each end of the cooler. Prior to wrapping the last wrap of strapping tape, apply a signed, numbered, and dated custody seal to each side of the cooler (a total of four signed custody seals must be used per cooler). Cover the custody seal with the last wrap of tape. This will provide a tamper evident custody seal system for the sample shipment. SOP CTO83-5 contains instructions for completing the custody seal.

3.12 Affix a shipping label to the top of the cooler containing all of the shipping information.

Overnight (e.g. FedEx Priority Overnight) courier services will be used for all sample shipments. Include the air bill number on the COC.

3.13 All samples will be shipped to the laboratory no more than 24 hours after completion of sampling of a given depositional environment. Under no circumstances will sample holding times be exceeded (See Table 5-4 of the WP/FSP).

STANDARD OPERATING PROCEDURE
NUMBER CTO83-4

BOREHOLE AND SOIL SAMPLE LOGGING

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe the standard procedures and technical guidance on borehole and sample logging at NSWC Crane.

The NSWC Crane Environmental Protection Department must approve any deviations from this procedure.

2.0 FIELD FORMS AND EQUIPMENT

Knife
Ruler (marked in tenths and hundredths of feet)
Boring Log
Writing utensil

3.0 RESPONSIBILITIES

A field geologist/engineer is responsible for supervising all boring activities and assuring that each borehole is properly and completely

4.0 PROCEDURES FOR BOREHOLE AND SAMPLE LOGGING

To maintain a consistent classification of soil, it is imperative that the field geologist understand and accurately use the field classification system described in this SOP. This identification is based on visual examination and manual tests.

4.1 USCS Classification

Soils are to be classified according to the Unified Soil Classification System (USCS). This method of classification is detailed in Figure 1 (Continued).

FIGURE 1

UNIFIED SOIL CLASSIFICATION (USCS)

FIELD IDENTIFICATIONPROCEDURES
(Excluding Particles Larger Than 3 Inches and Basing Fractions on Estimated Weights

COARSE-GRAINED SOILS
More Than Half of Material is LARGER Than No. 200 Sieve Sizes

			GROUP SYMBOL	TYPICAL NAMES
GRAVELS (50%(+)>1/4"∅	CLEAN GRAVELS (Low % Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
		Predominantly one size or a range of sizes with some intermediate sizes missing.	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines.
	GRAVELS W/FINES (High % Fines)	Non-plastic fines (for identification procedures, see ML)	GM	Silty gravels, poorly graded gravel-sand-silt mixtures.
		Plastic fines (for identification procedures, see CL)	GC	Clayey gravels, poorly graded gravel-sand-clay mixtures.
SANDS 50%(+)<1/4"∅	CLEAN SANDS (Low % Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	SW	Well graded sand, gravelly sands, little or no fines.
		Predominantly one size or a range of sizes with some intermediate sizes missing.	SP	Poorly graded sands, gravelly sands, little or no fines.
	SANDS W/FINES (High % Fines)	Non-plastic fines (for identification procedures, see MCL)	SM	Silty sands, poorly graded sand-silt mixtures.
		Plastic fines (for identification procedures, see CL)	SC	Clayey sands, poorly graded sand-clay mixtures.

FINE-GRAINED SOILS
More Than Half of Material is SMALLER Than No. 200 Sieve Size

FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger Than 3 Inches and Basing Fractions on Estimated Weights)				GROUP SYMBOL	TYPICAL NAMES
Identification Procedures on Fraction Smaller than No. 40 Sieve Size					
	DAY STRENGTH (Crushing Characteristics)	DILATANCY (Reaction to Shaking)	TOUGHNESS (Consistency Near Plastic Limit)		
SILTS AND CLAYS Liquid Limit <50	None to Slight	Quick to Slow	None	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity.
	Medium to High	None to Very Slow	Medium	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
	Slight to Medium	Slow	Slight	OL	Organic silts and organic silt-clays of low plasticity.
SILTS AND CLAYS Liquid Limit >50	Slight to Medium	Slow to None	Slight to Medium	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
	High to Very High	None	High	CH	Inorganic clays of high plasticity, fat clays.
	Medium to High	None to Very Slow	Slight to Medium	OH	Organic clays of medium to high plasticity.
HIGHLY ORGANIC SOILS	Readily identified by color, odor, spongy feel and frequently by fibrous texture.			Pt	Peat and other organic soils

Boundary classifications: Soils possessing characteristics of two groups are designated by combining group symbols. For example, GW-GC, well graded gravel-sand mixture with clay binder.
All sieve sizes on this chart are U.S. Standard.

DENSITY OF GRANULAR SOILS

DESIGNATION	STANDARD PENETRATION RESISTANCE-BLOWS/FOOT
Very Loose	0-4
Loose	5-10
Medium Loose	11-30
Dense	31-50
Very Dense	Over 50

CONSISTENCY OF COHESIVE SOILS

CONSISTENCY	UNC COMPRESSIVE STRENGTH (TONS/SQ. FT.)	STANDARD PENETRATION RESISTANCE-BLOWS/FOOT	FIELD IDENTIFICATION METHODS
Very Soft	Less than 0.25	0 to 2	Easily penetrated several inches by fist
Soft	0.25 to 0.50	2 to 4	Easily penetrated several inches by thumb.
Medium Stiff	0.50 to 1.0	4 to 8	Can be penetrated several inches by thumb.
Stiff	1.0 to 2.0	8 to 15	Readily indented by thumb.
Very Stiff	2.0 to 4.0	15 to 30	Readily indented by thumbnail.
Hard	More than 4.0	Over 30	Indented with difficulty by thumbnail.

This method of classification identifies soil types on the basis of grain size and cohesiveness.

Fine-grained soils, or fines, are smaller than the No. 200 sieve and are of two types: silt (M) and clay (C). Some classification systems define size ranges for these soil particles, but for field classification purposes, they are identified by their respective behaviors. Organic material (O) is a common component of soil but has no size range; it is recognized by its composition. The careful study of the USCS will aid in developing the competence and consistency necessary for the classification of soils.

Coarse-grained soils shall be divided into rock fragments, sand, or gravel. The terms sand and gravel not only refer to the size of the soil particles but also to their depositional history. To insure accuracy in description, the term rock fragments shall be used to indicate angular granular materials resulting from the breakup of rock. The sharp edges typically observed indicate little or no transport from their source area, and therefore the term provides additional information in reconstructing the depositional environment of the soils encountered. When the term "rock fragments" is used it shall be followed by a size designation such as "(1/4 inchΦ-1/2 inchΦ)" or "coarse-sand size" either immediately after the entry or in the remarks column. The USCS classification would not be affected by this variation in terms.

4.2 Color

Soil colors shall be described utilizing a single color descriptor preceded, when necessary, by a modifier to denote variations in shade or color mixtures. A soil could therefore be referred to as "gray" or "light gray" or "blue-gray." Since color can be utilized in correlating units between sampling locations, it is important for color descriptions to be consistent from one boring to another.

Colors must be described while the sample is still moist. Soil samples shall be broken or split vertically to describe colors. Samplers tend to smear the sample surface creating color variations between the sample interior and exterior.

The term "mottled" shall be used to indicate soils irregularly marked with spots of different colors. Mottling in soils usually indicates poor aeration and lack of good drainage.

4.3 Relative Density and Consistency

To classify the relative density and/or consistency of a soil, the geologist is to first identify the soil type. Granular soils contain predominantly sands and gravels. They are noncohesive (particles do not adhere well when compressed). Finer-grained soils (silts and clays) are cohesive (particles will adhere together when compressed).

Granular soils are given the USCS classifications GW, GP, GM, SW, SP, SM, GC, or SC (see Figure 1).

The consistency of cohesive soils is determined by performing field tests and identifying the consistency as shown in Figure 2.

Cohesive soils are given the USCS classifications ML, MH, CL, CH, OL, or OH (see Figure 1).

The consistency of cohesive soils is determined by hand by determining the resistance to penetration by the thumb. The thumb determination methods are conducted on a selected sample of the soil, preferably the lowest 0.5 foot of the sample. The sample shall be broken in half and the thumb pushed into the end of the sample to determine the consistency. Do not determine consistency by attempting to penetrate a rock fragment. If the sample is decomposed rock, it is classified as a soft decomposed rock rather than a hard soil. One of the other methods shall be used in conjunction with it. The designations used to describe the consistency of cohesive soils are shown in Figure 2.

FIGURE 2

CONSISTENCY FOR COHESIVE SOILS

Consistency	Standard Penetration Resistance (Blows per Foot)	Unconfined Compressive Strength (Tons/Sq. Foot by pocket penetration)	Field Identification
Very soft	0 to 2	Less than 0.25	Easily penetrated several inches by fist
Soft	2 to 4	0.25 to 0.50	Easily penetrated several inches by thumb
Medium stiff	4 to 8	0.50 to 1.0	Can be penetrated several inches by thumb with moderate effort
Stiff	8 to 15	1.0 to 2.0	Readily indented by thumb but penetrated only with great effort
Very stiff	15 to 30	2.0 to 4.0	Readily indented by thumbnail
Hard	Over 30	More than 4.0	Indented with difficulty by thumbnail

4.4 Weight Percentages

In nature, soils are comprised of particles of varying size and shape, and are combinations of the various grain types. The following terms are useful in the description of soil:

Terms of Identifying Proportion of the Component	Defining Range of Percentages by Weight
Trace	0 - 10 percent
Some	11 - 30 percent
Adjective form of the soil type (e.g., "sandy")	31 - 50 percent

Examples:

- Silty fine sand: 50 to 69 percent fine sand, 31 to 50 percent silt.
- Medium to coarse sand, some silt: 70 to 80 percent medium to coarse sand, 11 to 30 percent silt.
- Fine sandy silt, trace clay: 50 to 68 percent silt, 31 to 49 percent fine sand, 1 to 10 percent clay.
- Clayey silt, some coarse sand: 70 to 89 percent clayey silt, 11 to 30 percent coarse sand.

4.5 Moisture

Moisture content is estimated in the field according to four categories: dry, moist, wet, and saturated. In dry soil, there appears to be little or no water. Saturated samples obviously have all the water they can hold. Moist and wet classifications are somewhat subjective and often are determined by the individual's judgment. A suggested parameter for this would be calling a soil wet if rolling it in the hand or on a porous surface liberates water, i.e., dirties or muddies the surface. Whatever method is adopted for describing moisture, it is important that the method used by an individual remains consistent throughout an entire drilling job.

4.6 Summary of Soil Classification

In summary, soils shall be classified in a similar manner by each geologist/engineer at a project site. The hierarchy of classification is as follows:

- Density and/or consistency
- Color
- Plasticity (Optional)
- Soil types
- Moisture content
- Other distinguishing features

4.7 Classification of Soil Grain Size for Chemical Analysis

To determine the gross grain size classification (e.g., clay, silt, and sand) from the USCS classification described above, the following table shall be used. This step is necessary for selecting the appropriate samples for chemical analysis as described in SOP CTO83-2.

Gross Soil Grain Size Classification	USCS Abbreviation	Description
Clay	CL	inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays,
	CH	inorganic clays of high plasticity, fat clays
	OH	organic clays of medium to high plasticity, organic silts
Silt	ML	inorganic silts and very fine sands, rock four, silty or clayey fine sands with slight plasticity
	OL	organic silts and organic silty clays of low plasticity
	MH	inorganic silts, micaceous or diatomaceous fine sand or silty soils
Sand	SW	well graded sands, gravelly sands, little or no fines
	SP	poorly graded sands, gravelly sands, little or no fines
	SM	silty sands, sand-silt mixtures
	SC	clayey sands, sand-clay mixtures

STANDARD OPERATING PROCEDURE
NUMBER CTO 83-5

SAMPLE CUSTODY AND DOCUMENTATION OF FIELD ACTIVITIES

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish the procedures for sample custody and documentation of field sampling and field analyses activities. Forms are provided along with instructions on how to complete each form.

The Naval Surface Warfare Center (NSWC) Crane Environmental Protection Department must approve any deviations from this procedure.

2.0 FIELD FORMS LIST

The following log books, forms, labels, and tags are required.

Site Log Book
Field Log Book
Sample label and tag
Chain-of-Custody
Custody seal
Boring Log
Equipment Calibration Log Sheet
Soil Sample Log Sheet

3.0 PROCEDURES

This section describes custody and documentation procedures. All entries made into the log books, custody documents, logs, and log sheets described in this SOP must be made in indelible ink (black is preferred). No erasures are permitted. If an incorrect entry is made, the entry shall be crossed out with a single strike mark, initialed, and dated.

3.1 Site Log Book

The site log book is a hardbound, paginated, controlled-distribution record book in which all major onsite activities are documented. At a minimum, the following activities/events shall be recorded (daily) in the site log book:

- All field personnel present
- Arrival/departure of site visitors
- Arrival/departure of equipment
- Start or completion of sampling activities
- Daily onsite activities performed each day
- Sample pickup information
- Health and Safety issues
- Weather conditions

The site log book is initiated at the start of the first onsite activity (e.g., site visit or initial reconnaissance survey). Entries are to be made for every day that onsite activities take place.

The following information must be recorded on the cover of each site log book:

- Project name
- Project number
- Book number
- Start date
- End date

Information recorded daily in the site log book need not be duplicated in other field notebooks, but must summarize the contents of these other notebooks and refer to specific page locations in these notebooks for detailed information (where applicable). At the completion of each day's entries, the site log book must be signed and dated by the Field Operations Leader (FOL).

Upon completion of the fieldwork or when completely filled, the Site Log Book is stored in the NSWC Crane records repository.

3.2 Field Log Books

The Field Log Book is a separate dedicated notebook used by field personnel, as needed, to document the activities in the field. This notebook is hardbound and paginated.

Upon completion of the fieldwork or when completely filled, Field Log Books are stored in the NSWC Crane records repository.

3.3 Sample Label and Tag

Adhesive sample container labels must be completed and applied to every sample container. Each adhesive label is numbered. A second, identical (including number) adhesive sample label will be completed and affixed onto a tag that will be attached to the neck of the sample container with string. Once the laboratory receives the sample, the tag will be removed from the sample container and returned to the task manager. Sample tags will be stored in the NSWC Crane records repository. Attachment 1 contains a sample label and tag.

3.4 Chain-of-Custody Form

The Chain-of-Custody (COC) is a multi-part form that is initiated as samples are acquired and accompanies a sample (or group of samples) as they are transferred from person to person. Each COC is numbered. This form must be used for any samples collected for laboratory chemical analysis. The original (top) signed copy of the COC form shall be placed inside a large Ziploc-type bag and taped inside the lid of the shipping cooler. If multiple coolers are sent, a separate COC must be included with each cooler and reflect the sample containers in that particular cooler. Once the samples are received at the laboratory, the sample custodian checks the contents of the cooler against the enclosed COC. Any problems are noted on the enclosed COC form (discrepancies between the sample labels, tags, COC form, etc.) and will be resolved through communication between the laboratory point-of-contact and the task manager. The COC form is signed and retained by the laboratory and becomes part of the sample's corresponding analytical data package.

The number of each COC associated with a monitoring point is recorded in the Site Log Book. Each COC is placed into a binder and stored in the NSWC Crane records repository. Attachment 2 contains a sample COC. Appendix A contains an example COC.

3.5 Custody Seal

The Custody Seal is an adhesive-backed label with a number on each seal. It is part of a chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field and sealed in coolers for transit to the laboratory. The Custody Seals are signed and dated by the samplers and affixed across the opening edges of each cooler (four seals per medium to larger coolers; two seals per small cooler) containing environmental samples. The laboratory sample custodian will examine the Custody Seal for evidence of tampering and will notify the task manager if evidence of tampering is observed. The number of each custody seal is recorded on the COC. Attachment 3 contains a sample custody seal.

3.6 Equipment Calibration Log

The Equipment Calibration Log is used to document calibration of measuring equipment (e.g. multi-parameter water quality meter) used in the field. All Equipment Calibration Logs are numbered. The Equipment Calibration Log documents that the manufacturer's instructions were followed for calibration of the equipment, including frequency and type of standard or calibration device. An Equipment Calibration Log must be maintained for each electronic measuring device requiring calibration. Entries must be made for each day the equipment is used.

The number of each Equipment Calibration Log associated with a monitoring point is recorded in the Site Log Book. Each calibration log is placed into a binder and stored in the NSWC Crane records repository. Attachment 4 contains a sample equipment calibration log. Appendix A contains an example Equipment Calibration Log sheet.

3.7 Boring Log Sheet

The Boring Log Sheet is used to lithology encountered during advancement of the boring. This sheet is used in conjunction with the borehole advancement procedures outlined SOP CTO83-1 and the lithologic documentation process outlined in SOP CTO83-4. Appendix A contains an example Boring Log Sheet.

3.8 Soil Sample Log Sheet

The soil sample Log Sheet is used to document the samples taken from each boring. This sheet is used in conjunction with SOP CTO83-1 and SOP CTO83-4. Attachment 5 contains a sample soil sample log sheet. Appendix A contains an example Soil Sample Log Sheet.

ATTACHMENT 1

SAMPLE LABEL AND TAG

INSTRUCTIONS FOR COMPLETION OF SAMPLE LABELS AND TAGS

Sample labels and tags are used to document sample ID, date, time, tag number, analysis, preservative, matrix, sampler, laboratory, and gross grain size classification. For each sample, a label and a tag will be completed and attached to the sample container. The label and tag for each sample container are identical.

1 Enter the sample date.
2 Enter the time that the sample container was filled, in military time.
3 Enter the sampler's initials.
4 Circle the gross grain size classification (i.e., clay, silt, or sand) according to SOP CTO83-4.

Example Sample ~~Tag~~ Label

Tetra Tech NUS, Inc. 661 Andersen Drive Pittsburgh, 15220 (412)921-7090	**Project:** CTO 038 **Location:** NSWC CRANE	
Sample No: BGSBP0401		Tag # : A0001
Date: (1)	Time: (2)	Preserve: 4° C
Analysis: TAL Metals + Tin		Matrix: SOIL
Sampled By: (3)		Laboratory: LAUCKS
Grain Size: Clay Silt Sand		

Example Sample Tag

Tetra Tech NUS, Inc. 661 Andersen Drive Pittsburgh, 15220 (412)921-7090	**Project:** CTO 038 **Location:** NSWC CRANE	
Sample No: BGSBP0401		Tag # : A0001
Date: (1)	Time: (2)	Preserve: 4° C
Analysis: TAL Metals + Tin		Matrix: SOIL
Sampled By: (3)		Laboratory: LAUCKS
Grain Size: Clay Silt Sand		

ATTACHMENT 2

CHAIN-OF-CUSTODY

INSTRUCTIONS FOR COMPLETION OF THE CHAIN OF CUSTODY RECORD

The Chain-of-Custody Record (COC) is a multi-part, standardized form designed to summarize and document pertinent sample information such as sample identification and type, matrix, date and time of collection, preservation, and requested analyses. Furthermore, through the sequential signatures of various sample custodians (e.g., sampler, airbill number, laboratory sample custodian), the COC report documents sample custody and tracking.

1 Enter the signature of the person(s) that sampled this monitoring point.
2 Enter the date that the sample was collected.
3 Enter the time (in military time) that the sample was collected.
4 Enter the sample’s alpha numeric tracking number.
5 Enter the number of containers associated with the corresponding date and time.
6 Enter the a check mark for the required analysis. Since only metals is to be conducted for this investigation only the metals box should be checked. Add “TAL + tin” in the space provided beside the word “Metals”.
7 Because none of these parameters are to be analyzed for this investigation disregard these fields and leave these spaces blank.
8 If additional analyses are required that differ from the preprinted analyses, these spaces will serve as a place for that additional analysis.
9 A check mark will be placed here to indicate to the laboratory that this parameter is to be analyzed.
10 Enter the number from the corresponding sample tag that is tied to the neck of the sample container.
11 Enter any remarks (duplicate, MS/MSD, low sample volume, etc.) that relate to anything out of the ordinary with a particular sample. This remarks column is for field personnel comments only.
12 Enter the signature of the person who relinquishes the sample cooler to another person. The first “relinquished by” space should be that of the sampler(s).
13 Enter the date that the sample cooler was relinquished.
14 Enter the time (using military time) that the sample cooler was relinquished.
15 Enter the signature of the person receiving the sample cooler from the relinquisher.
16 Enter the signature of the person receiving the sample cooler for the laboratory.
17 Enter the date that the laboratory received the sample cooler.
18 Enter the time (in military time) that the laboratory received the sample cooler.
19 Enter the airbill number from the courier’s shipping label.
20 Enter the temperature of the Temperature Blank (in degrees Celsius) at shipping.
21 Enter the temperature of the Temperature Blank (in degrees Celsius) upon arrival of the sample cooler at the laboratory.
22 Enter the numbers of the cooler custody seals used to ship that cooler.
23 This space is for remarks by the laboratory only.

TETRA TECH NUS, INC.
661 Andersen Drive • Pittsburgh, PA 15220

CHAIN OF CUSTODY RECORD

NSWC CRANE, INDIANA

PROJECT NO.:

SAMPLERS (SIGNATURE):
(1)

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS	VOLATILES	DISSOLVED GASES	SULFIDE	TOX	SEMIVOLATILES	EXPLOSIVES	METALS	CYANIDE	PESTICIDES/PCBS	HERBICIDES	DIOXINS/FURANS	TOC	SULFATE	AMMONIA	CHLORIDE	PHOSPHORUS	(8)	(8)	TAG NO.	REMARKS
(2)	(3)	(4)	(5)	(6)	(6)	(7)	(7)	(6)	(6)	(6)	(7)	(6)	(6)	(6)	(7)	(7)	(7)	(7)	(7)	(9)	(9)	(10)	(11)

RELINQUISHED BY (SIGNATURE):	DATE/TIME		RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE/TIME	
(12)	(13)	(14)	(15)	(12)	(13)	(14)

RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE/TIME		RECEIVED FOR LAB BY (SIGNATURE):	DATE/TIME	
(15)	(12)	(13)	(14)	(16)	(17)	(18)

AIR BILL NO.: (19)

TEMP. BLANK: AT SHIPMENT (20) °C AT LAB (21) °C

COOLER CUSTODY SEAL NOS: (22)

REMARKS:
(23)

ATTACHMENT 3

CUSTODY SEAL

INSTRUCTIONS FOR COMPLETION OF CUSTODY SEALS

Custody seals are tamper-evident self-sticking labels. The seals are used in conjunction with strapping tape to seal coolers containing samples and COC(s) for shipment to the laboratory.

1 Enter date cooler is sealed.
2 Enter signature.

Note: Four custody seals will be used on a medium size cooler.

ATTACHMENT 4

EQUIPMENT CALIBRATION LOG SHEET

INSTRUCTIONS FOR COMPLETION OF THE EQUIPMENT CALIBRATION LOG

This field form is used to document equipment calibration. One equipment calibration log will be completed for each piece of equipment calibrated. The calibration log is to be used for all on site equipment calibration (all columns on the form may not apply to each instrument).

1 Enter instrument make and model.
2 Enter instrument serial number.
3 Enter name of instrument manufacturer.
4 Use this column to enter instrument calibration date.
5 Use this column to enter instrument initial settings.
6 Use this column to enter standards used during calibration.
7 Use this column to enter procedures used during calibration, i.e. as per instrument manual.
8 Use this column to enter any adjustments made to the instruments.
9 Use this column to enter instruments final settings.
10 Enter personnel signature.
12 Enter comments pertaining to the calibration of the instrument.
13 Enter the name of the rental company that the instrument was rented from.

NSWC Crane
Field Form
Revison: 0
January 1999

EQUIPMENT CALIBRATION LOG

INSTRUMENT NAME/MODEL : __________(1)____________________ PROJECT NAME : NSWC Crane

SERIAL NUMBER: ____________(2)_______________________ PROJECT NUMBER : ______________

MANUFACTURER : ____________(3)_________________________

CALIBRATION DATE	INITIAL SETTINGS	STANDARDS USED	PROCEDURE	ADJUSTMENTS MADE	FINAL SETTINGS	SIGNATURE	COMMENTS
(4)	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**

Instrument Rented From: _________(12)_________________

ATTACHMENT 5

SOIL SAMPLE LOG SHEET

INSTRUCTIONS FOR COMPLETION OF THE SOIL SAMPLE LOG SHEET

This field form is used to document date, times, and additional data at soil sampling locations.

1 Enter the sample ID number.
2 Enter the sample location, i.e. BA 1, BA2, and BA3.
3 Print the name of the sampler(s).
4 Enter the C.O.C. number associated with samples taken on this form.
5 Check surface or subsurface soil sample.
6 Enter date sampled.
7 Enter sample time, using military time.
8 Enter sample method (i.e., hand auger).
9 Enter depth sample was taken.
10 Enter color of sample.
11 Enter sample description (following SOP CTO83-4 as will fit in the box).
12 Enter PID reading.
13 Enter the analysis to be conducted on the sample
14 Enter the container requirements for that particular sample
15 Place a check mark indicating that the sample was collected
16 Enter observations/notes or other important information not input in Steps 1 through 15.
17 Draw a sketch of the sample location
18 Circle if a MS sample was taken at this sample interval
19 Enter, if taken, Duplicate ID number; if none was taken, enter No.
20 Enter sampler's signature(s).

Tetra Tech NUS, Inc.

SOIL SAMPLE LOG SHEET

Page___ of ___

Project Site Name: NSWC Crane
Project No.: 0087

Sample ID No.: 1
Sample Location: **2**
Sampled By: **3**
C.O.C. No.: **4**

5 [] Surface Soil
[] Subsurface Soil
[] Other: ______
[] QA Sample Type: ______

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

		Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:	**6**	**9**	**10**	**11**
Time:	**7**			
Method:	**8**			
Monitor Reading (ppm)	**12**			

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
13	**14**	**15**	

OBSERVATIONS / NOTES:

16

MAP:

17

Circle if Applicable:

MS/MSD	Duplicate ID No.:
18	**19**

Signature(s):

20

STANDARD OPERATING PROCEDURE
NUMBER CTO 83-6

DECONTAMINATION OF FIELD SAMPLING EQUIPMENT

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish the procedures to be followed when decontaminating non-dedicated field sampling equipment.

The NSWC Crane Environmental Protection Department must approve any deviations from this procedure.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Field Log Book
Potable water
Deionized water
LiquiNox detergent
Brushes, spray bottles, paper towels, etc.

3.0 DECONTAMINATION PROCEDURES

3.1 Decontaminate non-dedicated sampling equipment prior to field sampling and between samples.

3.2 Rinse the equipment with potable water. Rinsing may be conducted by spraying with water from a spray bottle or by dipping. Collect the potable water rinsate into a container.

3.3 Wash the equipment with a solution of LiquiNox detergent. Prepare the LiquiNox wash solution in accordance with the instructions on the LiquiNox container. Collect the LiquiNox wash solution into a container. Use brushes or sprays as appropriate for the equipment.

3.4 Rinse the equipment with potable water. Rinsing may be conducted by spraying with water from a spray bottle or by dipping. Collect the potable water rinsate into a container.

3.5 Rinse the equipment with deionized water. Rinsing may be conducted by spraying with water from a spray bottle or by dipping. Collect the deionized water rinsate into a container.

3.6 Remove excess water by air drying, shaking, or by wiping with paper towels as necessary.

3.7 Document decontamination by recording it in the Field Log Book.

3.8 Containerized decontamination solutions will be managed in accordance with the procedures described in section 5.2.9 of this Work Plan/Field Sampling Plan.

STANDARD OPERATING PROCEDURE
NUMBER CTO 83-7

USE OF PHOTOIONIZATION DETECTOR

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish procedures for the use, maintenance, and calibration of the photoionization detector (PID). The Photovac 2020 Photoionization Air Monitor will be used for the Background Investigation. The procedures for it's use are discussed in detail in the following sections.

2.0 GLOSSARY

Electron volt (eV) - A unit of energy equal to the energy acquired by an electron when it passes through a potential difference of 1 volt in a vacuum. It is equal to $1.602192 \pm 0.000007 \times 10^{-19}$ volts.

Intrinsically Safe (I.S.) - Based on wiring, configuration, design, operation, gasketing, construction, this instrument may be employed within locations in which flammable gases and/or vapors may exist.

Ionization Potential (I.P.) - The energy required to remove an electron from a molecule yielding a positively charged ion and a negatively charged free electron. The instrument measures this energy level.

Photoionization Detector (PID) - Photoionization detector employed as general reference to air monitors of this type. PIDs detection method employs ultraviolet (UV) radiation as an energy source. As air and contaminant are drawn through the ionization chamber the UV light source causes the contaminant with ionization potentials equal to or less than the UV source to break into positive and negatively charge ions. The created ions are subjected to an electrostatic field. The voltage difference is measured in proportion to the calibration reference and the concentration of the contaminant.

Ultraviolet Radiation (UV) - Ultraviolet radiation is the energy source employed by the instrument to ionize collected sample gas streams. The UV lamp source is required to be equal to or greater than the ionization potential of the substance drawn through the instrument in order to create separate ionized species.

3.0 REQUIRED EQUIPMENT

Pen

Equipment Calibration Form

4.0 PROCEDURES

4.1 Principle of Operation

The Photovac portable photoionizer detects the concentration of many organic (and a few inorganic). The basis for detection of this instrument is the ionization of components of captured gaseous streams. The incoming gas molecules are subjected to ultraviolet (UV) radiation, which is energetic enough to ionize many gaseous compounds. Molecules are transformed into charged-ion pairs, creating a current between two electrodes. Each molecule has a characteristic ionization potential, which is the energy required to remove an electron from the molecule, yielding a positively-charged ion and the free electron. The instrument measures this energy level.

This instrument measures the concentration of airborne photoionizable gases and vapors and automatically displays and records these concentrations. It does not distinguish between individual substances. Readings displayed represent the total concentration of all photoionizable chemicals present in the sample. This instrument is factory set to display concentration in units of ppm or mg/m^3. The meter display updates itself once per second.

2020 also performs short-term exposure limit (STEL), time-weighted average (TWA) and PEAK calculations. You can view any of these results, but only one mode may be viewed at a time.

2020 has 6 keys for alphanumeric entry and for accessing multiple functions. The keys are used to set up and calibrate 2020. They allow you to manipulate the concentration data in various ways.

All information entered with the keys and stored in 2020's memory is retained when the instrument is switched off. The clock and calendar continue to operate and do not need to be set each time 2020 is turned on.

4.1.1 Displays

The 2020 has a meter display for reporting detected concentration, and a display used to display status information and guide you through configuration options. All functions of the 2020 will be controlled or reported using one of these displays.

4.1.1.1 <u>Meter Display</u>

The meter display is a 4-digit display. It will always be used for reporting detected concentration. When the detector and pump are off, the meter display will be blank.

In order to accommodate the range of concentrations 2020 can detect, the meter reading will be reported using one of 2 resolutions. A resolution of 0.1 will be used for concentrations below 100 ppm, and a resolution of 1 will be used for concentrations above 100 ppm.

4.1.1.2 <u>Status Display</u>

The status display is a 2 line by 16 character display. The top line is used to display status information and prompts you for information. The bottom line is used for soft key names. Up to 3 names can be displayed for the 3 soft keys. If a name does not appear for a soft key, then the soft key has no associated function.

4.1.2 Keys

4.1.2.1 <u>Fixed Keys</u>

The three round keys below the soft keys each have a fixed function. The first key is the ON/OFF key, the middle key is the EXIT key, and the last key is the ENTER key.

The ON/OFF key is used to both turn power on to the 2020 as well as turn the power off. To turn on 2020, press the ON/OFF key. To turn the power off, press the ON/OFF key and hold it down for 2 seconds, and then release it. This is done to prevent accidental power off.

The EXIT key provides a way of returning to the default display. In the functional map, the soft keys allow you to advance and the EXIT key provides a way to go back. If you are at the initial entry of the menu, EXIT will return you to the default display.

The ENTER key has a context sensitive function. When you are operating or navigating through the function map, the ENTER key is used to exit the functions and return you to the default display. When entering data such as a name, number, date, or time, ENTER is used to confirm the entry.

4.1.2.2 Soft Keys

The three soft keys on 2020 are located directly below the status display. Each key has varying functions for configuring 2020, editing the data logger, and controlling the display. Since only three soft keys are available, each function is broken down into a path.

4.1.2.3 Entering Text With the Soft Keys

For all information that you must enter, the left, center, and right soft keys correspond to the up, down, and right arrow.

The up and down arrows are used to change the character highlighted by the cursor. The right arrow is used to advance the cursor to the next character on the right. When the cursor is advanced past the right most character, it wraps around to the first character again. To accept the changes, press the ENTER key. To ignore the change, press EXIT.

Formatting characters, such as the colon (:) in the time, the decimal (.) in a concentration, and the slash (/) in the date are skipped when advancing the cursor.

All inputs are an 8 character input, which is displayed on the right side of the top line of the status display. The prompt, describing the input, occupies the left half of the top line. The soft keys are defined on the bottom line of the status display.

4.2 Default Display

The meter display shows the detected concentration. The resolution of the display changes with the magnitude of the reading. A reading of 0 to 99.9 will be displayed with a resolution of 0.1 ppm or mg/m^3. A reading greater than 99.9 will be shown with a resolution of 1 ppm or mg/m^3. The meter will display concentrations up to 2000 ppm or 2(XX) mg/m^3.

The status display is used to display the instrument status, date, time, units, and active soft keys.

The default display provides the following information: instrument status, current detected concentration, time, date, and measurement units. The status display toggles between showing time and units and then the date.

When the display mode is MAX, the date and time correspond to the date and time the MAX concentration was recorded. In TWA mode, the time represents the number of hours and minutes during which the TWA has been accumulating. For PEAK and STEL monitoring, the date and time correspond to the current date and time.

4.3 Monitoring

4.3.1 Instrument Status

The instrument status is shown on the left of the first line of the status display and on the Table and Graph outputs. Each status has a priority assigned to it. If more than one status is in effect, then the status with the highest priority is displayed until the condition is corrected or until the option is turned off.

4.3.2 Alarms

While operating the instrument, any one of three alarm conditions can occur. To accurately identify the source of the alarm, each type of alarm has been given a unique status.

In addition to the status, 2020 also has an audible alarm and a visual alarm LED. To conserve power, the 2020 alternates between these two alarm indicators, rather than operating both concurrently. Different alarms are identified by the frequency at which the 2020 alternates as follows: PEAK alarm-5 times per second; STEL alarm-2.5 times per second; and TWA alarm-1.25 times per second.

The left soft key is used for acknowledging alarms, and is named "Ack." If no alarm exists, then the "Ack" key is not shown. To clear the alarm, press the "Ack" key. Once acknowledged, the alarm indicators are cleared. The alarm status will remain until the alarm condition clears.

2020 updates the peak concentration once every second. Following every update, the peak concentration is compared to the peak alarm level, and if exceeded, an alarm is triggered.

If 15 minute average exceeds the selected STEL, a STEL alarm is generated.

The TWA alarm is generated when the current average of concentration, since the TWA was last cleared, has exceeded the TWA exposure limit.

During calibration, all alarms are disabled. Once the calibration is complete the alarms are re-enabled.

4.4 STEL, TWA, MAX, and PEAK Operation

The 2020's meter display can be configured to show one of four values: STEL, TWA, PEAK, and MAX.

4.4.1 Short-term Exposure Limit (STEL) Mode

The Short-term Exposure Limit (STEL) mode displays the concentration as a 15 minute moving average. 2020 maintains 15 samples, each representing a one-minute averaging interval.

Once every minute, the oldest of the 15 samples is replaced with a new one minute average. This moving average provides a 15-minute average of the last 15 minutes with a one-minute update rate. Since the average is calculated using 15 one-minute averages, the meter display will only update once every minute.

STEL is set to zero each time the instrument is turned on. Since STEL is a 15-minute moving average, there is no need to clear or reset the STEL.

STEL calculations are always being performed by 2020. You can display the results of the calculations by selecting STEL as the Display mode.

4.4.2 Time-weighted Average (TWA) Mode

The TWA accumulator sums concentrations every second until 8 hours of data have been combined. If this value exceeds the TWA alarm setting, a TWA alarm is generated. The TWA is not calculated using a moving average. Once 8 hours of data have been summed, the accumulation stops. In order to reset the TWA accumulator, press the "Clr" key.

This sum will only be complete after 8 hours, so the meter displays the current sum divided by 8 hours. While you are in TWA mode, the time on the status display will show the number of minutes and hours of data that TWA has accumulated. When this reaches 8 hours 2020 stops accumulating data and the TWA is complete.

TWA calculations are always being performed by 2020. You can display the results of the calculations by selecting TWA as the Display mode.

4.4.3 MAX Mode

The MAX mode displays the maximum signal, with the date and time that it was recorded. 2020 continues to log data according to the selected averaging interval, but only the maximum detected concentration is displayed on the meter display.

The right soft key is used to clear the meter when displaying MAX. The "Clr" key only affects the reading that the meter is displaying. For example, if you display the MAX reading, and you press "Clr," only the MAX value is cleared. The TWA is still accumulating in the background.

4.4.4 PEAK Mode

The PEAK mode displays the current detected concentration. The reading is updated once a second. In the background, the 2020 data logger is sampling the concentration and measuring minimum, maximum, and average concentrations for the selected averaging interval. At the end of every interval, one entry is placed in the data logger until the data logger is full. Typical application concerning the use of this instrument is operated in this mode. Operation within the other specialized modes are the responsibility of the SSO.

4.5 <u>Set Functions</u>

Set functions are used to setup 2020. There are three functions which can be set on the 2020: Calibration, Pump and Clock.

4.5.1 Pump

The Pump function is used to control the pump. After selecting Set Pump, 2020 responds by displaying the new pump status.

The detector is also turned off when you turn the pump off. This prevents the detector from being damaged when there is no sample flowing through the detector.

When the pump and the detector are off, the meter display will be blank. Turn the pump and detector off when concentration measurements are not necessary, and 2020 will only be used for reviewing data or generating reports. By operating the instrument with the pump and detector off when you do not need them, you will conserve the lives of the battery and ultraviolet (UV) lamp.

1. Press the ENTER key. The top line of the status display changes to "Select?". The bottom line displays 3 soft key names: "Set," "Log," and "Disp."
2. Press the soft key below "Set."
3. The names of the soft keys change to reflect the Set options. The display now shows 3 devices which can be set: "Clock," "Pump," and "Cal." Press the "Pump" key.
4. The 2020 turns the pump off. If the pump was off, pressing "Pump" will turn the pump on.
5. A message will be displayed to show you the status of the pump. 2020 reverts back to the previous menu after a few seconds.
6. To return to the default display, press the ENTER key.

4.5.2 Clock

The Clock function is used to set both the current date and time.

1. Press the ENTER key.
2. Press the "Set" key.
3. When the names of the soft keys change, press the "Clock" key.
   The up and down arrows are used to change the character underlined by the cursor. The right arrow is used to advance the cursor to the next character on the right. When the cursor is advanced past the right-most character, it wraps around to the first character again.
   Formatting characters, such as the colon (:) in the time and the slash (/) in the date are skipped when advancing the cursor.
4. Use the "arrow keys" to enter the correct time. The time is formatted as Hour:Minute:Second.
5. Press the ENTER key to confirm the time and move to the date option.
6. When setting the date, the 2020 prompts you for the current date formatted as Year/Month/Day. Use the "arrow keys" to enter the correct date.
7. Press the ENTER key to confirm the date and return to the Set options. You can wait for the display to timeout or press ENTER to return to the default display.

4.5.3 Calibration (Cal)

Cal allows you to setup and calibrate 2020. You have three options under the Cal function: "Zero," Span," and "Mem."

A calibration memory consists of a name, a response factor, and PEAK, TWA, and STEL alarm levels.

The "Zero" and "Span" keys are covered in detail in the manufacturer's operations manual for the instrument.

To edit the calibration memory, select "Mem" and then "Chng." The 2020 prompts you with two new soft keys: "User" and "Lib."

4.5.4 Library (Lib)

Library selections simplify Cal Memory programming, and provide standard response factors for approximately 70 applications. "Lib" allows you to select an entry from a pre-programmed library. The name, response factor, and three alarm levels are all set from the library. To select a library entry to program the selected Cal Memory:

1. Select "Set," "Cal," "Mem," "Chng," and "Lib."
2. Use the "Next" and "Prev" keys to scroll through the list. See the manufacturer's manual Appendix 8.7 for a list of the library entries.

4.6 <u>Preparing for Field Operation of the Photovac 2020</u>

Turning 2020 On

1. Turn 2020 on by pressing the ON/OFF key.
2. 2020 will display the software version number. Wait for the 2020 to proceed to the default display.
3. Allow 10 minutes for the instrument to warm up and stabilize.
4. Press the Enter Key. The default display will provide 3 soft key selection "Set," "Log," and "Display."
5. Press "Set." From this option 3 other soft key selections will be offered: "Pump," "Clock," and "Cal."
6. Press "Cal." This will begin the calibration sequence. The first selection is to Zero the instrument.

7. Press Enter, zeroing will begin. (Note: When employing zero gas attach and activate zero gas supply at this time.)
8. The next selection offered will be Span. Press Enter at which time the concentration will be requested. The isobutylene calibration gas employed under general service will be marked on the side of the container. Use the soft keys to toggle into position and to log the concentration. Once the concentration is logged press "Enter." The direction or status display will indicate spanning. At this time hook up the span gas with a regulator to the Photovac 2020, and open it to supply enough flow to elevate the flow rate indicator to the green indicator line (1/8" from the rest position).
9. Once spanning is complete, the alarms which have been disabled during calibration will activate indicating that calibration is complete.
10. Document this calibration procedure using a Document of Calibration form (included in Appendix A).

This instrument is ready for general purpose application.

Calibration is to be performed daily or prior to each use in accordance with this section.

4.7 Maintenance and Calibration Schedule

Function	Frequency
Routine Calibration	Prior to each use
Factory Inspection and Calibration	Once a year, or when malfunctioning
Wipe Down the Outer Casing of the Unit	After each use
Clean UV Light Source	Every 24 hours of operation
Sample Inlet Filter	Change on a weekly basis or as required by level of use
Battery charging	After each use
Clean ionization chamber	Monthly

4.7.1 Cleaning the UV Light Source Window

1. Turn the FUNCTION switch to the OFF position. Use 2020 multi-tool and remove lamp housing cover.
2. Tilt the lamp housing with one hand over the opening, slide the lamp out of the housing.
3. The lamp window may now be cleaned with any of the following compounds using lens paper:
   a. 11.7 eV Lamp - Dry Aluminum Oxide Powder (3.0 micron powder)
   b. HPLC Grade Methanol - All other lamps

4. Following cleaning, reassemble by first sliding the lamp back into the lamp housing. Replace o-ring as necessary, reinstall lamp housing cover, tighten using 2020 multi-tool. (Do not over tighten).
5. Recalibrate as per Section 4.6.

4.7.2 Cleaning the Ionization Chamber

1. Turn the FUNCTION switch to the OFF position and remove the lamp housing cover and lamp as per Section 4.7.1.
2. Using a gentle jet of compressed air, gently blow out any dust or dirt.
3. Following cleaning, reassemble by first sliding the lamp back into the lamp housing. Replace o-ring as necessary, reinstall lamp housing cover, tighten using 2020 multi-tool. (Do not over tighten).
4. Recalibrate as per Section 4.6.

4.8 Instrument Advantages

The Photovac 2020 is easy to use in comparison to many other types of monitoring instrumentation. Its detection limit range is in the low parts-per-million range. Response time rapidly reaches 90 percent scale of the indicated concentration (less than 3 seconds for benzene). This instrument's automated performance covers multiple monitoring functions simultaneously, incorporating data logging capabilities.

4.9 Limitations of the Photovac 2020 Photoionization Monitor

- Since the 2020 is a nonspecific total gas/vapor detector, it cannot be used to identify unknown chemicals; it can only quantitate them in relationship to a calibration standard (relative response ratio).

- For appropriate application of the 2020, ionization potentials of suspected contaminants must be known.

- Because the types of compounds that the 2020 can potentially detect are only a fraction of the chemicals possibly present at a hazardous waste site or incident, a background or zero reading on this instrument does not necessarily signify the absence of air contaminants.

- The 2020 instrument can monitor only certain vapors and gases in air. Many nonvolatile liquids, toxic solids, particulates, and other toxic gases and vapors cannot be detected.

- PID's are generally not specific. Their response to different compounds is relative to the calibration gas used. This is referred to as relative response ratio. Instrument readings may be higher or lower than the true concentration. This can be an especially serious problem when monitoring for total contaminant concentrations if several different compounds are being detected at once.

- The 2020 is a small, portable instrument which cannot be expected to yield results as accurately as laboratory instruments.

4.9.1 Variables Affecting Monitoring Data

Monitoring hazardous waste site environment can pose a significant challenge in assessing airborne concentrations and the potential threats to site personnel. Several variables may influence both dispersion and the instrument's ability to detect actual concentrations. Some of the variables which may impact these conditions are as follows:

- Temperature - changes in temperature or pressure will influence volatization, and effect airborne concentrations. Additionally, an increase or decrease in temperature ranges may have an adverse effect on the instrument's ability to detect airborne concentrations.

- Humidity - excessive levels of humidity may interfere with the accuracy of monitoring results.

- Rainfall - through increased barometric pressure and water may influence dispersion pathways effecting airborne emissions.

- Electromagnetic interference - high voltage sources, generators, other electrical equipment may interfere with the operation and accuracy of direct-reading monitoring instruments.

5.0 TROUBLESHOOTING

5.1 Fault Messages

When the "Fault" status is displayed, 2020's operation is comprised.

Fault 1: Signal from zero gas is too high.

Cause: If another fault occurred while 2020 was setting its zero point, then this fault is displayed.

Action: Ensure no faults are occurring and calibrate 2020 again.

Cause: Contamination of sample line, sample line, sample probe or fittings before the detector.

Action: Clean or replace the sample line, sample probe or the inlet filter.

Cause: Span gas and zero air are mixed up.

Action: Ensure clean air is used to zero 2020. If you are using gas bags, mark the calibration and zero gas bags clearly.

Cause: Ambient air is contaminated.

Action: If you are unsure about the quality of ambient air, use a supply of commercial zero grade air to zero 2020.

Fault 2: Signal from span gas is too small.

Cause: Operator may have confused the span gas and zero air.

Action: Ensure clean air is used to zero 2020. If you are using gas bags, mark the calibration and zero gas bags clearly.

Action: Ensure the span gas is of a reliable concentration.

Cause: UV lamp window is dirty.

Note: Do not remove the detector lamp in a hazardous location.

Action: Clean the UV lamp window.

Cause: UV lamp is failing.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: Install a new UV lamp.

Cause: Incompatible application.

Action: The concentration and sample gas are incompatible for use with 2020.

Fault 3: UV lamp fault. UV lamp has not started.

Cause: UV lamp has not started immediately.

Action: This fault may be seen momentarily when 2020 is first turned on. Allow 30 to 60 seconds for the UV lamp to start and the fault to clear.

Cause: UV lamp serial number label is blocking the photocell.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: If you have a UV lamp with a white serial number label, it is possible that the label is blocking the photocell. Rotate the lamp approximately 90 degree and then try to start 2020 again. If the fault persists, replace the lamp.

Cause: UV lamp not installed.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: Install a UV lamp.

Cause: UV lamp has failed.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: Install a new UV lamp.

Cause: Electronic problem.

Action: If a new UV lamp still generates this fault, then contact the Photovac Service Department.

Fault 4: Pump current too low or too high.

Cause: If the pump sounds labored, then the pump is operating beyond normal operating parameters.

Action: Check for an obstruction in the sample line. Make sure sample line, sample probe or inlet filter are not plugged.

Note: Do not replace the inlet filter in a hazardous location.

Action: Replace the inlet filter.

Action: Ensure the sample outlet, located on the underside of 2020, is not obstructed.

Cause: UV lamp is too wide, causing flow to be restricted.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: If you have a UV lamp with a white serial number label, it is possible that the lamp is too wide for the lampholder. Contact the Equipment Manager.

Cause: 2020 has been exposed to a solvent that can pass through the inlet filter and liquid has been aspirated.

Action: Contact the Equipment Manager.

Cause: The pump has failed.

Action: Contact the Equipment Manager.

5.2 Specific Problems

Problem: Very low or no instrument response detected, yet compounds are known to be present.

Cause: 2020 has not been calibrated properly.

Action: Ensure the calibration gas is of a reliable concentration and then calibrate the instrument as outlined in Section 4.6 of the User's Manual. After the instrument has been calibrated, sample the bag of calibration gas. A reading equivalent to the calibration gas should be displayed. If not, contact the Equipment Manager.

Note: Do not remove or recharge the battery pack in a hazardous location.

Action: Disconnect the battery charger before calibrating 2020.

Cause: Calibration Memories have not been programmed correctly.

Action: Program all the calibration memories you require for your application. You must use the correct calibration gas and concentration for each Cal Memory.

Cause: Response factor has been set to zero.

Action: Enter the correct response factor. Refer to Appendix 8.6 for a list of response factors. If the compound is not listed in Appendix 8.6 or you are measuring gas mixtures, then enter a value of 1.0. See User's Manual.

Cause: You are not using the correct Cal Memory.

Action: Select the correct Cal Memory for your application.

Note: It does not matter which Cal Memory is selected or which response factor is entered. 2020's response is not specific to any one compound. The reading displayed represents the total concentration of all ionizable compounds in the sample.

Cause: Detector is leaking. A decrease in sensitivity may be due to a leak in the detector.

Note: Do not remove or replace the detection lamp in a hazardous location.

Action: Ensure the UV lamp has been installed correctly.

Action: Ensure the lamp cover has been tightened down. Do not overtighten the cover.

Action: Ensure the o-ring seal on the lamp cover is positioned correctly.

Cause: UV lamp is too long, causing flow to be restricted.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: If you have a UV lamp with a white serial number label, it is possible that the lamp is too long for the lampholder. Replace the lamp and contact the Equipment Manager.

Cause: UV lamp is too wide, causing flow to be restricted.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: If you have a UV lamp with a white serial number label, it is possible that the lamp is too wide for the lampholder. Contact the Equipment Manager.

Cause: Sampling environment is extremely humid.

Action: Water vapor is not ionized by the PID, but it does scatter and absorb the light and results in a lower reading. The 2020 detector has been designed to operate under high humidity conditions. Under extreme conditions you may notice decreased response due to humidity.

Cause: UV lamp is failing.

Note: Do not remove or replace the detector lamp in a hazardous location.

Cause: High concentration of non-ionizable compounds.

Action: Chemical compounds, such as methane, with IPs greater than the 10.6 eV scatter and absorb the UV light. Sensitivity may be decreased significantly. Application with high backgrounds of such materials, may be incompatible with 2020. Contact the Photovac Applications Group for more information.

Problem: Erroneously high readings.

Cause: Sampling environment is extremely humid.

Action: Water vapor may contain mineral salts which carry a charge. The water vapor becomes an electrolytic solution which becomes ionized when it enters the detector. Atmospheric water in areas around the sea or stagnant water may produce a response in the absence of contaminants. The same effect may be seen when conducting ground water investigations in areas where the water is hard because it contains a significant concentration of minerals.

Cause: 2020 has not been calibrated properly.

Action: Ensure the calibration gas is of a reliable concentration and then calibrate the instrument as outlined in Section 5.6. After the instrument has been calibrated, sample the bag of calibration gas. A reading equivalent to the calibration gas should be displayed. If not contact the Equipment Manager.

Cause: Cal Memories have not been programmed correctly.

Action: Program all the Cal Memories you require for your application. You must use the correct calibration gas and concentration for each Cal Memory. See Section 3.4, of the User's Manual.

Cause: You are not using the correct Cal Memory.

Action: Select the correct Cal Memory for your application. See Section 3.2.2 or 3.3.2, of the User's Manual.

Note: It does not matter which Cal Memory is selected or which response factor is entered. 2020's response is not specific to any one compound. The reading displayed represents the total concentration of all ionizable compounds in the sample.

Cause: Detector has been short circuited by foreign matter in the detector cell.

Note: Do not service 2020 in a hazardous location.

Action: Do not touch the wire grid inside the detector cell. Use a gentle jet of compressed air to remove any dust in the detector cell.

Warning: Do not insert any object, other than the UV lamp, into the lampholder.

Cause: There is an undetermined problem.

Action: Contact the Equipment Manager.

Problem: Date and time settings are not retained.

Cause: The battery pack has been removed before 2020 was turned off.

Note: Do not remove or recharge the battery pack in a hazardous location.

Action: Replace the battery pack and reset the time and date. Ensure 2020 has been turned off before removing the battery pack.

Cause: 2020 has not been used for 3 months or more and the internal battery (not the external battery pack) has discharged.

Note: Do not remove or recharge the battery pack in a hazardous location.

Action: Connect 2020 to the AC adapter and turn 2020 on. Turn the pump off. While 2020 is running the internal battery is charging. Leave the instrument running for approximately 24 hours.

Problem: Instrument status shows "Over."

Cause: High concentrations of gases and vapors will cause a rapid change in signal level. The detector and associated electronics may become temporarily saturated.

Action: Wait a few seconds for the status to return to normal. PIDs are designed to detect relatively low concentrations of gases and vapors. Exposure to very high concentrations may result in a very high or maximum response.

Cause: The detector has become saturated.

Action: Move 2020 to a location where it can sample clean air. Sample clean air until the reading stabilizes around 0.

Cause: Detector has been short circuited by foreign matter in the detector cell.

Note: Do not service 2020 in a hazardous location.

Action: Do not touch the wire grid inside the detector cell. Use a gentle jet of compressed air to remove any dust or dirt in the detector cell.

Warning: Do not insert any object, other than the UV lamp, into the lampholder.

Cause: There is an undetermined problem.

Action: Contact the Equipment Manager.

Problem: Display is blank.

Cause: Battery pack is critically low.

Note: Do not remove or recharge the battery pack in a hazardous location.

Action: Replace the battery pack or connect 2020 to the AC adapter.

Cause: The battery pack is not connected to the instrument correctly.

Action: Ensure the battery pack connector is securely attached to the connector on 2020.

Cause: There is an undetermined problem.

Action: Reset 2020. You must leave the instrument on while you disconnect the battery pack. This will reset the instrument. Reconnect the battery pack and close the battery hatch. Turn on 2020, set the time and date and program all the calibration memories that you are using.

Action: Contact the Equipment Manager.

Problem: Sample flow rate is less than 300 ml/min.

Cause: Inlet filter is plugged.

Note: Do not replace the inlet filter in a hazardous location.

Action: Replace inlet filter.

Cause: Inlet filter has not been installed properly.

Action: Ensure that the inlet filter has been installed correctly.

Cause: UV lamp is too long, causing flow to be restricted.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: If you have a UV lamp with a white serial number label, it is possible that the lamp is too long for the lampholder. Replace the lamp and contact the Equipment Manager.

Cause: UV lamp is too wide, causing flow to be restricted.

Action: If you have a UV lamp with a white serial number label, it is possible that the lamp is too wide for the lampholder. Contact the Equipment Manager.

Cause: 2020 has been exposed to a solvent that can pass through the inlet filter and liquid has been aspirated.

Action: Contact the Equipment Manager.

Cause: Sample outlet is obstructed.

Action: Ensure the sample outlet is? not obstructed in any way.

Cause: Pump has been damaged.

Action: Contact the Equipment Manager.

Problem: Liquid has been aspirated.

Cause: 2020 has been exposed to a solvent that can pass through the inlet filter.

Action: Contact the Equipment Manager.

Problem: Corrosive gases and vapors have been sampled.

Cause: 2020 has been exposed to corrosive gases and vapors.

Action: Corrosive gases and vapors can affect the electrodes within the detector as well as the lamp window. Prolonged exposure to corrosive materials may result in permanent fogging or etching of the window. If 2020 is exposed to corrosive material, contact the Equipment Manager.

6.0 SHIPPING

The Photovac may be shipped as cargo or carried on as luggage providing there is no calibration gas cylinder accompanying the kit. When shipping or transporting the calibration gas, a Hazardous Airbill must be completed.

7.0 REFERENCES

Photovac 2020 Photoionization Monitor User's Manual, 1995.

APPENDIX C

HEALTH AND SAFETY PLAN

Final
Health and Safety Plan
for
Background Sampling

Naval Surface Warfare Center
Crane Division
Crane, Indiana

Southern Division
Naval Facilities Engineering Command
Contract Number N62467-94-D-0888
Contract Task Order 0083

October 1999

FINAL
HEALTH AND SAFETY PLAN
FOR
BACKGROUND SAMPLING
AT
NAVAL SURFACE WARFARE CENTER (NSWC)
CRANE, INDIANA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
TetraTech NUS
Foster Plaza 7 661 Andersen Drive
Pittsburgh, Pennsylvania 15220

CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0083

OCTOBER 1999

PREPARED UNDER
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PITTSBURGH, PENNSYLVANIA

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1.0 INTRODUCTION

Authorization: The Health and Safety Plan (HASP) and the work described within are completed under the authorization of

Contract:	Comprehensive Long-Term Environmental Action Navy
Contract Number:	N62467-94-D-0888
Contract Task Order:	0083

Application: This HASP is specifically written for site activities that are to be conducted at the Naval Surface Warfare Center Crane (NSWC Crane), located in Crane, Indiana under Contract Task Order 0083. Activities to be conducted under this CTO 0083 include the following:

- Base-Wide Background Sampling

Compliance: The elements of this HASP are in compliance with the requirements established by:

- OSHA 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response" (HAZWOPER)
- Applicable sections of 29 CFR 1926 "Safety and Health Regulations For Construction."
- Tetra Tech NUS Health and Safety Program
- Select NSWC Crane policies and procedures.

Modifications/Changes: The following conditions are considered sufficient basis for change and will serve as triggers to institute review and possible change to this document

- The addition of activities outside of those specified in Section 3.0, Scope of Work.
- Task modifications to those activities specified within Section 3.0, Scope of Work.
- New information becomes available through the course of the investigation or from outside sources.

All changes to the HASP will be requested through the Tetra Tech NUS Health and Safety Manager (HSM) and the Task Order Manager (TOM). It is the responsibility of the TOM to notify all affected personnel of all changes to this HASP.

1.1 KEY PROJECT PERSONNEL AND ORGANIZATION

This section defines responsibility for site safety and health for Tetra Tech NUS and subcontractor employees engaged in on-site activities. Personnel assigned to these positions will exercise the primary responsibility for on-site health and safety. These persons will be the primary points of contact for any questions regarding the safety and health procedures and the selected control measures that are to be implemented for on-site activities.

Tetra Tech NUS TOM is responsible for the overall direction of health and safety for this project.

Project Health and Safety Officer (PHSO) is responsible for developing the HASP in accordance with applicable OSHA regulations.

Tetra Tech NUS Field Operations Leader (FOL) is responsible for implementation of the HASP with the assistance of an appointed SSO. The FOL manages field activities, executes the work plan, and enforces safety procedures as applicable to the work plan.

SSO supports site activities by advising the FOL on all aspects of health and safety on-site.

CLEAN HSM monitors compliance with this document and approves all changes and modifications.

1.2 SITE INFORMATION AND PERSONNEL ASSIGNMENTS

Site Name: NSWC Crane

Address: Crane, Indiana

Client Contact: Mr. Thomas Brent

Phone Number: (812) 854-6160

Alternate Contact: Ms. Chris Freeman

Phone Number: (812) 854-4423

Project Team:

Tetra Tech NUS Personnel:	Discipline/Tasks Assigned:	Phone No.
Keith Henn	Task Order Manager	(412) 921-8146
Matthew M. Soltis, CIH, CSP	CLEAN Health and Safety Manager	(412) 921-8912
Tom Dickson	Project Health and Safety Officer	(412) 921-8457
Keith Simpson	FOL/SSO	(412) 921-8131
Scott Neil	Field Technician	(412) 921-8608
Tom Patton	Equipment Manager	(412) 262-4583

Non-Tetra Tech NUS Personnel	Affiliation/Discipline/Tasks Assigned	
TBA	Analytical Laboratory	
TBA	Surveyor	
FedEx	Sample/Parcel Delivery	1(800)463-3339

Prepared by: Tom Dickson

2.0 EMERGENCY ACTION PLAN

2.1 INTRODUCTION

This section has been developed as part of a planning effort to direct and guide field personnel in the event of an emergency. All site activities will be coordinated with the client contact. In the event of an emergency that cannot be mitigated using onsite resources, personnel will evacuate to a safe place of refuge and the appropriate emergency response agencies will be notified. It has been determined that the majority of potential emergency situations would be better supported by outside emergency responders. Based on this determination, TtNUS and subcontractor personnel will provide emergency response support only to the capabilities of onsite response. Workers who are ill or who have suffered a minor injury may be transported by site personnel to nearby medical facilities, provided that such transport does not aggravate or further endanger the welfare of the injured/ill person. The emergency response agencies listed in this plan are capable of providing the most effective response, and as such, will be designated as the primary responders. These agencies are located within a reasonable distance from the area of site operations, which ensures adequate emergency response time. Client contact(s) will be notified when outside response agencies are contacted. This Emergency Action Plan conforms to the requirements of 29 CFR 1910.38(a), as allowed in 29 CFR 1910.120(l)(1)(ii).

Tetra Tech NUS will through necessary services include incidental response measures for incidents such as:

- Initial stage fire fighting support and prevention
- Initial spill control and containment measures and prevention
- Removal of personnel from emergency situations
- Provide initial medical support for injuries or illnesses requiring only first-aid level support
- Provide site control and security measures as necessary

Note: Emergency support in the initial stages will only be provided to the capabilities of on-site personnel and available resources.

2.2 EMERGENCY PLANNING

Through the initial hazard/risk assessment effort, injuries or illnesses resulting from exposure to chemical or physical hazards or fire are the most probable emergencies that could be encountered during site activities.

To minimize and eliminate these potential emergency situations, the FOL/SSO are responsible for, emergency planning activities associated with this project:

- Coordinating with NSWC Crane Emergency Services personnel to ensure that Tetra Tech NUS emergency action activities are compatible with existing facility emergency response procedures.
- Establishing and maintaining information at the project staging area (support zone) or Field Office for easy access in the event of an emergency. This information will include the following:
  - Chemical Inventory (used on-site), with Material Safety Data Sheets.
  - On-site personnel medical records (medical data sheets).
  - A logbook identifying personnel on site each day.
- Identifying a chain of command for emergency action.
- Educating site workers to the hazards and control measures associated with planned activities at the site, and to provide early recognition and prevention where possible.

It is understood that the use of two-way communication devices (cellular phones and radios) must be pre-approved by the NSWC Crane Safety Office .

2.3 EMERGENCY RECOGNITION AND PREVENTION

The primary focus of this section is the ability to recognize and control factors which could contribute to an emergency situation/condition. The FOL/SSO will preview all site work locations prior to committing people or resources. Their actions will be as follows:

- Identify and remove or barricade any physical hazards within the estimated work area.
- Identify prevalent emergency conditions and their control measures and ensure they are stated on the Safe Work Permits (see Section 9.2).
- Provide the necessary equipment to control potential emergencies (i.e., safety cans for gasoline storage, spill containment equipment, PPE, and emergency equipment such as fire extinguishers).
- Evaluate operations to ensure the necessary measures have been taken to control and/or minimize the impact of emergency situations/conditions.

Field Crew shall:

- Identify and remove or barricade any physical hazards within the estimated work area.
- Follow the guidelines for control of emergency situations/conditions
- Report any potential emergency situations/conditions to the FOL/SSO.

2.4 SAFE DISTANCES AND PLACES OF REFUGE

The FOL shall be responsible for ensuring the following:

- Identifying a Place of Refuge in the event of an emergency – This place should be selected and conveyed to the Field Crew as part of issuing the Safe Work Permit.

- Directing site personnel that during an evacuation, personnel reporting to the refuge location will remain there until directed otherwise by the Tetra Tech NUS FOL.

- Taking a head count at this location to account for and to confirm the location of all site personnel. The site logbook will be used to take the head count. Emergency response personnel will be immediately notified of any unaccounted personnel.

2.5 DECONTAMINATION PROCEDURES / EMERGENCY MEDICAL TREATMENT

During an evacuation, decontamination procedures will be performed only if doing so does not further jeopardize the welfare of site workers. Decontamination will not be performed if it could further endanger the well-being of an injured person. However, it is unlikely that an evacuation would occur at this site which would require workers to evacuate the site without first performing decontamination procedures.

2.5.1 Emergency Medical Treatment

The FOL/SSO shall ensure that the First-Aid Kit is properly stocked and available at the work site at all times. In addition, portable fire extinguishers (Type ABC) and a portable eye wash is also to be maintained at the work site.

Tetra Tech NUS and subcontractor personnel are only permitted to provide treatment in accordance with training received.

In the event of an emergency, site personnel are to observe the following guidance:

(1) Notify the FOL/SSO of the incident.

(2) The FOL/SSO is to contact the appropriate emergency response services. Obtain medical attention for any injuries or illnesses immediately.

(3) Take the necessary precautions to prevent direct contamination of yourself with the injured person's body fluids.

a) Use surgeons gloves to offer the first line of defense for handling cuts, abrasions, bites, punctures, etc. or any part of the injured person. The use of safety glasses and surgeons masks may be necessary if there is the potential for uncontrolled spread of body fluids.

b) If it is necessary to provide Cardio-Pulmonary Resuscitation (CPR) use a CPR Micro-Shield mouthpiece.

(4) Consult the First-Aid guidance provided in Attachment 1.

2.6 EMERGENCY ALERTING AND ACTION/RESPONSE PROCEDURES

If an emergency occurs on Base, the following procedures are to be initiated:

- Initiate an emergency notification by hand signals, voice commands, air horn, or two-way radios to the FOL/SSO. Describe to the FOL/SSO (who will serve as the Incident Coordinator) what has occurred and as many details as possible.
- Have your partner evacuate non-essential persons from the incident scene, engage initial response measures given the emergency type (i.e., spill response, fire extinguisher, first-aid)

In the event that site personnel cannot control the incident through offensive and defensive measures, the FOL/SSO will enact the emergency notification procedures to secure additional outside assistance in the following manner:

- On Base, call 854-3300 or 854-1333* and other appropriate emergency contacts (Table 2-1) and report the emergency. Give the emergency operator the location of the emergency, the type of emergency, the number of injured, and a brief description of what occurred. Stay on the phone and follow the instructions given by the operator. The operator will then notify and dispatch the proper emergency response agencies.

***NOTE:** On-base extensions 3300 and 1333 are the primary emergency phone numbers. From an NSWC Crane phone, on Base extensions must be preceded by "854". Off-base numbers can only be reached by dialing "990" or "991" first. Furthermore, all emergencies involving site activities should subsequently be reported to the Environmental Office (x6160).

- Evacuate all Tetra Tech NUS and subcontractor personnel to the identified safe place of refuge. Conduct a head count of site personnel using the site logbook.

2.7 PPE AND EMERGENCY EQUIPMENT

A first aid kit, eye wash units, fire extinguishers (strategically placed) will be maintained on-site and shall be immediately available for use in the event of an emergency. PPE available for emergency use will be the same as that used for the planned tasks.

2.8 EMERGENCY CONTACTS

Prior to performing work at any of the sites, all personnel will be thoroughly briefed on the emergency procedures to be followed in the event of an incident. A mobile phone may be available on site. Table 2-1 provides a list of emergency contacts and their associated telephone numbers. This table must be posted on site where it is readily available to all site personnel. The telephone number for the Base Environmental Office is listed in Table 2-1.

In addition, TtNUS personnel who are injured or become ill on the job must notify appropriate company representative. Attachment VII presents the procedure for reporting an injury/illness, and the form to use for this purpose. **Further, if the emergency involves personnel exposure to chemicals, follow the steps provided in Figure 2-1.**

TABLE 2-1
EMERGENCY REFERENCE
NSWC Crane, Crane, Indiana

AGENCY	TELEPHONE
Base Emergency Number (Fire Department, Base Security, Ambulance)	(812) 854-3300 or (812) 854-1333
Base Environmental Office	(812) 854-6160
Bedford Ambulance	(812) 279-6545
Bloomington Hospital (Bloomington, IN) Hospital, Bedford Medical Center (Bedford, IN)	(812) 336-9515 (812) 275-1200
Poison Control Center	1-800-382-9097
National Response Center	1-800-424-8802
Base Contact, Thomas Brent	(812) 854-6160
ABG Area Supervisor, Bob Tolbert	(812) 854-1470
DR and ORR Area Supervisor, Luther Webster	(812) 854-1426
Explosive Disposal Director, Walt Waggoner	(812) 854-1317
Contract Task Order Manager, Keith Henn	(412) 921-8146
Field Operations Leader, Keith Simpson	(412) 921-8131
Tetra Tech NUS Office, Pittsburgh	1-800-245-2730 (412) 921-7090
Project Health and Safety Officer, Tom Dickson	(412) 921-8457
CLEAN Health and Safety Manager, Matthew M. Soltis, CIH, CSP	(412) 921-8912

2.9 EMERGENCY ROUTE TO HOSPITAL

Directions to the Bloomington Hospital:*

Exit NSWC Crane on H-45 through the Bloomington Gate. Follow Highway 45 North to Bloomington at Highway 45 and Highway 37. Continue going straight over the overpass (Bloomfield Road). Follow Bloomfield Road North; this road turns into 2nd Street. Follow 2nd Street, hospital will be on the right (601 West 2nd Street)

Directions to Bedford Medical Center:*

Exit the base on H-58, through the Bedford Gate. Head West on State Highway 158. State Highway 158 becomes 16th Street upon entering the City of Bedford. The medical center is on the right shortly after Plaza Drive.

***NOTE:** The Bedford Gate is open only from 0600 - 0830 and 1500 - 1800 hours, whereas the Bloomington Gate is open 24 hours. A map indicating the travel route from the site to the Hospital will be inserted as Figure 2-2.

FIGURE 2-1
EMERGENCY RESPONSE PROTOCOL

The purpose of this protocol is to provide guidance for the medical management of exposure situations.

In the event of a personnel exposure to a hazardous substance or agent:

- Rescue, when necessary, employing proper equipment and methods.
- Give attention to emergency health problems -- breathing, cardiac function, bleeding, shock.
- Transfer the victim to the medical facility designated in this HASP by suitable and appropriate conveyance (i.e. ambulance for serious events)
- Obtain as much exposure history as possible (a Potential Exposure report is attached).
- If the exposed person is a Tetra Tech NUS employee, call the medical facility and advise them that the patient(s) is/are being sent and that they can anticipate a call from the Continuum Healthcare physician. Continuum Healthcare will contact the medical facility and request specific testing which may be appropriate. Continuum Healthcare physicians will monitor the care of the victim. Site officers and personnel should not attempt to get this information, as this activity leads to confusion and misunderstanding.
- Call Continuum Healthcare at 1-800-229-3674, being prepared to provide:

– Any known information about the nature of the exposure.

– As much of the exposure history as was feasible to determine in the time allowed.

– Name and phone number of the medical facility to which the victim(s) has/have been taken.

– Name(s) of the exposed Tetra Tech NUS, Inc. employee(s).

– Name and phone number of an informed site officer who will be responsible for further investigations.

– Fax appropriate MSDS to Continuum Healthcare at (770) 457-1429.

- Contact Corporate Health and Safety Department (Matt Soltis) at 1-800-245-2730.

As environmental data is gathered and the exposure scenario becomes more clearly defined, this information should be forwarded to the Continuum Healthcare Medical Director or Assistant Medical Director.

Continuum Healthcare will compile the results of all data and provide a summary report of the incident. A copy of this report will be placed in each victim's medical file in addition to being distributed to appropriately designated company officials.

Each involved worker will receive a letter describing the incident but deleting any personal or individual comments. This generalized summary will be accompanied by a personalized letter describing the individual's findings/results. A copy of the personal letter will be filed in the continuing medical file maintained by Continuum Healthcare.

FIGURE 2-1 (continued)
POTENTIAL EXPOSURE REPORT

Name: ______________________ Date of Exposure: ____________

Social Security No.: ____________ Age: ________ Sex: ________

Client Contact: ______________________ Phone No.: ____________

Company Name: ______________________

I. Exposing Agent

Name of Product or Chemicals (if known): ______________________

____

Characteristics (if the name is not known)

Solid   Liquid   Gas   Fume   Mist   Vapor

II. Dose Determinants

What was individual doing? ______________________

How long did individual work in area before signs/symptoms developed? ____________

Was protective gear being used? If yes, what was the PPE? ____________

Was there skin contact? ______________________

Was the exposing agent inhaled? ______________________

Were other persons exposed? If yes, did they experience symptoms? ____________

III. Signs and Symptoms (check off appropriate symptoms)

Immediately With Exposure:

Burning of eyes, nose, or throat
Tearing
Headache
Cough
Shortness of Breath
Chest Tightness / Pressure
Nausea / Vomiting
Dizziness
Weakness

Delayed Symptoms:

Weakness
Nausea / Vomiting
Shortness of Breath
Cough
Loss of Appetite
Abdominal Pain
Headache
Numbness / Tingling

IV. Present Status of Symptoms (check off appropriate symptoms)

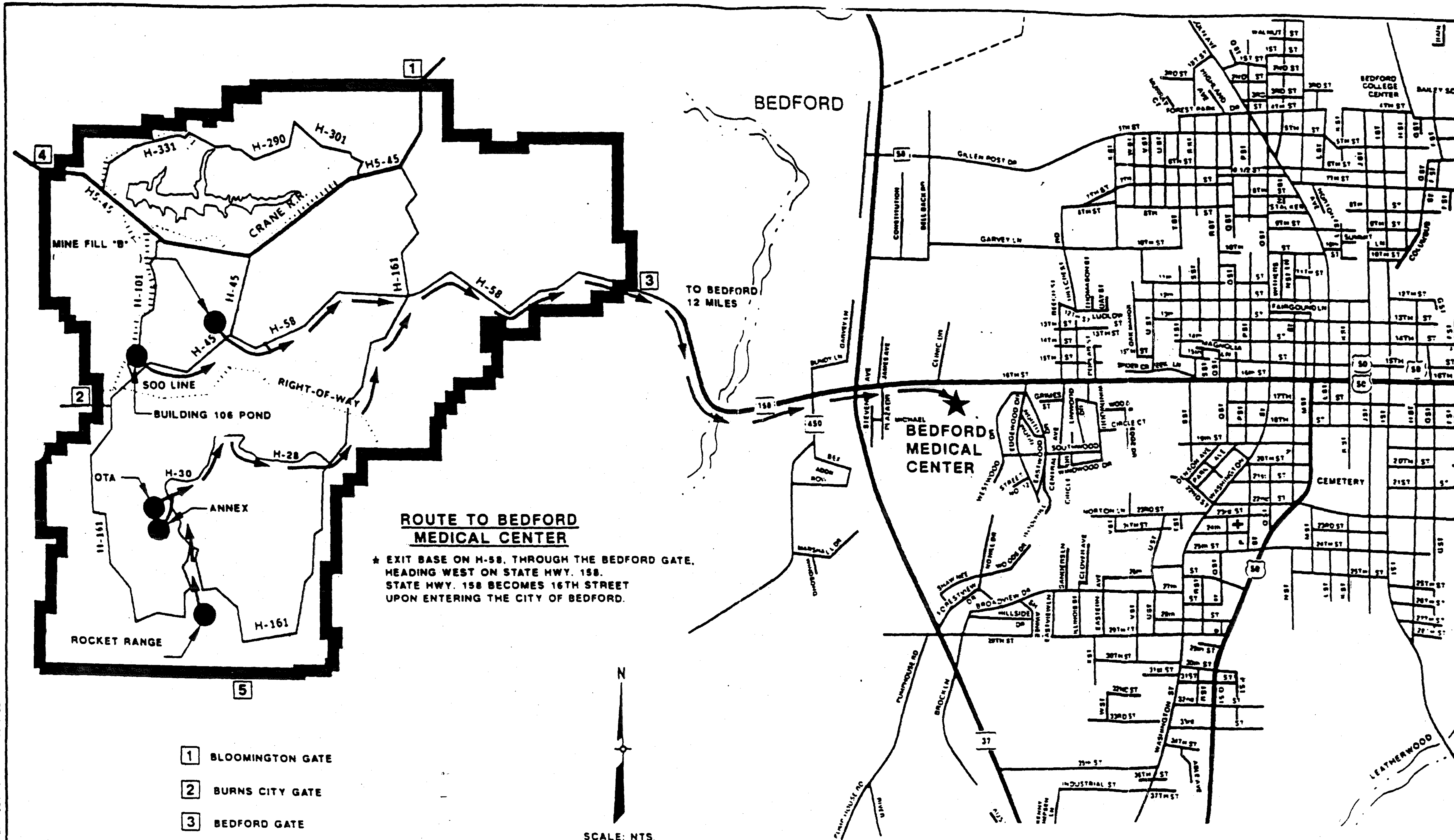
Burning of eyes, nose, or throat
Tearing
Headache
Cough
Shortness of Breath
Chest Tightness / Pressure
Cyanosis
Nausea / Vomiting
Dizziness
Weakness
Loss of Appetite
Abdominal Pain
Numbness / Tingling

Have symptoms: (please check off appropriate response and give duration of symptoms)

Improved: ________ Worsened: ________ Remained Unchanged: ________

V. Treatment of Symptoms (check off appropriate response)

None: ________ Self-Medicated: ________ Physician Treated: ________



1 BLOOMINGTON GATE
2 BURNS CITY GATE
3 BEDFORD GATE
4 CRANE GATE
5 DOVER HILL GATE

SOURCE: NORTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND, 1986.

MERCHANT MAP SHEET GUIDE AND INDEX, 1992.

FIGURE 2-2
HOSPITAL ROUTE MAP
RFI PHASE II RELEASE ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

3.0 SITE BACKGROUND

This section provides information pertaining to NSWC Crane and the specific sites that are to be investigated. This information will be revised if additional information becomes available or if additional sites are going to be investigated.

3.1 SITE HISTORY

NSWC Crane is located in Crane, Indiana approximately 75 miles southwest of Indianapolis and 71 miles northwest of Louisville, Kentucky. The facility encompasses more than 100 square miles (64,463 acres) in Davies, Greene, Lawrence, and Martin Counties. It is located in a rural, sparsely populated area. The acreage surrounding the Base is either wooded or farmed land. The facility, originally called Naval Ammunition Depot (NAD), Burns City, was opened in 1941 to serve as an inland ammunition production and storage center. The Depot's name was changed to NAD, Crane in 1943. In 1975, the name was changed to Naval Weapons Support Center, Crane and in 1992, the name was again changed to Naval Surface Warfare Center, Crane. Today NSWC Crane's mission is to "provide quality and responsive engineering, technical and material support to the Fleet for combat subsystems, equipment and components, microelectronic technology, microwave components, electronic warfare, acoustic sensors tests, engineering pyrotechnics, small arms, electronic module test and system command." Under the Single Service Management Program, a segment of the Center's mission is to provide support (including environmental protection) to the Crane Army Ammunition Activity (CAAA). The Army is tasked with the production and renovation of conventional ammunition and related items, the performance of manufacturing, engineering, and product quality assurance to support production; and the storage, shipment, demilitarization, and disposal of conventional ammunition and related components. Because of the nature of the Army's operations, CAAA contributes significant financial support for the environmental program through an Inter-service Support Agreement.

3.2 SPECIFIC SITES TO BE INVESTIGATED

Three general areas have been identified for this background investigation, with one of these areas divided into two subareas. These areas have been designated as follows:

1. Background Area 1

2. Background Area 2

   - Background Area 2a

   - Background Area 2b

3. Background Area 3

A description of each of these areas is described in detail in Section 4.2.2 of the Work Plan that accompanies this HASP. Figure 4-1 of the Work Plan illustrates in general the extent of these background areas. More detailed maps of these areas can be found on Figures 5-1, 5-2, and 5-3 of the Work Plan.

4.0 SCOPE OF WORK

4.1 BASE-WIDE BACKGROUND SAMPLING

Under CTO 0083, Base-wide background sampling of surface and subsurface soils will be performed. Sample acquisition will be accomplished using hand augers to gain access to soils from ground surface to a maximum depth of six (6) feet. The objective of this sampling is to determine concentrations of naturally occurring metals. The sampling of these substances is further subdivided between the classification of soils in which they may occur. The results obtained will establish a reference number by which previously measured substances detected will be compared and qualified (i.e., to determine if they are above naturally-occurring levels).

The sample locations were selected representing the different types of soil classifications represented at NSWC Crane and to look at areas which were not adversely influenced by previous or ongoing operations. Sample locations and their state plane coordinates are provided in the Work Plan.

All sample locations will be marked from the point-of-entry from the road to the sample location to assist personnel in and out of the remote locations.

4.2 CLEARING VEGETATION

In order to gain access to some of the identified locations, the removal of vegetation will be necessary. This activity will be accomplished through the primary use of hand tools such as machetes and brush hooks.

4.3 SURVEYING

All sample locations will be surveyed using a GPS system. This system will also be used to gain access to the points through the most direct route possible.

4.4 DECONTAMINATION

Stainless steel hand augers will be used in sample acquisition. An adequate number of buckets/stems/handles will be taken into the field to permit sample acquisition within a single region prior to the need for decontamination of this equipment.

5.0 TASK HAZARDS ASSESSMENTS AND CONTROL MEASURES

Table 5-1 of this section serves as the primary portion of this HASP which identifies the tasks that are to be performed. The anticipated hazards, recommended control measures, air monitoring recommendations, required Personal Protective Equipment (PPE), and decontamination measures for each site task are discussed in detail. The FOL/SSO will utilize this table as the primary reference for completion of the task-specific Safe Work Permits.

5.1 HAZARD MONITORING: BASE-WIDE BACKGROUND SAMPLING

A Photoionization Detector (PID) with 10.6 eV lamp or Flameionization Detector (FID) will be used at each of the background sampling locations sites to be investigated. These instruments have been selected because of the wide range of substances that they can detect. Either of these instruments are acceptable for detecting volatile organic compounds. The use of either of these instruments has been recommended strictly as a precaution. That is, because the focus of this investigation is to evaluate background levels at areas supposedly unaffected by site operations, it is not anticipated that volatile substances will be encountered. However, one of these devices is to be used to initially and then periodically screen the work areas to confirm that volatile hazards do not exist in these areas for this scope of work. Any sustained readings (above daily-established background levels) in worker breathing zones will be sufficient cause to terminate the activity and notify the PHSO and the Task Order Manager. The instrument that is selected should be based on the field crew's level of competence and confidence in its use. The PID or FID is to be used during all intrusive (soil boring) activities.

In addition to using the instrument to initially and periodically screen worker breathing zones, it can also be used as a general screening instrument to ensure background samples are free from volatiles. Positive detections above background within the sample media may be sufficient cause to select a different location. Positive results may indicate the presence of chemical compounds, which may negate considering that location as a non-contaminated area. In this event, at the discretion of the FOL, a different sampling location is to be selected.

No other additional monitoring will be employed during base-wide background sampling.

Information concerning operation, calibration, maintenance, and trouble-shooting for the PID and FID is contained in Section 1.0 of the TtNUS Health and Safety Guidance Manual. More specifically Appendix B (of this Work Plan) contains the Standard Operating Procedures CTO # 83-7 for use of the Photovac 2020.

The information presented above demonstrates that worker exposure to potential chemical contamination is not anticipated for these sampling tasks. Air monitoring instruments will be used strictly as a precautionary measure. However, there are potential physical hazards that may be anticipated based on the nature of the work. These potential hazards, as well as the appropriate methods to evaluate and control them, are addressed in Section 6.0 of this HASP. They are also summarized on Table 5-1 and on the Safe Work Permits included as Attachment 2.

The Safe Work Permit is the primary tool for accomplishing safety and health reviews with filed personnel prior to the initiation of any tasks. These permits are to be completed by the FOL/SSO and reviewed with all field personnel at the beginning of each day's activities.

TABLE 5-1
TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM
FOR
NSWC CRANE PROJECT

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Air Monitoring Type/Action Levels	Personal Protective Equipment	Decontamination Procedures
Mobilization/ Demobilization	Physical hazards including 1) Lifting (muscle strains and pulls) 2) Slip, trips, and falls 3) Biological hazards (Insect/animal bites and stings)	1) Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques. 2) Preview and prepare work locations where unstable/uneven terrain exists. 3 Avoid nesting areas, use repellents. Report potential hazards to the FOL. Frequently inspect clothing and person during and after activities in wooded areas.	Not required.	Level D - (Minimum Requirements) - Standard field attire (Sleeved shirt; long pants; or coveralls) - Safety shoes (Boots with steel toe) - Safety glasses (when eye hazards exist, or when required by the SSO) - Hardhat (when overhead hazards exists, or when required by the SSO) - Reflective vest for high traffic areas	Not required All equipment arriving/leaving the site will be decontaminated and inspected prior to permitting this equipment to enter or exit the site. Once the decontamination is complete the FOL/SSO will inspect the equipment and give the clearance to allow the equipment to pass. Failure to pass inspection will prohibit entering or exiting the site. All equipment which fails the inspection will have to be decontaminated to a level acceptable to the FOL/SSO prior to passage on or offsite. Standard field attire which becomes stained or visibly soiled will be laundered or discarded as appropriate.
Brush clearing using hand tools such as machetes and brush axes Surveying activities are also covered by this entry.	**Chemical hazards** No chemical contamination is anticipated while performing this activity. **Physical hazards** 1) Cuts or abrasions 2) Biological hazards (Insect/animal bites and stings, contact with poisonous plants)	1) All equipment to be employed will be inspected and maintained in proper working order. Cutting edges of hand tools should be kept sharpened. - Establish safe zones in work areas. Workers must ensure that no persons are within the range of the swing area or reach of the hand tools. All personnel not directly supporting this activity will remain at least 10 feet from the individuals working with the hand tools. - All personnel working in amongst equipment traffic are required to wear reflective vests for high visibility 2) Avoid nesting areas, employ repellents. Tape bottom of pant legs to boots to prevent ticks from entering. Wear Tyvek coveralls if poisonous plants are observed in the work area Follow the direction provided in section 6.2 of the Health and Safety Plan. Report potential hazards to the Health and Safety Manager.	Not required during brush clearing activities.. It is not anticipated that chemical hazards will be encountered during these activities.	Level D - (Minimum Requirements) For vegetation clearance activities: - Field attire (Long sleeve shirt; long pants) - Leather or heavy cloth work gloves - Safety shoes (Steel toe) - Safety glasses with side shields - Snake chaps or pants in remote areas - Hardhat (as directed by SSO) - Reflective vest for high traffic areas - Tyvek coveralls (if poisonous plants observed in work area) - Tape pants/boots to prevent tick access **Note:** The Safe Work Permit(s) for this task (see Attachment II) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task.	**Personnel Decontamination** will consist of: - Wash hands and face, leave contamination reduction zone

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Air Monitoring Type/Action Levels	Personal Protective Equipment	Decontamination Procedures
Hand auguring and soil sampling	**Chemical hazards** 1) Chemical contaminants are not anticipated in the sampling areas because the intention is to work in areas unaffected by past operations to obtain background values. **Physical hazards** 2) Lifting (muscle strains and pulls) 3) Slip, trips, and falls 4) Biological hazards (Insect/animal bites and stings, poisonous plants)	1) The use of a PID or FID is specified as a precaution to verify that volatile chemicals are not present in the work area. Periodic screening of worker breathing zone areas is to be performed. Restrict the cross use of equipment and supplies from location to location without first going through a suitable decontamination. 2) Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques. 3) Preview work locations for unstable/uneven terrain. Identify all access/egress routes and locations for purposes of evacuation. 4) Avoid nesting areas, use repellents. Report potential hazards to the SSO. Tape up pants to boots. Wear Tyvek if poisonous plants are observed in the work area.	Monitoring instrumentation will be employed to confirm that work areas are clear of volatile chemical concerns by periodically screening worker breathing zone areas. The instrument may also be used as specified in the QA/QC plan to bias samples. Because no chemical contaminants are anticipated to be present, the occurrence of any sustained monitoring instrument readings above background in workers' breathing zone areas will be cause for immediate retreat to an unaffected area. In this event, the TOM must be contacted and a new sample location may be designated.	Level D - (Minimum Requirements) For confirmation sampling activities: - Standard field attire (sleeve shirt; long pants) - Work gloves (leather or heavy cloth) - Safety shoes (Steel toe/shank) - Safety glasses - Hardhat (as directed by the SSO) - Tyvek coveralls (if poisonous plants observed in work area) - Tape pants/boots to prevent tick access **Note:** The Safe Work Permit(s) for this task (see Attachment II) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task.	• Personal decontamination will consist of: • Equipment/sample/tool drop • Wash/rinse any reusable items • Remove outer PPE • Dispose of single-use PPE items • Wash hands and face Decontaminate sample containers in accordance with the QA/QC Plan. Personnel decontamination: • Wash and rinse outer protective garments • Remove outer protection garments • Wash hands and face, leave contamination reduction zone.
Decontamination of Sampling and Heavy Equipment	*Chemical Hazards* 1) Chemical contaminants are not anticipated in the sampling areas because the intention is to work in areas unaffected by past operations to obtain background values. 2) Decontamination fluids - Liquinox (detergent) and deionized water *Physical Hazards* 3) Lifting (muscle strains and pulls) 4) Slips, trips, and falls	1) and 2) Employ protective equipment to minimize contact with site contaminants and hazardous decontamination fluids. Obtain manufacturer's MSDS (if applicable) for any decontamination solutions used onsite. Use appropriate PPE as identified on MSDS. All chemicals used must be listed on the Chemical Inventory for the site, and site activities must be consistent with the Hazard Communication section of the Health and Safety Guidance Manual (Section 5). 3) Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques. 4) Preview work locations for unstable/uneven terrain.	Not necessary based on nature of work being conducted.	For decontamination of sampling equipment, the following PPE is required Level D Minimum requirements - - Standard field attire (Long sleeve shirt; long pants) - Safety shoes (Steel toe/shank) - Nitrile outer gloves - Safety glasses	**Personnel Decontamination** will consist of a soap/water wash and rinse for reusable outer protective equipment (i.e., gloves, as applicable). The decon function will take place at an area adjacent to the site activities. This procedure will consist of: - Equipment drop - Soap/water wash and rinse of outer gloves, as applicable **Sampling Equipment Decontamination** Sampling equipment will be decontaminated as per the requirements in the Sampling and Analysis Plan and/or Work Plan. All equipment used in the exclusion zone will require a complete decontamination between locations and prior to removal from the site. The FOL or the SSO will be responsible for evaluating equipment arriving on and leaving the site. No equipment will be authorized access or exit without this evaluation.

6.0 HAZARD ASSESSMENT

This section provides information regarding the chemical, physical, and biological hazards associated with the NSWC Crane site and the activities that are to be conducted as part of the planned scope of work.

6.1 CHEMICAL HAZARDS

Given the nature of the tasks to be completed, (i.e., background sampling) significant **chemical contaminants adversely impacting the field crews are not anticipated.** However, limited physical and biological hazards may be encountered. These are addressed in the following sections. The only anticipated potential for chemical exposures related to the planned activities are decontamination fluids, (Liquinox). For these substances, the SSO is responsible for completing section 5 of the Health and Safety Guidance Manual instituting a site-specific Hazard Communication Program, and for collecting the appropriate Material Safety Data Sheets (MSDS) from the chemical manufacturers/suppliers. The SSO is also responsible for completing the Safe Work Permit for the decontamination task using the appropriate MSDS (specifying any necessary PPE, etc.) and for reviewing the contents of the MSDSs and the Safety Work Permit with anyone who will use these substances.

6.2 PHYSICAL HAZARDS

Various physical hazards may be present during the performance of site activities. Each of these are addressed as they relate to the planned work in the following parts of this section.

Potential Physical Hazards

- Slips, trips, and falls
- Cuts (or other injuries associated with hand tool use)
- Lifting

These hazards and their associated control measures are discussed below.

Slips, trips, and falls - To find areas of certain soils types previously undisturbed by Base operations may require accessing remote areas. Conditions such as the terrain and/or heavy vegetation may create an increased potential for slip, trip, and fall hazards.

Control Measures –

1. The most feasible avenues of approach to sample points will be identified and cleared as necessary to permit field crews access to sample locations.
2. Establish anchor points and rope handrails for traversing/ascending/descending angles and slopes greater than 45% grade.
3. Footwear with an aggressive lug to provide adequate traction is recommended.

Cuts or other injuries associated with hand tool use – The clearing of brush and vegetation will be done using hand tools including machetes and brush axes. The use of these tools presents several potential physical hazards.

Control Measures –

1. Wear leather or heavy cotton work gloves when using these tools to protect against blisters, cuts, or other hand injuries.
2. Wear eye protection (safety glasses with side shields) to protect the eyes from twigs, sticks, or flying debris.
3. Make sure that other persons are not in the immediate cutting area (radius of the tool swing area).
4. Wear long pants and long-sleeved shirts to protect against abrasions.
5. If work will involve areas with overhead hazards (overhanging branches, etc.) wear hard hats
6. Wear sturdy work boots

6.3 BIOLOGICAL HAZARDS

As previously discussed, to enable acquisition of truly background samples the field crews may be required to go to remote locations. This increases the potential for field crews to encounter ticks, bees, mosquitoes and other insects, snakes, and poisonous vegetation.

Control Measures –

Ticks, insect/animal bites, and stings are difficult to control given the climate and environmental setting of NSWC Crane. However, in an effort to minimize this hazard the following control measures will be enacted where possible.

- Commercially available bug sprays and repellents will be used whenever possible – TCLP Pesticides analytical screening includes chlordane, endrin, lindane, methoxychlor, toxathene and heptachlor. Commercially available repellants may be used providing these components are not part of this analyte listing. Products such as DEET should not be applied directly to the skin due to potential irritation. This product, when permitted for use, should be applied over clothing articles.

- Loose fitting light colored clothing with long sleeves, where possible should be worn. This will also aid in insect control by providing a barrier between the field person and the insects and to provide easy recognition of crawling insects against the lighter background. Pant legs should be secured to the work-boots using duct tape to prevent access by ticks. Mosquito nets are also recommended for use when commercially available repellents are not permitted.

- Clothing/limited body checks for ticks and other crawling insects should be conducted upon exiting heavily vegetated areas. Workers should perform a more detailed check of themselves when showering in the evening. Ticks prefer moist areas of the body (arm-pits, genitals, etc.) and will migrate to those locations.

- The FOL/SSO will preview all access routes and work areas in an effort to identify physical hazards including nesting areas in and around the work sites. These areas will be flagged and communicated to all site personnel.

- The FOL/SSO must determine if site personnel (through their Medical Data Sheets), suffer allergic reactions to bee and other insect stings and bites. When personnel are on-site who are predisposed to these conditions, the FOL/SSO will take the appropriate measures to secure physician directed antidotes.

Note to all personnel: It is imperative that any allergies be reported on the Medical Data Sheets and to the SSO.

Tick and Mosquito Transmitted Illnesses And Diseases

Ticks and mosquitoes have been identified in the transmission of diseases including Lyme's disease and malaria. Warm months (Spring through early Fall) are the most predominant time for this hazard. However, due to the climate and environmental setting of NSWC Crane, this hazard may occur year round.

Information concerning vector transmitted Lyme's Disease including recognition, evaluation, tick removal, and control is provided in Section 4.0 of the Health and Safety Guidance Manual.

Malaria may occur when a mosquito or other infected insect sucks blood from an infected person, and the insect becomes the carrier to infect other hosts. The parasite reproduces within the mosquito, and is then is passed on to another person through the biting action.

Acute symptoms include chills accompanied by fever and general flu like symptoms. This generally terminates in a sweating stage. These symptoms may recur every 48 to 72 hours.

Conditions such as this should not be taken for granted and should be reported to the SSO immediately.

Snakes and Other Wild Animal Encounters

Indigenous animals including snakes (poisonous and non-poisonous varieties), raccoons, and other animals native to the region may have to be contended with. These animals may be encountered if work locations encroach on nesting or territories claimed by these animals.

To avoid the obvious hazards conveyed as part of a direct encounter, the following actions will be taken to minimize impact on the field crews and/or operations.

- FOL/SSO will preview access routes and work locations for nesting areas or signs of animal activities (tracks, foraging areas, etc.). All identified suspect areas will be communicated to the field crews. Snake chaps will be required as a precaution.

Snake Bites

First-Aid for snake bites should proceed in accordance with the First-Aid Attachment 5.

Poisonous Plants

Various plants which can cause allergic reactions may be encountered during field work. These include, but may not be limited to, poison ivy, poison oak, and poison sumac. Contact of field personnel with previous plants may occur when clearing vegetation for access to work areas, or through movement through these plants. An irritating, allergic reaction can occur when direct contact is achieved between the plant and the bare skin of a field person, or the plant and some piece of equipment or clothing article that then later comes in contact with the bare skin of a field person. Oils are transferred from the plant to exposed skin, clothing, or piece of equipment. The degree of the irritating, allergic reaction can vary significantly from one person to the next.

Protective measures to control and minimize the effects of this hazard may include, but not limited to, the following:

- Identify plants for field personnel.

  - Poison Ivy - Characterized by climbing vines, three leaf configuration ovate to elliptical in shape, deep green leaves with a reddish tint, greenish flowers, and white berries.

  - Poison Sumac - Characterized as a tall bush of the sumac family bearing compound leaves (7-13 entire leaflets), branched from a central axis, drooping, with axillary clusters of white fruit.

    NOTE: These white fruits and berries may exist only during pubescent stages.

  - Poison oak - Characterized as similar to poison ivy consisting of a shrub, stems erect, 0.3 to 2.0 meters tall, leaflets consist of broad thick lobes coarsely serrated configuration, denser at the base, less so than the top.

- Protective measures may include wearing disposable garments such as Tyvek when clearing brush. These may be carefully removed and disposed of along with any oils accumulated from the plants.

- Personal Hygiene - The oils obtained from the plants will only elicit an allergic response when the person's bare skin layer is contacted. This can be aggravated through skin pores open when perspiring, or through breaks in the skin such as cuts, nicks, scratches, etc.. This can also be accomplished when using excessively hot water for cleaning the skin, which also causes pores to open. Prior to break time, lunch time, etc. personnel should wash with cool water and soap to remove as much of the oils as possible. In heavily vegetated areas of these plants, additional measures including barrier creams and blocks may be used to prevent the oils from accessing and penetrating the skin.

All of these plants present an airborne sensitization hazard when burned. This is not to occur as part of this scope of work and therefore will not be addressed.

Each of these physical hazards is discussed greater detail in the Health and Safety Guidance Manual. Additionally, information on these physical hazards and their associated control measures are discussed in Table 5-1 of the site specific HASP.

7.0 AIR MONITORING

Monitoring devices such as Direct Reading Instruments (DRIs), will be used at the site to detect and evaluate the presence of site contaminants and other potentially harmful agents. The specific type of monitoring and the associated instruments, frequency of use, and applicable action levels are dependent upon the specific scope of work and the contaminants of concern. As a result, specific air monitoring measures and requirements have been established in Table 5-1 of this site specific HASP. Additionally, Section 1.0 of the Tetra Tech NUS Health and Safety Guidance Manual contains detailed information regarding direct reading instrumentation, personal and area air sampling procedures, as well as general calibration procedures of various instruments.

8.0 TRAINING/MEDICAL SURVEILLANCE REQUIREMENTS

8.1 INTRODUCTORY/REFRESHER/SUPERVISORY TRAINING

8.1.1 Requirements for Tetra Tech NUS Personnel

All Tetra Tech NUS personnel must complete 40 hours of introductory hazardous waste site training in accordance with 29 CFR 1910.120(e) prior to performing work at NSWC Crane. Additionally, Tetra Tech NUS personnel who have had introductory training more than 12 months prior to site work must have completed 8 hours of refresher training within the past 12 months before being cleared for site work. 8-hour Supervisory Training in accordance with 29 CFR 1910.120(e)(4) will be required for site supervisory personnel.

Documentation of Tetra Tech NUS Health and Safety Training will be maintained at the project site. Copies of certificates or other official documentation will be used to fulfill this requirement.

The FOL/SSO will conduct a brief meeting daily to discuss planned operations. This will at least cover the review of the Safe Work Permits for that day's activities. At the end of the workday, a short meeting will be held to discuss the operations completed and any problems that were encountered.

8.1.2 Requirements for Subcontractors

All Tetra Tech NUS subcontractor personnel must have completed introductory hazardous waste site training or equivalent work experience as defined in OSHA Standard 29 CFR 1910.120(e) and 8 hours of refresher training meeting the requirements of 29 CFR 1910.120(e)(8) prior to performing field work at NSWC Crane. Tetra Tech NUS subcontractors must certify that each employee has had such training by sending Tetra Tech NUS a letter, on company letterhead, containing the information in the example letter provided in Figure 8-1, and providing copies of all training certificates.

FIGURE 8-1

TRAINING LETTER

The following statements must be typed on company letterhead and signed by an officer of the company and accompany copies of associated training certificates:

LOGO
XYZ CORPORATION
555 E. 5th Street
Nowheresville, Kansas 55555

Month, day, year

Keith Henn
Task Order Manager
Tetra Tech NUS
Foster Plaza VII 661 Andersen Drive
Pittsburgh, Pennsylvania 15220

Subject: HAZWOPER Training for NSWC Crane

Dear Mr. Henn:

As an officer of XYZ Corporation, I hereby state that I am aware of potential hazardous nature of the subject project. I also understand that is out responsibility to comply with all applicable occupational safety and health regulations including those stipulated in Title 29 of the Code of Federal Regulations (CFR), Parts 1900 through 1910 and Part 126.

I also understand that Title 29 CFR 1910.120 entitled "Hazardous Waste Operations and Emergency Response" requires appropriate level of training for certain employees engaged in hazardous waste operations. In this regard, I hereby state that the following employees have had 40 hours of introductory hazardous waste site training or equivalent work experience as requested by 29 CFR 1910.120(e) and have had 8 hours of refresher training as required by 29 CFR 1910.120(e)(8),

LIST FULL NAMES OF EMPLOYEES AND THEIR SOCIAL SECURITY NUMBERS HERE

Should you have any questions, please contact me at (555) 555-5555.

Sincerely,

(Name of Company Officer)

8.2 SITE-SPECIFIC TRAINING

Tetra Tech NUS will provide site-specific training to all Tetra Tech NUS employees and subcontractor personnel who will perform work on this project. Site-specific training will also be provided to all site visitors (DOD, EPA, etc.) who may enter the site to perform functions that may or may not be directly related to site operations. Site-specific training will include:

- Names of personnel and alternates responsible for site safety and health
- Safety, health and other hazards present on site
- Use of personal protective equipment
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure to site contaminants
- The contents of the site-specific health and safety plan including the contents of Table 5-1 and 6-1.
- Emergency response procedures (evacuation and assembly points)
- Spill response procedures
- Review the contents of relevant Material Safety Data Sheets

Site-specific documentation will be established through the use of Figure 8-2. All site personnel and visitors must sign this document upon receiving site-specific training prior to commencement of site activities.

8.3 MEDICAL SURVEILLANCE

8.3.1 Medical Surveillance Requirements For Tetra Tech NUS Personnel

All Tetra Tech NUS personnel participating in project field activities will have had a physical examination meeting the requirements of Tetra Tech NUS' medical surveillance program and will be medically qualified to perform hazardous waste site work using respiratory protection.

Documentation for medical clearances will be maintained in the Tetra Tech NUS Pittsburgh office and made available as necessary.

FIGURE 8-2

SITE-SPECIFIC TRAINING DOCUMENTATION

My signature below indicates that I am aware of the potential hazardous nature of performing investigation activities at NSWC Crane, and that I have received site-specific training that included the elements presented below:

- Names of personnel and alternates responsible for site safety and health
- Safety, health and other hazards present on site
- Use of personal protective equipment
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure
- The contents of the health and safety plan including Table 5-1 and 6-1
- Emergency response procedures (evacuation and assembly points)
- Review contents of relevant Material Safety Data Sheets and Chemical Data Sheets / Hazard Lines

I further state that I have been given the opportunity to ask questions and that all of my questions have been answered to my satisfaction.

I further state by the presence of my signature below the date of my training (introductory, refresher, and supervisory, as applicable), and my medical surveillance requirements are accurate and correct to the best of my knowledge.

Name (Printed and Signature)	Site-Specific Training Date	40-Hour Training (Date)	8-Hour Refresher Training (Date)	8-Hour Supervisory Training (Date)	Medical Exam

8.3.2 Medical Surveillance Requirements For Subcontractors

Subcontractor personnel are required to obtain a certificate of their ability to perform hazardous waste site work and to wear respiratory protection. The "Subcontractor Medical Approval Form" provided in Figure 8-3 of this HASP shall be used to satisfy this requirement providing that it is properly completed and signed by a licensed physician.

Subcontractors who have a company medical surveillance program meeting the requirements of paragraph (f) of OSHA 29 CFR 1910.120 can substitute "Subcontractor Medical Approval Form" with a letter, on company letterhead, containing all of the information in the example letter presented in Figure 8-4.

8.3.3 Requirements For All Field Personnel

Each field team member (including subcontractors and visitors entering the exclusion zone) shall be required to complete and submit a copy of the Medical Data Sheet found in Attachment 4. This shall be provided to the SSO prior to participating in site activities. The purpose of this document is to provide site personnel and emergency responders with additional information that may be necessary in order to administer medical attention.

8.4 SUBCONTRACTOR EXCEPTION

Subcontractors who will not enter the exclusion zone during operation, and whose activities involve no potential for exposure to site contaminants, will not be required to meet the requirements for training/medical surveillance, other than site-specific training as stipulated in Section 8-2. **The use of this type of exception is permissible only with the prior consent of the CLEAN HSM.**

FIGURE 8-3

SUBCONTRACTOR MEDICAL APPROVAL FORM

For employees of____
Company Name

Participant Name: ______________________________ Date of Exam: ________________

Part A

The above-named individual has:

1. Undergone a physical examination in accordance with OSHA Standard 29 CFR 1910.120, paragraph (f) and found to be medically -

   ( ) qualified to perform work at the NSWC Crane work site
   ( ) not qualified to perform work at the NSWC Crane work site

   and,

2. Undergone a physical examination as per OSHA 29 CFR 1910.134(b)(10) and found to be medically -

   ( ) qualified to wear respiratory protection
   ( ) not qualified to wear respiratory protection

My evaluation has been based on the following information, as provided to me by the employer.

( ) A copy of OSHA Standard 29 CFR 1910.120 and appendices.
( ) A description of the employee's duties as they relate to the employee's exposures.
( ) A list of known/suspected contaminants and their concentrations (if known).
( ) A description of any personal protective equipment used or to be used.
( ) Information from previous medical examinations of the employee which is not readily available to the examining physician.

Part B

I, _______________________________, have examined _________________________________
Physician's Name (print) Participant's Name (print)
and have determined the following information:

FIGURE 8-3
SUBCONTRACTOR MEDICAL APPROVAL FORM
PAGE TWO

1. Results of the medical examination and tests (excluding finding or diagnoses unrelated to occupational exposure):

____

____

____

2. Any detected medical conditions that would place the employee at increased risk of material impairment of the employee's health:

____

____

____

3. Recommended limitations upon the employee's assigned work:

____

____

____

I have informed this participant of the results of this medical examination and any medical conditions that require further examination of treatment.

Based on the information provided to me, and in view of the activities and hazard potentials involved at the NSWC Crane work site, this participant

( ) may
( ) may not

perform his/her assigned task.

Physician's Signature ______________________

Address ______________________

Phone Number ______________________

NOTE: Copies of test results are maintained and available at:

____
Address

FIGURE 8-4

MEDICAL SURVEILLANCE LETTER

The following statements must be typed on company letterhead and signed by an officer of the company:

LOGO
XYZ CORPORATION
555 E. 5th Street
Nowheresville, Kansas 55555

Month, day, year

Keith Henn
Project Manager
Tetra Tech NUS Corp.
Foster Plaza VII 661 Andersen Drive
Pittsburgh, Pennsylvania 15220

Subject: Medical Surveillance for NSWC Crane

Dear Mr. Henn:

As an officer of XYZ Corporation, I hereby state that the persons listed below participate in a medical surveillance program meeting the requirements contained in paragraph (f) of Title 29 of the Code of Federal Regulations (CFR), Part 1910.120 entitled "Hazardous Waste Operations and Emergency Response" I further state that the persons listed below have had physical examinations under this program within the past 12 months and that they have been cleared, by a licensed physician, to perform hazardous waste site work and to wear positive and negative pressure respiratory protection. I also state that, to my knowledge, no person listed below has any medical restriction that would preclude him/her from working at the NSWC Crane Site.

LIST FULL NAMES OF EMPLOYEES AND THEIR SOCIAL SECURITY NUMBERS HERE

Should you have any questions, please contact me at (555) 555-5555.

Sincerely,

(Name of Company Officer)

9.0 SITE CONTROL

9.1 WORK ZONES

Tetra Tech NUS will delineate work zones and use a these work zones in conjunction with decontamination procedures to prevent the spread of contaminants into previously unaffected areas of the site. It is anticipated that a three zone approach will be used during work at this site; an Exclusion Zone, a Contamination Reduction Zone, and a Support Zone. This will be used to control access to the work areas, restricting the general public, avoiding potentials to spread any contaminants, and to protect individuals who are not cleared to enter by way of training and/or medical surveillance qualifications.

Section 10 of the Health and Safety Guidance Manual presents a detailed discussion on this three-zone approach. Basically, each sampling area will be established as an Exclusion Zone, with any personnel decontamination activities taking place immediately outside of each of these work areas. All exclusion zones will be delineated using barrier tape, cones and/or drive poles, and postings to inform and direct site personnel. For equipment decontamination, a centralized Contamination Reduction Zone may be established. The Support Zone can consist of a field trailer, a office space made available by the Base, or some other uncontaminated, controlled point. The Support Zone for this project will include a staging area where site vehicles can be parked, equipment will be unloaded, and where food and drink containers will be maintained. In all cases, the support zones will be established at areas of the site where exposure to site contaminants would not be expected during normal working conditions or foreseeable emergencies.

9.2 SAFE WORK PERMITS

All exclusion zone work conducted in support of this project will be performed using Safe Work Permits to guide and direct field crews on a task by task basis. An example of the Safe Work Permit to be used is included in Figure 9-1. These work permits will be further supported by the daily meetings conducted by the FOL/SSO. This will ensure that site-specific considerations and changing conditions are incorporated into the planning effort. All permits will require the signatures of the FOL/SSO. All personnel engaged in onsite activities must be made aware of the elements indicating levels of protection and precautionary measures to be used.

The use of these permits will establish and provide for reviewing protective measures and hazards associated with each operation. This HASP will be used as the primary reference for selecting levels of protection and control measures. The work permit will take precedence over the HASP when more conservative measures are required based on specific site conditions.

9.3 SITE MAP

Once the areas of contamination, access routes, topography, dispersion routes are determined, a site map will be generated and adjusted as site conditions change. This map will be posted to illustrate up-to-date information of contaminants and adjustment of zones and access points.

9.4 BUDDY SYSTEM

Personnel engaged in on-site activities will practice the "buddy system" to ensure the safety of all personnel involved in this operation.

9.5 MATERIAL SAFETY DATA SHEET (MSDS) REQUIREMENTS

Tetra Tech NUS personnel will provide MSDS's for all chemicals brought on-site. The contents of these documents will be reviewed by the SSO with the user(s) of the chemical substances prior to any actual use or application or the substances on-site. The MSDS's will be maintained in a central location (i.e., temporary office) and will be available for anyone to review upon request. The SSO will be responsible for implementing a site-specific Hazard Communication Program using section 5 of the Health and Safety Guidance Manual. This includes collection of MSDSs, creation and maintenance of an accurate Chemical Inventory Listing, addressing container labelling and personnel training issues, and other aspects as defined in that section.

9.6 COMMUNICATION

It is anticipated that site personnel will be working in close proximity during proposed field activities. In the event that site personnel are in isolated areas or are separated by significant distances, a supported means of communication between field crews will be utilized. Two-way radio communication devices, if needed, will be submitted for NSWC Crane approval.

External communications will be accomplished utilizing telephones at predetermined and approved locations or through cellular phones. External communication will primarily be used for the purpose of resource and emergency resource communications. Prior to the commencement of site activities, the FOL will determine and arrange for telephone communications, if it is determined a cellular means will not be used.

9.7 SITE VISITORS

Potential site visitors that may be encountered during the performance of the field work could include the following:

- Personnel invited to observe or participate in operations by Tetra Tech NUS.
- Regulatory personnel (i.e., DOD, EPA, OSHA, etc.)
- Southern Division Navy personnel
- Other authorized visitors

All non-DOD personnel working on this project are required to gain initial access to the base by coordinating with our TOM or designee and following established base access procedures.

Once access to the base is obtained, all personnel who require access to Tetra Tech NUS work sites (areas of ongoing operations) will be required to obtain permission from the FOL and the Base Contact. Upon gaining access to the work site, all site visitors wishing to observe operations in progress will be required to meet the minimum requirements as stipulated below.

- All site visitors will be routed to the FOL, who will sign them into the field logbook. Information to be recorded in the logbook will include the individuals name (proper identification required), who they represent, and the purpose for the visit. **The FOL is responsible for ensuring that site visitors are escorted at all times.**

- All site visitors will be required to produce the necessary information supporting clearance on to the site. This includes information attesting to applicable training (40-hours of HAZWOPER training required for all Southern Division Navy Personnel), and medical surveillance as stipulated in Section 8.3, of this document. In addition, to enter the sites operational zones during planned activities, all visitors will be required to first go through site-specific training covering the topics stipulated in Section 8.2 of this HASP.

Once the site visitors have completed the above items they will be permitted to enter the site and applicable operational areas. All visitors are required to observe the protective equipment and site restrictions in effect at the work areas visited. Any and all visitors not meeting the requirements as stipulated in this plan for site clearance will not be permitted to enter the site operational zones during planned activities. Any incidence of unauthorized site visitation will cause all on-site activities to be terminated until that visitor can be removed. Removal of unauthorized visitors will be accomplished with support form the Base Contact, if necessary. At a minimum, the Base Contact will be notified of any unauthorized visitors.

9.8 SITE SECURITY

As this activity will take place at a Navy facility, the first line of security will take place at the base gate restricting the general public. The second line of security will take place at the work site referring interested parties to the FOL and Base Contact.

Security at the work areas will be accomplished using field personnel. This is a multiple person operation, involving multiple operational zones. Tetra Tech NUS personnel will retain complete control over active operational zones.

The Base Contact will serve as the focal point for base personnel and interested parties and will serve as the primary enforcement contact.

FIGURE 9-1
SAFE WORK PERMIT

Permit No. ________________ Date: ______________________________ Time: From _________ to _________

SECTION I: General Job Scope (To be filled in by person performing work)

I. Work limited to the following (description, area, equipment used): ____

II. Names: ____

III. Onsite Inspection conducted ☐ Yes ☐ No Initials of Inspector ________________ ________________
TtNUS

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. Protective equipment required
Level D ☐ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required
Full face APR ☐ Escape Pack ☐
Half face APR ☐ SCBA ☐
SKA-PAC SAR ☐ Bottle Trailer ☐
Skid Rig ☐ None ☐

Modifications/Exceptions: ____

V. Chemicals of Concern	Action Level(s)	Response Measures
________________	________________	________________
________________	________________	________________

VI. Additional Safety Equipment/Procedures

Hardhat	☐ Yes	☐ No	Hearing Protection (Plugs/Muffs)	☐ Yes	☐ No
Safety Glasses	☐ Yes	☐ No	Safety belt/harness	☐ Yes	☐ No
Chemical/splash goggles	☐ Yes	☐ No	Radio	☐ Yes	☐ No
Splash Shield	☐ Yes	☐ No	Barricades	☐ Yes	☐ No
Splash suite/coveralls	☐ Yes	☐ No	Gloves (Type)	☐ Yes	☐ No
Steel toe/shank Workboots	☐ Yes	☐ No	Work/rest regimen	☐ Yes	☐ No

Modifications/Exceptions: ____

VII. Procedure review with permit acceptors

	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☐	☐	Emergency alarms	☐	☐
Procedure for safe job completion	☐	☐	Evacuation routes	☐	☐
Contractor tools/equipment inspected	☐	☐	Assembly points	☐	☐

VII. Equipment Preparation

	Yes	NA
Equipment drained/depressured	☐	☐
Equipment purged/cleaned	☐	☐
Isolation checklist completed	☐	☐
Electrical lockout required/field switch tested	☐	☐
Blinds/misalignments/blocks & bleeds in place	☐	☐
Hazardous materials on walls/behind liners considered	☐	☐

VIII. Additional Permits required (Hot work, encl PMed entry, excavation etc.). ☐ Yes ☐ No
If yes, fill out appropriate section(s) on safety work permit addendum

IX. Special instructions, precautions: ____

Permit Issued by: ______________________ Permit Accepted by: ______________________
Job Completed by: ______________________ Date: ______________________

10.0 SPILL CONTAINMENT PROGRAM

10.1 SCOPE AND APPLICATION

It is not anticipated that bulk hazardous materials (over 55-gallons) will be handled at any given time as part of the scope of work. It is not anticipated that spillage of any materials will constitute a danger to human health or the environment.

11.0 CONFINED SPACE ENTRY

It is not anticipated, under the proposed scope of work, that confined space and permit-required confined space activities will be conducted. **Therefore, personnel under the provisions of this HASP are not allowed, under any circumstances, to enter confined spaces**. A confined space is defined as an area which has one or more of the following characteristics:

- Is large enough and so configured that an employee can bodily enter and perform assigned work.
- Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry).
- Is not designed for continuous employee occupancy.

A Permit-Required Confined Space is one that:

- Contains or has a potential to contain a hazardous atmosphere.
- Contains a material that has the potential to engulf an entrant.
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section.
- Contains any other recognized, serious, safety or health hazard.

For further information on confined space, consult the Health and Safety Guidance Manual or call the PHSO. If confined space operations are to be performed as part of the scope of work, detailed procedures and training requirements will have to be addressed.

12.0 MATERIALS AND DOCUMENTS

The Tetra Tech NUS FOL shall ensure the following materials/documents are taken to the project site and utilized as required.

- Blank Incident Report forms
- Medical Data Sheets
- Material Safety Data Sheets for decon solutions and other substances brought to the site
- Follow-Up Reports (to be completed by the FOL)
- OSHA Job Safety and Health Poster (posted at the site)
- Training/Medical Surveillance Documentation Form (Blank)
- OSHA 29 CFR 1910.120 (HAZWOP) training certificates
- First Aid Supply Usage Form
- Emergency Reference Form (Section 2.0, extra copy for posting)
- Health and Safety Guidance Manual

13.0 GLOSSARY

ABG	Ammunition Burning Grounds
ACGIH	American Conference of Governmental Industrial Hygienists
APR	Air Purifying Respirators
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CLEAN	Comprehensive Long-Term Environmental Action Navy
CNS	Central Nervous System
CQP	Construction Quality Plan
CSP	Certified Safety Professional
CTO	Contract Task Order
DR	Demolition Range
DRI	Direct Reading Instruments
eV	electron Volts
FID	Flame Ionization Detector
FOL	Field Operations Leader
HSGM	Health and Safety Guidance Manual
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	High Efficiency Particulate Air
HSM	Health and Safety Manager
IDLH	Immediately Dangerous to Life and Health
N/A	Not Available
NIOSH	National Institute Occupational Safety and Health
NSWC	Naval Surface Warfare Center
OJT	Old Jeep Trail
ORR	Old Rifle Range
OSHA	Occupational Safety and Health Administration (U.S. Department of Labor)
PEL	Permissible Exposure Limit
PHSO	Project Health and Safety Manager
PID	Photo Ionization Detector
PPE	Personal Protective Equipment
PPM	Parts Per Million
PVC	Poly Vinyl Chloride
RCRA	Resource Conservation and Recovery Act

SAP	Sampling and Analyses Plan
SCBA	Self Contained Breathing Apparatus
SSO	Site Safety Officer
STEL	Short Term Exposure Limit
SWL	Sanitary Waste Landfill
TOM	Task Order Manager
TWA	Time Weighted Average
UV	Ultra Violet
WP	Work Plan

ATTACHMENT 1
GENERAL EMERGENCY FIRST AID MEASURES

This attachment is intended to provide general instruction in the provision of First-Aid. This attachment is not intended to be all-inclusive, it is however intended to provide the field crew person with limitations as to the extent of care. **If First Aid treatment is necessary because of an exposure to a chemical product brought to the work site, *always* consult the chemical's Material Safety Data Sheet for appropriate First Aid treatment.**

The First-Aid topics discussed in this text are those in which Tetra Tech NUS personnel may potentially encounter through the course of normal field work.

First-Aid For Eye Injuries

First-Aid Supplies/Equipment

- Eyewash (See note for size and type)
- Sterile gauze wraps or pads
- Cold Pack(s)

The speed of providing that initial flush of the eyes is critical. Insure all emergency care equipment is readily available and not buried within your supplies. A small amount of eyewash delivered immediately is better than 15 minutes worth delivered late.

First-Aid Procedure for Eye Injuries (Chemicals)

For Acids/Caustics

1. Have someone notify emergency medical support identified in Table 2-1 of your HASP.
2. Hold eyes open. If your assistance is required in flushing the injured persons eyes apply surgeons gloves and Safety Glasses
3. Flush with water for 15 minutes
4. If irritation & discomfort is evident, apply loosely fitting gauze bandage over the eyes.
5. Transport for medical evaluation/treatment

For Incidental Splashes of Dilute Chemicals

1. Hold eyes open. If your assistance is required in flushing the injured persons eyes apply surgeons gloves and Safety Glasses
2. Flush with water (Portable eyewash bottles)
3. If irritation & discomfort are evident or persists seek medical attention

First-Aid Procedure for Eye Injuries
(Lacerations, Puncture, or Eye Loss)

1. Have someone notify emergency medical support identified in Table 2-1 of your HASP.
2. Cover both eyes with loose sterile dressing.

DO NOT ATTEMPT TO WASH THE EYE(S)

3. If ambulance service is not available as part of the emergency action plan or you are in a remote location, transport victim to medical support facility IMMEDIATELY.

First-Aid Procedure for Eye Injuries
(Blunt Injury/Contusion)

1. Apply loose sterile dressing over the eye(s).
2. Over the dressing, apply a Cold Pack to control swelling
3. Assess the seriousness of the damage.
4. Transport for medical evaluation, as necessary.

First-Aid Procedure for Eye Injuries
(Foreign Objects)

1. Attempt to locate the object by gently pulling down the lower or up the upper eyelid, as appropriate.
2. Once the object is located, try to dislodge using the corner of a clean tissue or cloth (Never use dry cotton around the eye).
3. Hold eyes open. If your assistance is required in flushing the injured person's eyes apply surgeons gloves and Safety Glasses
4. Flush with water (Portable eyewash bottles)
5. If irritation & discomfort is evident or persists, Seek Medical Attention

First-Aid For Skin Injuries	First-Aid For Skin Injuries
For Acids/Caustics 1. Deluge affected area with water. If it necessary for you to provide physical assistance put on surgeon gloves and safety glasses. 2. Wash area with mild soap and plenty of water. 3. If you cannot assess whether the materials were successfully removed prior to causing damage, or if irritation & discomfort is evident, apply loosely fitting gauze bandage over the affected area. 4. If ambulance service is not available as part of the emergency action plan or you are in a remote location, transport victim to medical support facility for medical evaluation/treatment. **For Incidental Splashes of Dilute Chemicals** 1. Deluge area splashed with eyewash bottle or other clean water source. If your assistance is required in flushing the injured persons skin apply surgeons gloves and Safety Glasses 2. If irritation & discomfort is evident or persists, Seek Medical Attention	**For Lacerations/Incisions with Severe Bleeding** 1. Have someone notify emergency medical support identified in Table 2-1 of your HASP. 2. With surgeon's gloves, and safety glasses in place, apply direct pressure by hand over a padded dressing covering the wound. **Note:** As dressings become soaked, apply additional dressings. Do NOT remove the soaked dressings. 3. Elevate the wound above the level of the heart. 4. If this is unsuccessful in controlling the bleeding, pressure on a supplying artery may be necessary. Compression points: ➢ Inside the bicep - Apply pressure to the brachial artery against the arm bone. ➢ On the inside of the uper thigh – Apply pressure to the femoral artery against the pelvic bone. 5. If ambulance service is not available as part of the emergency action plan or you are in a remote location, transport victim to medical support facility.

First-Aid For Skin Injuries	First-Aid For Skin Injuries
For Wounds Without Severe Bleeding 1. Wash your hands with soap & water. 2. Wash the area around the wound with mild soap & water. 3. Flush the wound with clean water to remove any foreign objects. Debris may be removed using sterilized tweezers and repeated flushing of the wound. 4. Blot dry using a sterile dressing. 5. Apply a sterile dressing and secure it in place. 6. Transport for medical evaluation/treatment	**For Blunt Trauma (Closed Wounds)** 1. Treat for shock (as appropriate). 2. Apply cold compress or ice pack. 3. Transport for medical evaluation/treatment

Note: The selection of an Eyewash - If your job entails you working around or directly with corrosive materials that present a splash potential and extreme eye hazards, suitable provisions for an eyewash must be taken. These provisions require the eyewash selected must be capable of delivering sufficient amount or volume (Capable of 15 minutes uninterrupted flow).

ATTACHMENT 2
SAFE WORK PERMITS

SAFE WORK PERMIT
Hand Augering

Permit No. ________________ Date: ________________________ Time: From ________ to ________

SECTION I: General Job Scope (To be filled in by person performing work)

I. Work limited to the following (description, area, equipment used): Base-Wide surface and subsurface soil sampling using hand auger. Equipment to be used: stainless steel hand augers (buckets and stems), stainless steel mixing bowls, and disposable spatulas.

II. Names: ____

III. Onsite Inspection conducted ☐ Yes ☐ No Initials of Inspector ______________ TtNUS ______________

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. Protective equipment required

Level D ☒ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required

Full face APR	☐	Escape Pack	☐
Half face APR	☐	SCBA	☐
SKA-PAC SAR	☐	Bottle Trailer	☐
Skid Rig	☐	None	☒

Modifications/Exceptions: Clear areas of underground utilities prior to sampling

V.

Chemicals of Concern	Action Level(s)	Response Measures
None	PID/FID> background in BZ	Retreat

VI. Additional Safety Equipment/Procedures – Check appropriate box for ALL entries

Hardhat	☐ Yes	☐ No	Hearing Protection (Plugs/Muffs)	☐ Yes	☒ No
Safety Glasses	☒ Yes	☐ No	Safety belt/harness	☐ Yes	☒ No
Chemical/splash goggles	☐ Yes	☒ No	Radio	☐ Yes	☐ No
Splash Shield	☐ Yes	☒ No	Barricades	☐ Yes	☐ No
Splash suit/coveralls	☐ Yes	☐ No	Gloves (Type- Inner nitrile)	☒ Yes	☐ No
Steel toe Work-boots	☒ Yes	☐ No	Work/rest regimen	☐ Yes	☒ No

Modifications/Exceptions: Gloves - inner nitrile type surgeons gloves, layered if necessary. Tape pant legs to boots and wear light colored clothing due to heavy tick infestation. Use insect repellants. Work-boots should have aggressive lug to control slip, trip, and fall hazards when traversing or coming up and down steep terrain. Remote and selected locations (due to habitat considerations) will require the use of snake chaps/pants. Hard hats and hearing protection at SSO direction.

VII. Procedure review with permit acceptors

	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☐	☐	Emergency alarms	☐	☐
Procedure for safe job completion per HASP	☐	☐	Evacuation routes	☐	☐
Contractor tools/equipment inspected	☐	☐	Assembly points	☐	☐

VIII. Site Preparation

Utility Clearances Obtained for any areas of subsurface investigations ☐ Yes ☐ No

IX.. Equipment Preparation

	Yes	NA
Equipment drained/depressurized	☐	☒
Equipment purged/cleaned	☐	☒
Isolation checklist completed	☐	☒
Electrical lockout required/field switch tested	☐	☒
Blinds/misalignments/blocks & bleeds in place	☐	☒
Hazardous materials on walls/behind liners considered	☐	☒

X. Additional Permits required (Hot work, Confined Space Entry, Excavation etc.)........................ ☐ Yes ☒ No
If yes, contact the Health Sciences Department

XI. Special instructions, precautions: The above selected PPE and safety control measures are intended to protect individuals from hazards associated with this task. Avoid insect nesting areas to the extent possible as well as poisonous plant varieties discussed in the biological hazards section. Buddy system; GPS or compass and maps for remote areas. Rope handrails shall be used for traversing, ascending, and descending hillside angles greater than 45° slope.

Permit Issued by:______________________ Permit Accepted by:______________________

SAFE WORK PERMIT
Brush Clearing

Permit No. ________________ Date: ____________________________ Time: From _________ to _________

SECTION I: General Job Scope (To be filled in by person performing work)

I. Work limited to the following (description, area, equipment used: Clearing of brush using hand tools such as machetes and brush axes.

II. Names: ________________________________

III. Onsite Inspection conducted ☐ Yes ☐ No Initials of Inspector ______________ ______________
TtNUS

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. Protective equipment required

Level D ☒ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required

Full face APR	☐	Escape Pack	☐
Half face APR	☐	SCBA	☐
SKA-PAC SAR	☐	Bottle Trailer	☐
Skid Rig	☐	None	☒

Modifications/Exceptions: ________________________________

V.

Chemicals of Concern	Action Level(s)	Response Measures
None	None	None

VI. Additional Safety Equipment/Procedures – Check appropriate box for ALL entries

Hardhat	☐ Yes ☐ No		Hearing Protection (Plugs/Muffs)	☐ Yes ☒ No	
Safety Glasses	☒ Yes ☐ No		Safety belt/harness	☐ Yes ☐ No	
Chemical/splash goggles	☐ Yes ☒ No		Radio	☐ Yes ☐ No	
Splash Shield	☐ Yes ☒ No		Barricades	☐ Yes ☐ No	
Splash suit/coveralls	☐ Yes ☐ No		Gloves	☒ Yes ☐ No	
Steel toe Work-boots	☒ Yes ☐ No		Work/rest regimen	☐ Yes ☐ No	

Modifications/Exceptions: Leather or heavy cloth work gloves. It is recommended pant legs taped to boots and light colored clothing due to heavy tick infestation. Use insect repellants. It is also recommended that the work-boot have soles with aggressive lug to control slip, trip, and fall hazards when traversing or coming up and down steep terrain. Remote and selected locations (due to habitat considerations) will require the use of snake chaps/pants. Hard hats if working among low overhead branches or if other overhead hazards exist. Wear Tyvek if poison ivy or other poisonous plants are in the areas to be cleared.

VII. Procedure review with permit acceptors

	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☐	☐	Emergency alarms	☐	☐
Procedure for safe job completion per HASP	☐	☐	Evacuation routes	☐	☐
Contractor tools/equipment inspected	☐	☐	Assembly points	☐	☐

VIII. Site Preparation
Utility Clearances Obtained for any areas of subsurface investigations ☐ Yes ☐ No ☐ NA

IX.. Equipment Preparation

	Yes	NA
Equipment drained/depressurized	☐	☒
Equipment purged/cleaned	☐	☒
Isolation checklist completed	☐	☒
Electrical lockout required/field switch tested	☐	☒
Blinds/misalignments/blocks & bleeds in place	☐	☒
Hazardous materials on walls/behind liners considered	☐	☒

X. Additional Permits required (Hot work, Confined Space Entry, Excavation etc.)................. ☐ Yes ☐ No
If yes, contact the Health Sciences Department

XI. Special instructions, precautions: The above selected PPE and safety control measures are intended to protect individuals from hazards associated with this task. Avoid identified nesting areas to the extent possible as well as poisonous plant varieties discussed in the biological hazards section. Buddy system; GPS or compass and maps for remote areas. Rope handrails shall be used for traversing, ascending, and descending hillside angles greater than 45° slope.

Permit Issued by: ____________________ Permit Accepted by: ____________________

SAFE WORK PERMIT
Surveying

Permit No. ________________ Date: ______________________________ Time: From ________ to _________

SECTION I: General Job Scope (To be filled in by person performing work)

I. Work limited to the following (description, area, equipment used): Site surveying (nonintrusive) activities

II. Names: ____

III. Onsite Inspection conducted ☐ Yes ☐ No Initials of Inspector ________________ ________________ TtNUS

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. Protective equipment required

Level D ☒ Level B ☐
Level C ☐ Level A ☐
Detailed on Reverse

Respiratory equipment required

Full face APR	☐	Escape Pack	☐
Half face APR	☐	SCBA	☐
SKA-PAC SAR	☐	Bottle Trailer	☐
Skid Rig	☐	None	☒

Modifications/Exceptions: ____

V.

Chemicals of Concern	Action Level(s)	Response Measures
None	None	None

VI. Additional Safety Equipment/Procedures – Check appropriate box for ALL entries

Hardhat	☐ Yes ☒ No	Hearing Protection (Plugs/Muffs)	☐ Yes	No
Safety Glasses	☐ Yes ☐ No	Safety belt/harness	☐ Yes	☒ No
Chemical/splash goggles	☐ Yes ☒ No	Radio	☐ Yes	☐ No
Splash Shield	☐ Yes ☒ No	Barricades	☐ Yes	☒ No
Splash suit/coveralls	☐ Yes ☒No	Gloves (Type-__________)	☐ Yes	☐ No
Steel toe Work-boots	☐Yes ☒ No	Work/rest regimen	☐ Yes	☒ No

Modifications/Exceptions: Long pants and sleeved shirts. Tape pant legs to boots and wear light colored clothing due to heavy tick infestation. Work-boot should have an aggressive lug to control slip, trip, and fall hazards when traversing or coming up and down steep terrain. Remote and selected locations (due to habitat considerations) will require the use of snake chaps/pants. Gloves and safety glasses at SSO direction.

VII.

Procedure review with permit acceptors	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☐	☐	Emergency alarms	☐	☐
Procedure for safe job completion per HASP	☐	☐	Evacuation routes	☐	☐
Contractor tools/equipment inspected	☐	☐	Assembly points	☐	☐

VIII. Site Preparation

Utility Clearances Obtained for any areas of subsurface investigations ☐ Yes ☐ No NA

IX.

Equipment Preparation	Yes	NA
Equipment drained/depressurized	☐	☒
Equipment purged/cleaned	☐	☒
Isolation checklist completed	☐	☒
Electrical lockout required/field switch tested	☐	☒
Blinds/misalignments/blocks & bleeds in place	☐	☒
Hazardous materials on walls/behind liners considered	☐	☒

X. Additional Permits required (Hot work, Confined Space Entry, Excavation etc.) ☐ Yes ☒ No
If yes, contact the Health Sciences Department

XI. Special instructions, precautions: The above selected PPE and safety control measures are intended to protect individuals from hazards associated with this task. Avoid insect nesting areas to the extent possible as well as poisonous plant varieties discussed in the biological hazards section. Buddy system; compass and maps for remote areas. Rope handrails shall be used for traversing, ascending, and descending hillside angles greater than 45° slope.

Permit Issued by: ______________________________ Permit Accepted by: ______________________________

SAFE WORK PERMIT
Equipment Decontamination

Permit No. ________________ Date: __________________________ Time: From ________ to ________

SECTION I: General Job Scope (To be filled in by person performing work)

I. Work limited to the following (description, area, equipment used): Decontamination of equipment and sampling tools.

II. Names: ________________________________

III. Onsite Inspection conducted ☐ Yes ☐ No Initials of Inspector ________________ ________________ TtNUS

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. Protective equipment required

Level D ☒ Level B ☐
Level C ☐ Level A ☐
Detailed on Reverse

Respiratory equipment required

Full face APR	☐	Escape Pack	☐
Half face APR	☐	SCBA	☐
SKA-PAC SAR	☐	Bottle Trailer	☐
Skid Rig	☐	None	☒

Modifications/Exceptions: If any chemicals are used in decon, consult and follow MSDS requirements

V. Chemicals of Concern	Action Level(s)	Response Measures
None	None	None

VI. Additional Safety Equipment/Procedures – Check appropriate box for ALL entries

Hardhat	☐ Yes ☒ No		Hearing Protection (Plugs/Muffs)	☐ Yes ☐ No	
Safety Glasses	☐ Yes ☐ No		Safety belt/harness	☐ Yes ☒ No	
Chemical/splash goggles	☐ Yes ☐ No		Radio	☐ Yes ☐ No	
Splash Shield	☐ Yes ☐ No		Barricades	☐ Yes ☐ No	
Splash suit/coveralls	☐ Yes ☐ No		Gloves (Type-____________)	☐ Yes ☐ No	
Steel toe Work-boots	☒ Yes ☐ No		Work/rest regimen	☐ Yes ☒ No	

Modifications/Exceptions: If steam or high-pressure washing is performed, wear safety glasses and faceshield, or chemical splash goggles. Also, wear splash suit and gloves as directed by SSO.

VII. Procedure review with permit acceptors

	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☐	☐	Emergency alarms	☐	☐
Procedure for safe job completion per HASP	☐	☐	Evacuation routes	☐	☐
Contractor tools/equipment inspected	☐	☐	Assembly points	☐	☐

VIII. Site Preparation

Utility Clearances Obtained for any areas of subsurface investigations ☐ Yes ☐ No ☒ NA

Note: For areas specified by NSWC Crane, given industrial development

IX.. Equipment Preparation

	Yes	NA
Equipment drained/depressurized	☐	☒
Equipment purged/cleaned	☐	☒
Isolation checklist completed	☐	☒
Electrical lockout required/field switch tested	☐	☒
Blinds/misalignments/blocks & bleeds in place	☐	☒
Hazardous materials on walls/behind liners considered	☐	☒

X. Additional Permits required (Hot work, Confined Space Entry, Excavation etc.) ☐ Yes ☒ No

If yes, contact the Health Sciences Department

XI. Special instructions, precautions: The above selected PPE and safety control measures are intended to protect individuals from hazards associated with this task.

Permit Issued by: ______________________________ Permit Accepted by: ______________________________

ATTACHMENT 3
OSHA POSTER

POST ON SITE

JOB SAFETY & HEALTH PROTECTION

The Occupational Safety and Health Act of 1970 provides job safety and health protection for workers by promoting safe and healthful working conditions throughout the Nation. Requirements of the Act include the following:

Employers

All employers must furnish to employees employment and a place of employment free from recognized hazards that are causing or are likely to cause death or serious harm to employees. Employers must comply with occupational safety and health standards issued under the Act.

Employees

Employees must comply with all occupational safety and health standards, rules, regulations and orders issued under the Act that apply to their own actions and conduct on the job.

The Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor has the primary responsibility for administering the Act. OSHA issues occupational safety and health standards, and its Compliance Safety and Health Officers conduct jobsite inspections to help ensure compliance with the Act.

Inspection

The Act requires that a representative of the employer and a representative authorized by the employees be given an opportunity to accompany the OSHA inspector for the purpose of aiding the inspection.

Where there is no authorized employee representative, the OSHA Compliance Officer must consult with a reasonable number of employees concerning safety and health conditions in the workplace.

Complaint

Employees or their representatives have the right to file a complaint with the nearest OSHA office requesting an inspection if they believe unsafe or unhealthful conditions exist in their workplace. OSHA will withhold, on request, names of employees complaining.

The Act provides that employees may not be discharged or discriminated against in any way for filing safety and health complaints or for otherwise exercising their rights under the Act.

Employees who believe they have been discriminated against may file a complaint with their nearest OSHA office within 30 days of the alleged discrimination.

Citation

If upon inspection OSHA believes an employer has violated the Act, a citation alleging such violations will be issued to the employer. Each citation will specify a time period within which the alleged violation must be corrected.

The OSHA citation must be prominently displayed at or near the place of alleged violation for three days, or until it is corrected, whichever is later, to warn employees of dangers that may exist there.

Proposed Penalty

The Act provides for mandatory penalties against employers of up to $1,000 for each serious violation and for optional penalties of up to $1,000 for each nonserious violation. Penalties of up to $1,000 per day may be proposed for failure to correct violations within the proposed time period. Also, any employer who willfully or repeatedly violates the Act may be assessed penalties of up to $10,000 for each such violation.

Criminal penalties are also provided for in the Act. Any willful violation resulting in death of an employee, upon conviction, is punishable by a fine of not more than $10,000, or by imprisonment for not more than six months, or by both. Conviction of an employer after a first conviction doubles these maximum penalties.

Voluntary Activity

While providing penalties for violations, the Act also encourages efforts by labor and management, before an OSHA inspection, to reduce workplace hazards voluntarily and to develop and improve safety and health programs in all workplaces and industries. OSHA's Voluntary Protection Programs recognize outstanding efforts of this nature.

Such voluntary action should initially focus on the identification and elimination of hazards that could cause death, injury, or illness to employees and supervisors. There are many public and private organizations that can provide information and assistance in this effort, if requested. Also, your local OSHA office can provide considerable help and advice on solving safety and health problems or can refer you to other sources for help such as training.

Consultation

Free consultative assistance, without citation or penalty, is available to employers, on request, through OSHA supported programs in most State departments of labor or health.

More Information

Additional information and copies of the Act, specific OSHA safety and health standards, and other applicable regulations may be obtained from your employer or from the nearest OSHA Regional Office in the following locations:

Atlanta, Georgia
Boston, Massachusetts
Chicago, Illinois
Dallas, Texas
Denver, Colorado
Kansas City, Missouri
New York, New York
Philadelphia, Pennsylvania
San Francisco, California
Seattle, Washington

Telephone numbers for these offices, and additional area office locations, are listed in the telephone directory under the United States Department of Labor in the United States Government listing.

Washington, D.C.
1985
OSHA 2203

William E. Brock, Secretary of Labor

U.S. Department of Labor
Occupational Safety and Health Administration

Under provisions of Title 29, Code of Federal Regulations, Part 1903.2(a)(1) employers must post this notice (or a facsimile) in a conspicuous place where notices to employees are customarily posted.

ATTACHMENT 4
MEDICAL DATA SHEETS
FOR
FIELD PERSONNEL

MEDICAL DATA SHEET

This Medical Data Sheet must be completed by all on-site personnel and kept in the command post during the conduct of site operations. This data sheet will accompany any personnel when medical assistance is needed or if transport to hospital facilities is required.

Project ____

Name ____________________ Home Telephone __________

Address ____

Age ________ Height ____________ Weight __________

Name of Next Kin __________________________________

Drug or other Allergies ______________________________

Particular Sensitivities ______________________________

Do You Wear Contacts? ______________________________

Provide a Checklist of Previous Illnesses or Exposure to Hazardous Chemicals __________

____

____

What medications are you presently using? ________________________

____

____

Do you have any medical restrictions? ________________________

____

____

Name, Address, and Phone Number of personal physician: ________________

____

____

I am the individual described above. I have read and understand this HASP.

__________________________ _______________

Signature Date

ATTACHMENT 5
RESPONDING TO SNAKE BITES

Snake Bites

All initial efforts will be directed to avoid, where possible, nesting and territorial areas claimed by these reptiles. However, should field personnel come close enough to startle these animals and receive a bite, the following actions are necessary.

1. Obtain a detailed description of the snake. This and the bite mark will enable medical personnel administering aid to provide prompt and correct antidotes as necessary.

2. Immobilize the bite victim to the extent possible. Physical exertion will mobilize the toxins (if poisonous varieties) from the bite point systemically through the body.

3. Apply a pressure wrap (for extremities), just above and over the bite area. With a couple wraps of the pressure wrap in place over the bite area, apply a splint and continue the application of the pressure wrap. The purpose for the splint is to restrict the movement of the extremity, this along with the pressure wrap will aid in restricting any toxins from leaving the site of the bite.

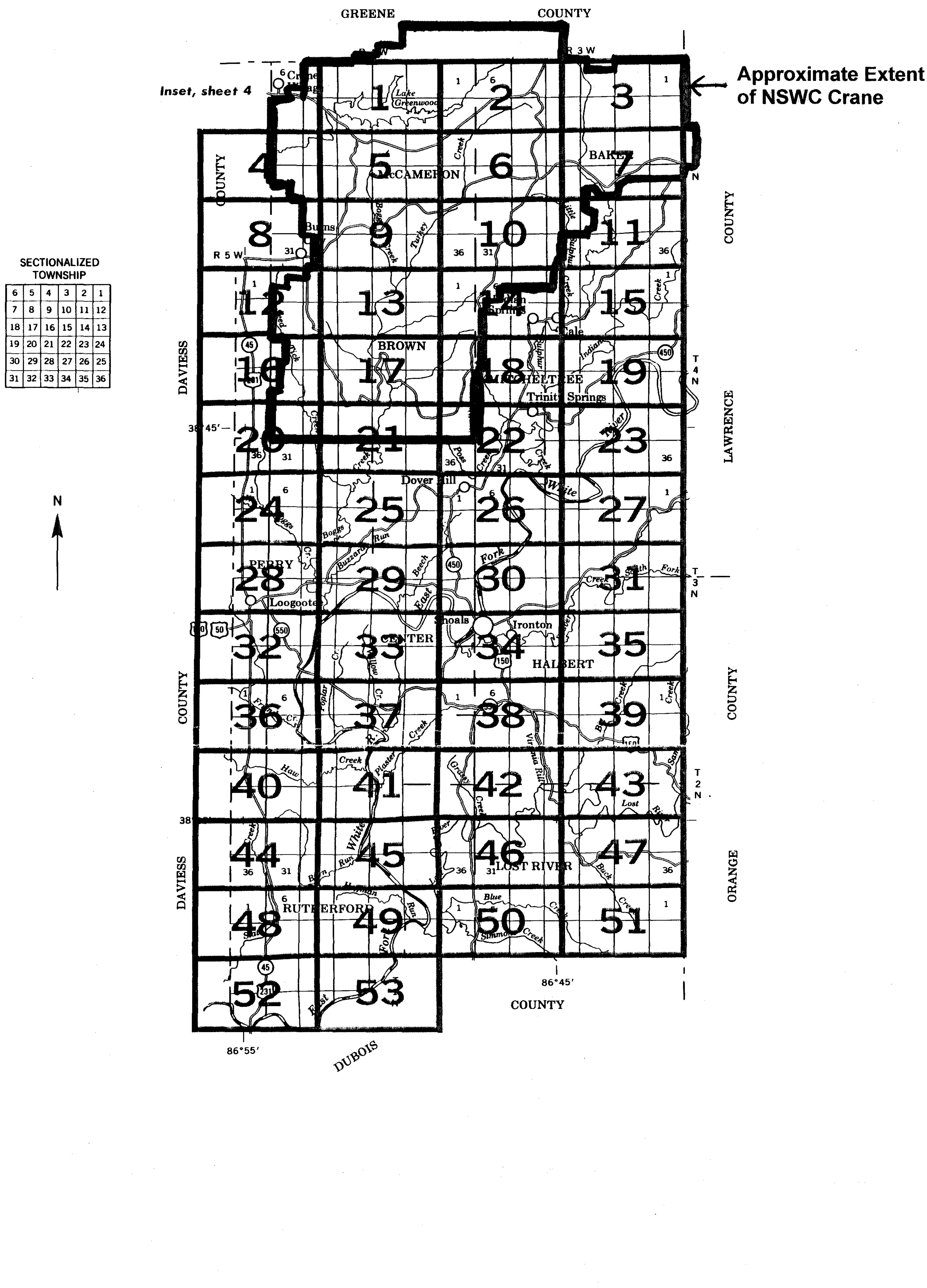
4. Seek medical attention immediately.

APPENDIX D

SOIL SURVEY MAPS

and loamy material on terraces and uplands

COMPILED 1985

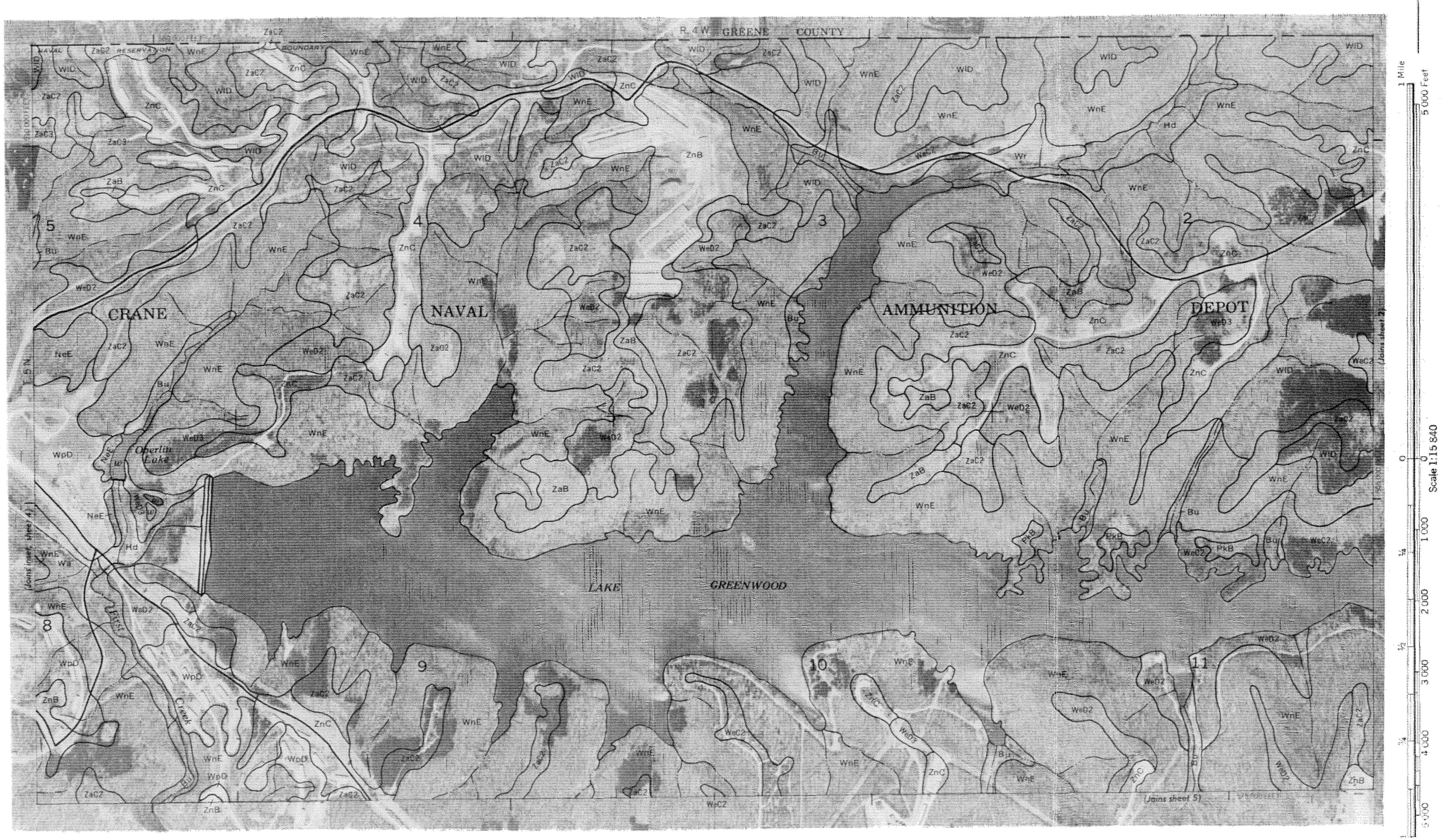


INDEX TO MAP SHEETS

MARTIN COUNTY, INDIANA

Scale 1:190,080

This figure and attached maps copied from McElrath, G., Jr., 1988, Soil Survey of Martin County, Indiana, Soil Conservation Service, United States Department of Aqriculture.


R. 4 W.
GREENE COUNTY
NAVAL RESERVATION BOUNDARY
CRANE
NAVAL
AMMUNITION
DEPOT
LAKE
GREENWOOD
Oberlin Lake
Creek
(Joins sheet 2)
(Joins sheet 4)
(Joins sheet 5)
1
N
1 Mile
5 000 Feet
Scale 1:15 840


2
N
1 Mile
5 000 Feet
Scale 1:15 840
GREENE COUNTY
R. 4 W.
R. 3 W.
CRANE
NAVAL
AMMUNITION
DEPOT
LAKE GREENWOOD
First Creek
Turkey Creek
(Joins sheet 1)
(Joins sheet 3)
(Joins sheet 6)
1
4
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6
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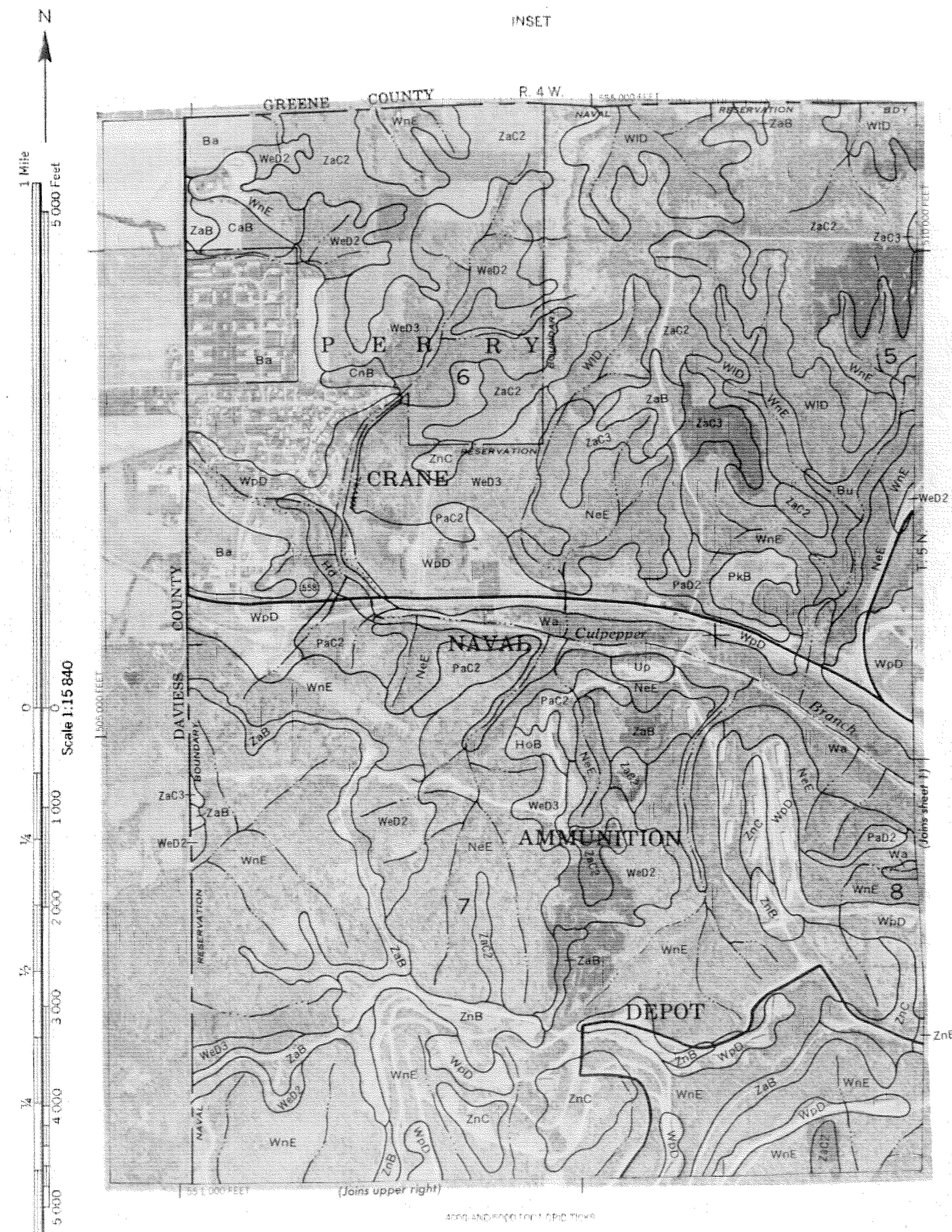
8
9
12

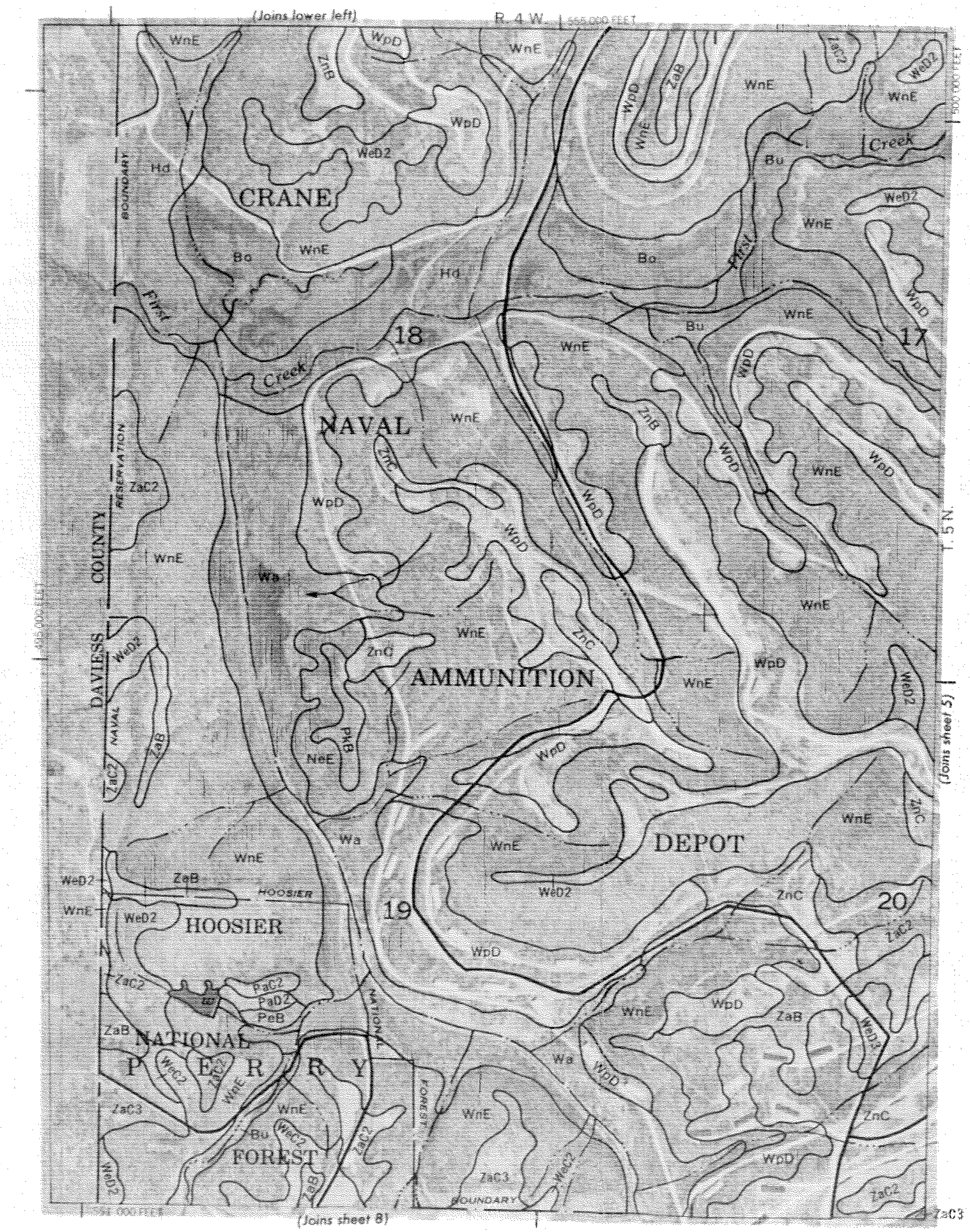
MARTIN COUNTY, INDIANA — SHEET NUMBER 3

(3)

4

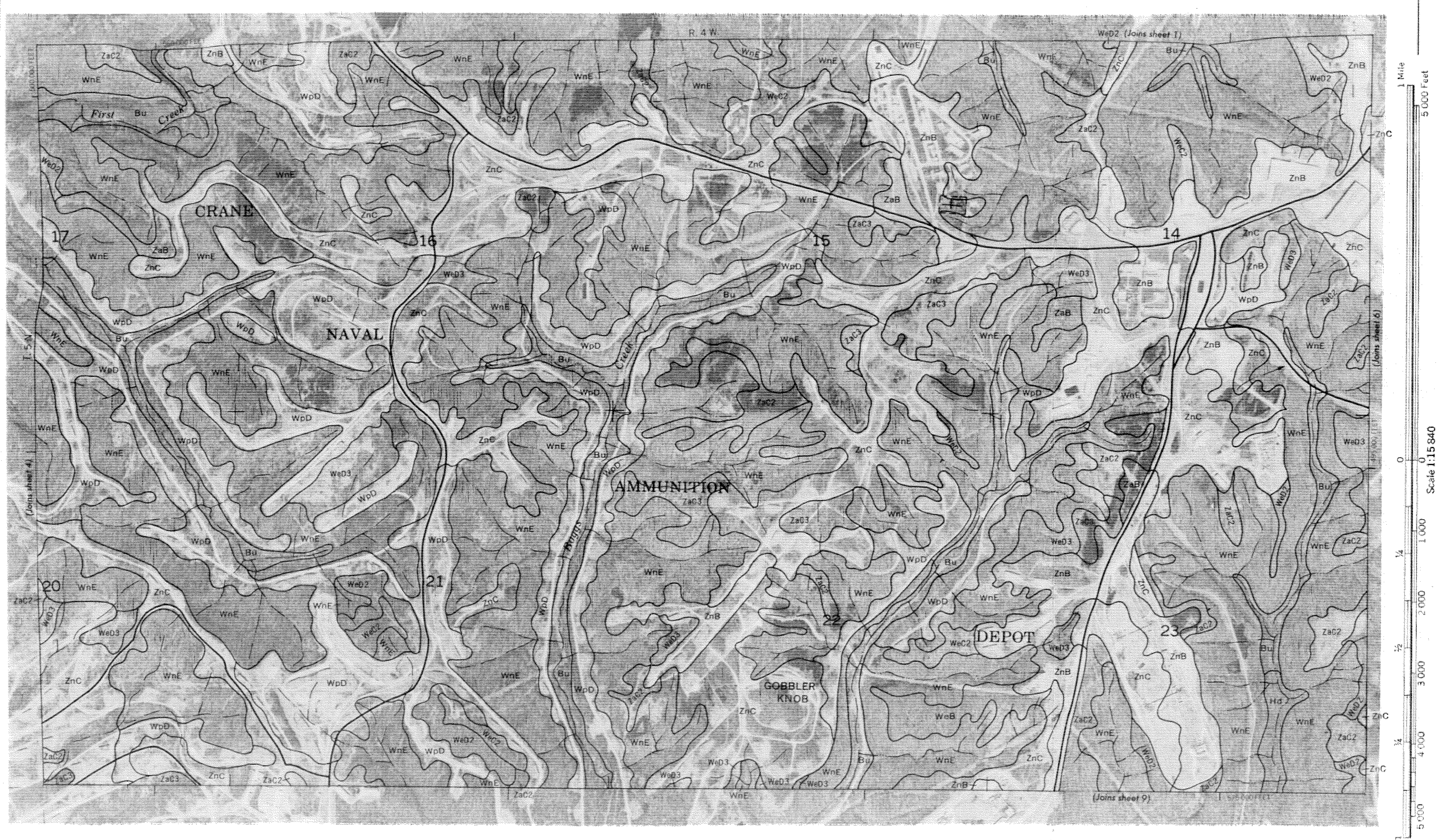
INSET

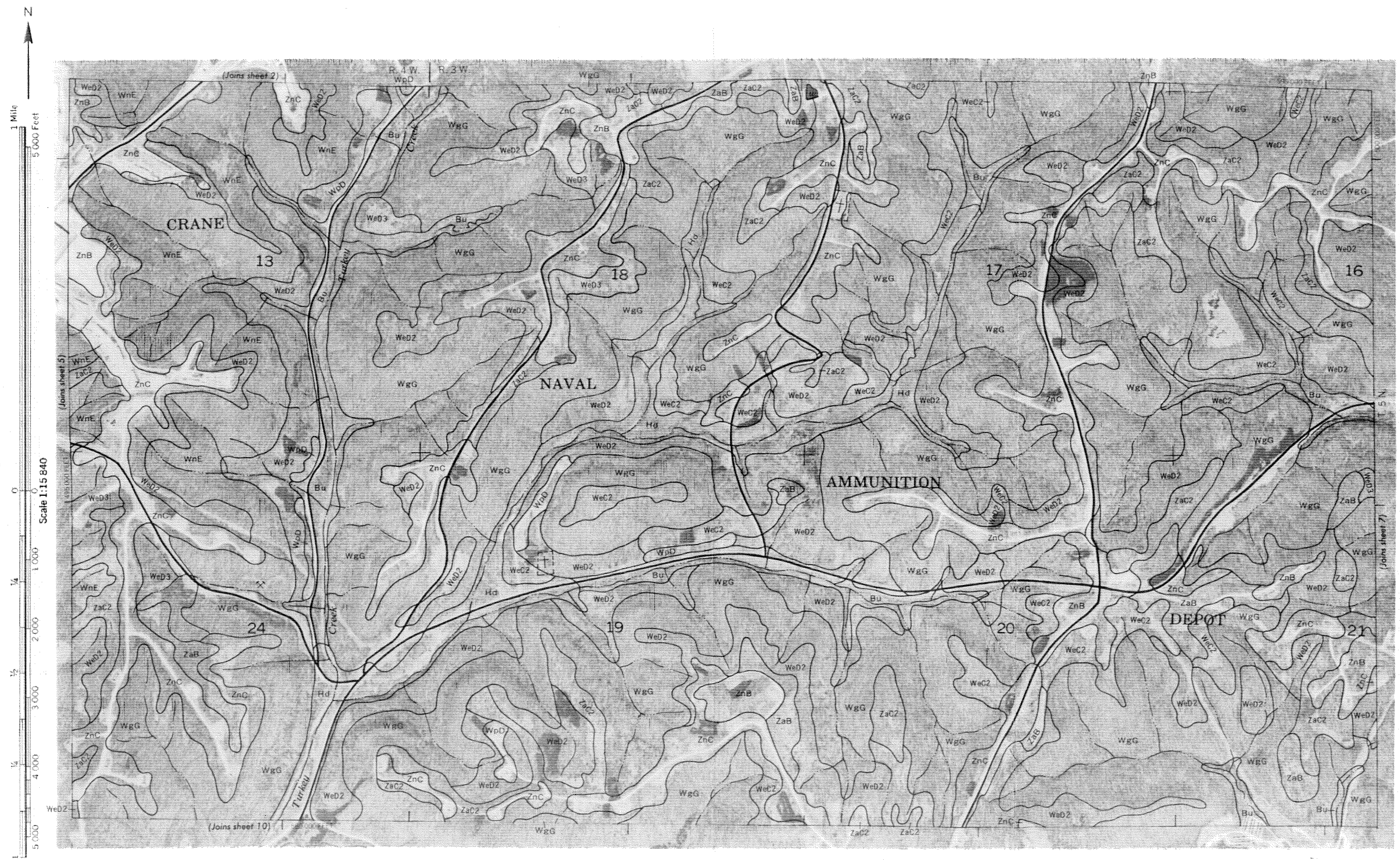




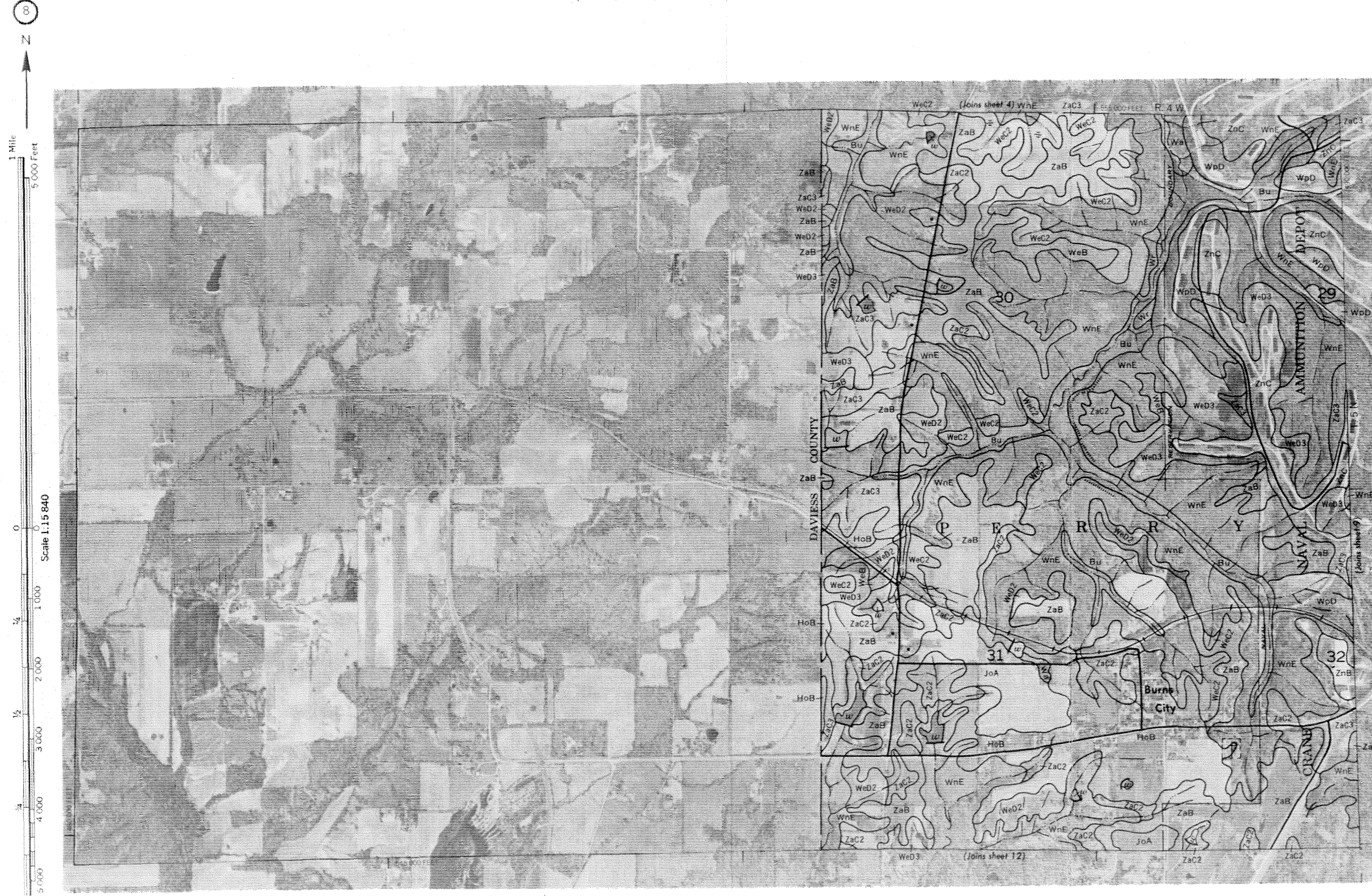
4000 AND 5000 FOOT GRID TICKS

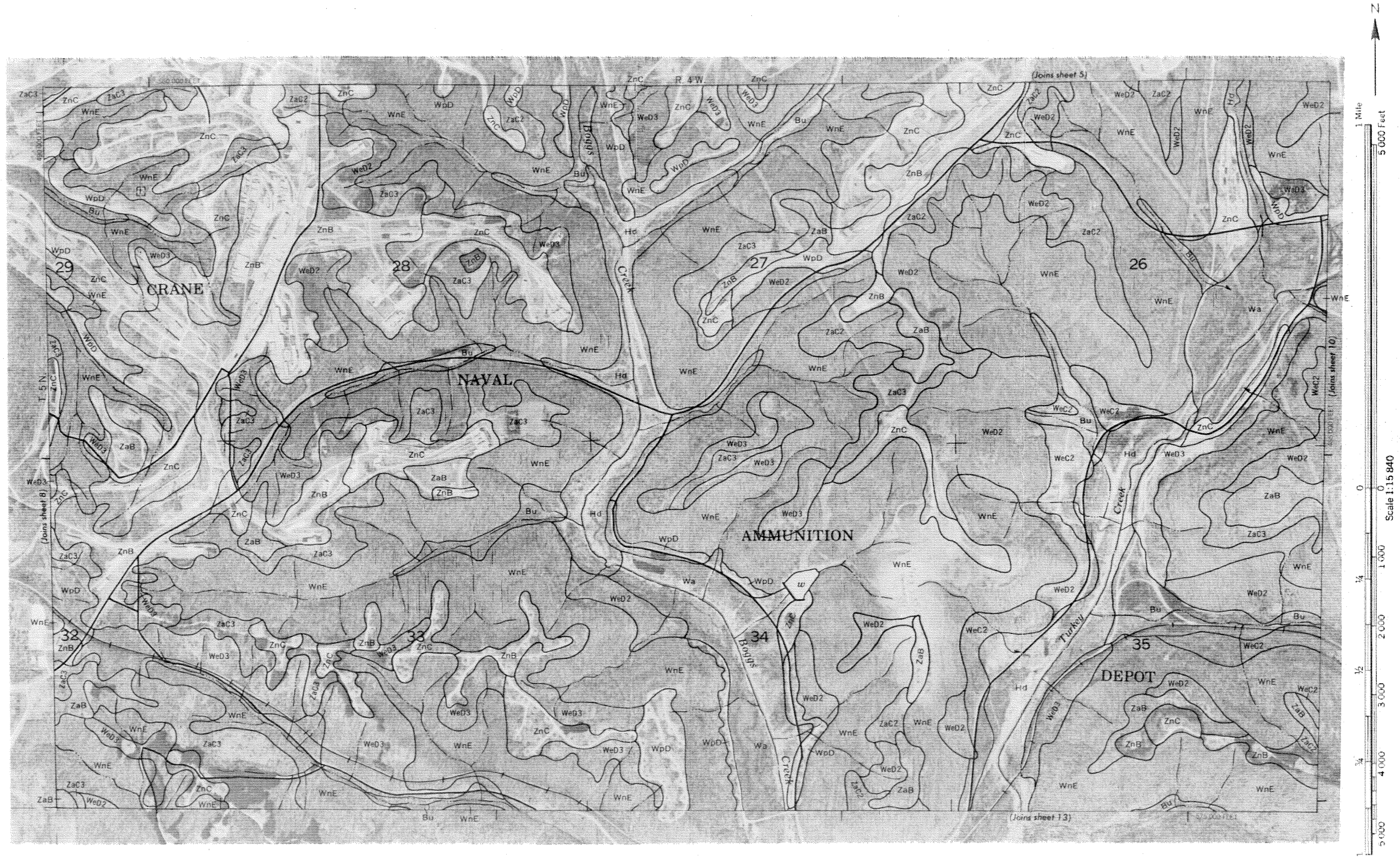
4000 AND 5000 FOOT GRID TICKS


5
N
CRANE
NAVAL
AMMUNITION
DEPOT
GOBBLER KNOB
First Creek
Boggs Creek
R. 4 W.
WeD2 (Joins sheet 1)
(Joins sheet 4)
(Joins sheet 6)
(Joins sheet 9)
17
16
15
14
20
21
22
23
1 Mile
5 000 Feet
Scale 1:15 840


6
N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 2)
(Joins sheet 10)
(Joins sheet 5)
(Joins sheet 7)
R. 4 W.
R. 3 W.
CRANE
NAVAL
AMMUNITION
DEPOT
Turkey Creek
13
18
17
16
24
19
20
21


R. 3 W.
(Joins sheet 3)
(Joins sheet 6)
(Joins sheet 11)
T. 5 N.
CRANE
NAVAL
AMMUNITION
DEPOT
LAWRENCE COUNTY
M I T C H E L T R E E
Sulphur
Creek
NAVAL RESERVATION BOUNDARY
16
15
14
13
21
22
23
24
N
1 Mile
5 000 Feet
Scale 1:15 840


8
N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 4)
(Joins sheet 12)
(Joins sheet 9)
R. 4 W.
DAVIESS COUNTY
PERRY
NAVAL AMMUNITION DEPOT
CRANE
Burns City
29
30
31
32
ZaB
ZaC2
ZaC3
WeB
WeC2
WeD2
WeD3
WnE
WpD
ZnB
ZnC
Bu
HoB
JoA


N
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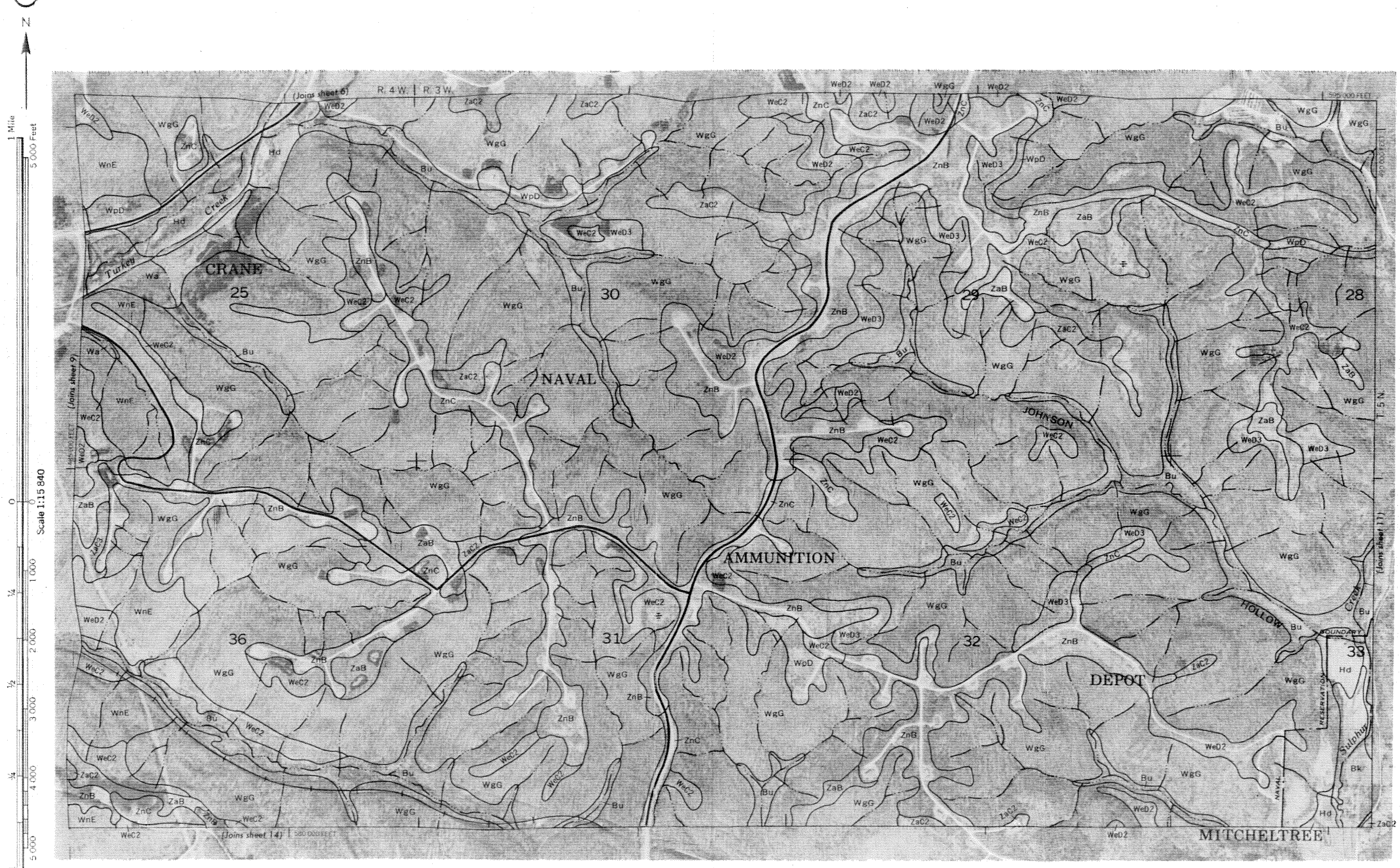
(Joins sheet 8)
(Joins sheet 10)
(Joins sheet 13)
R. 4 W.
T. 5 N.
CRANE
NAVAL
AMMUNITION
DEPOT
26
27
28
29
32
33
34
35
Boggs Creek
Turkey Creek
1 Mile
5 000 Feet
Scale 1:15 840
0
¼
½
¾
1 000
2 000
3 000
4 000
5 000
WnE
WeD2
WeD3
WeC2
WpD
ZnC
ZnB
ZaB
ZaC2
ZaC3
Bu
Hd
Wa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5 000 Feet
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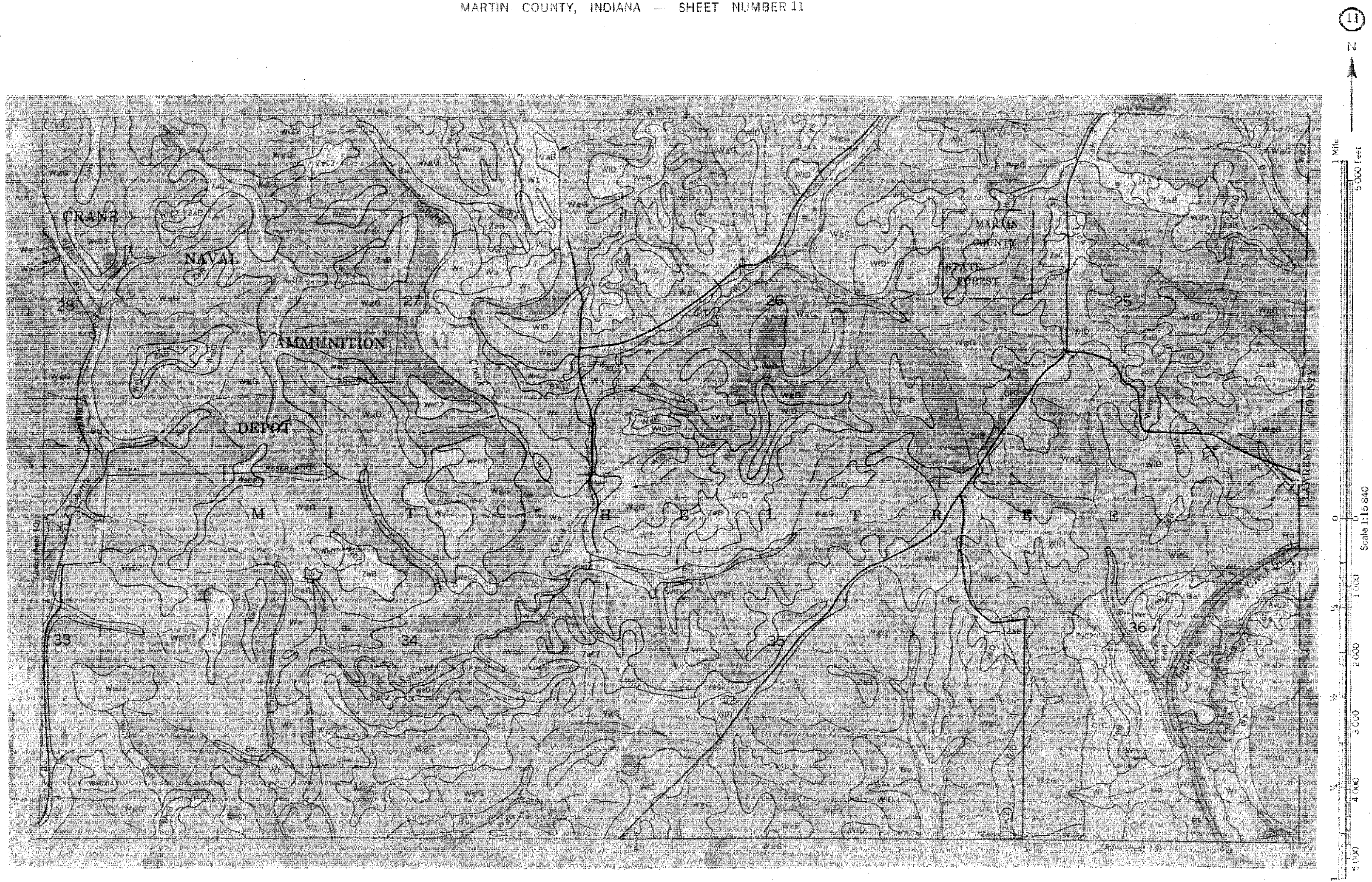
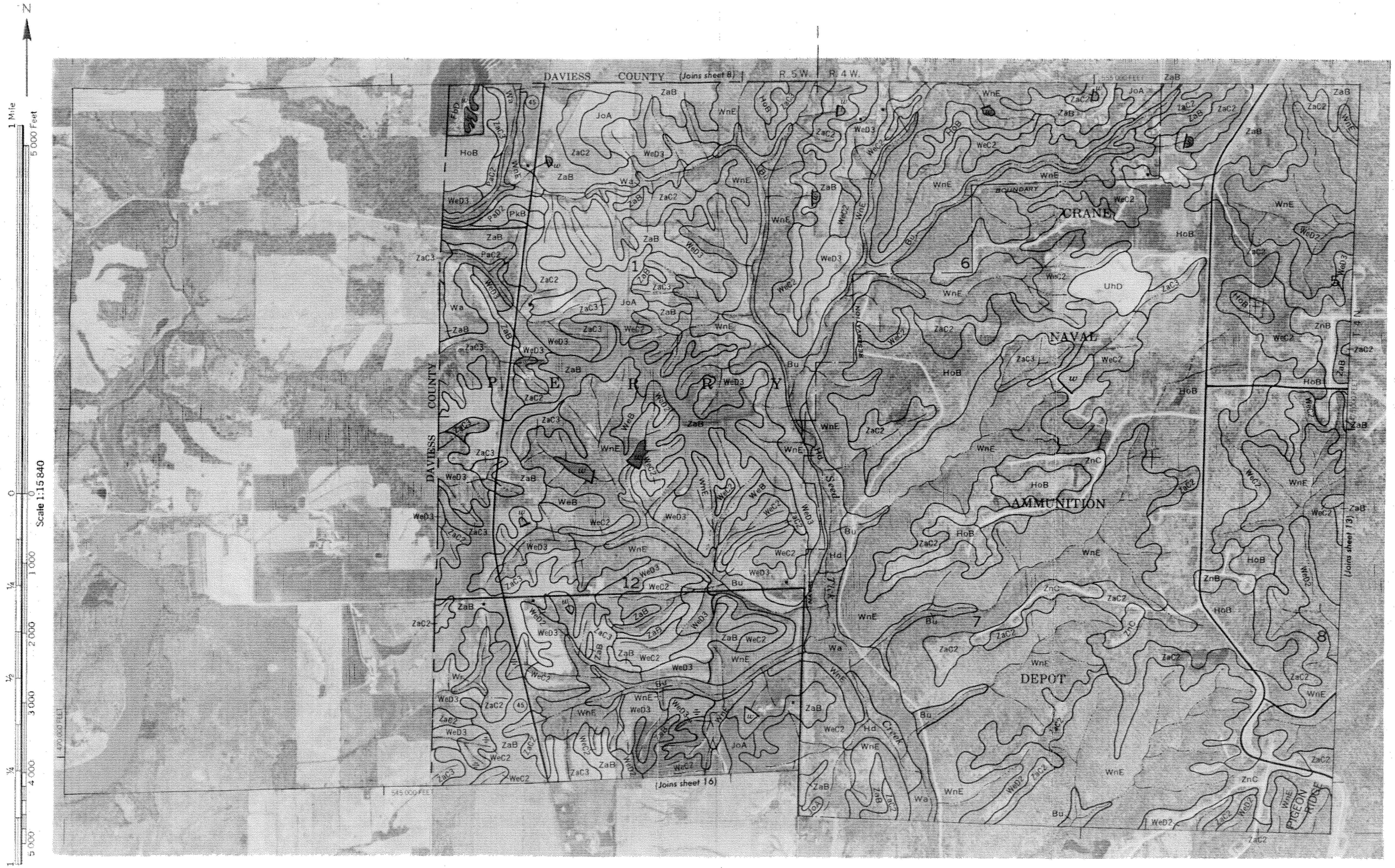
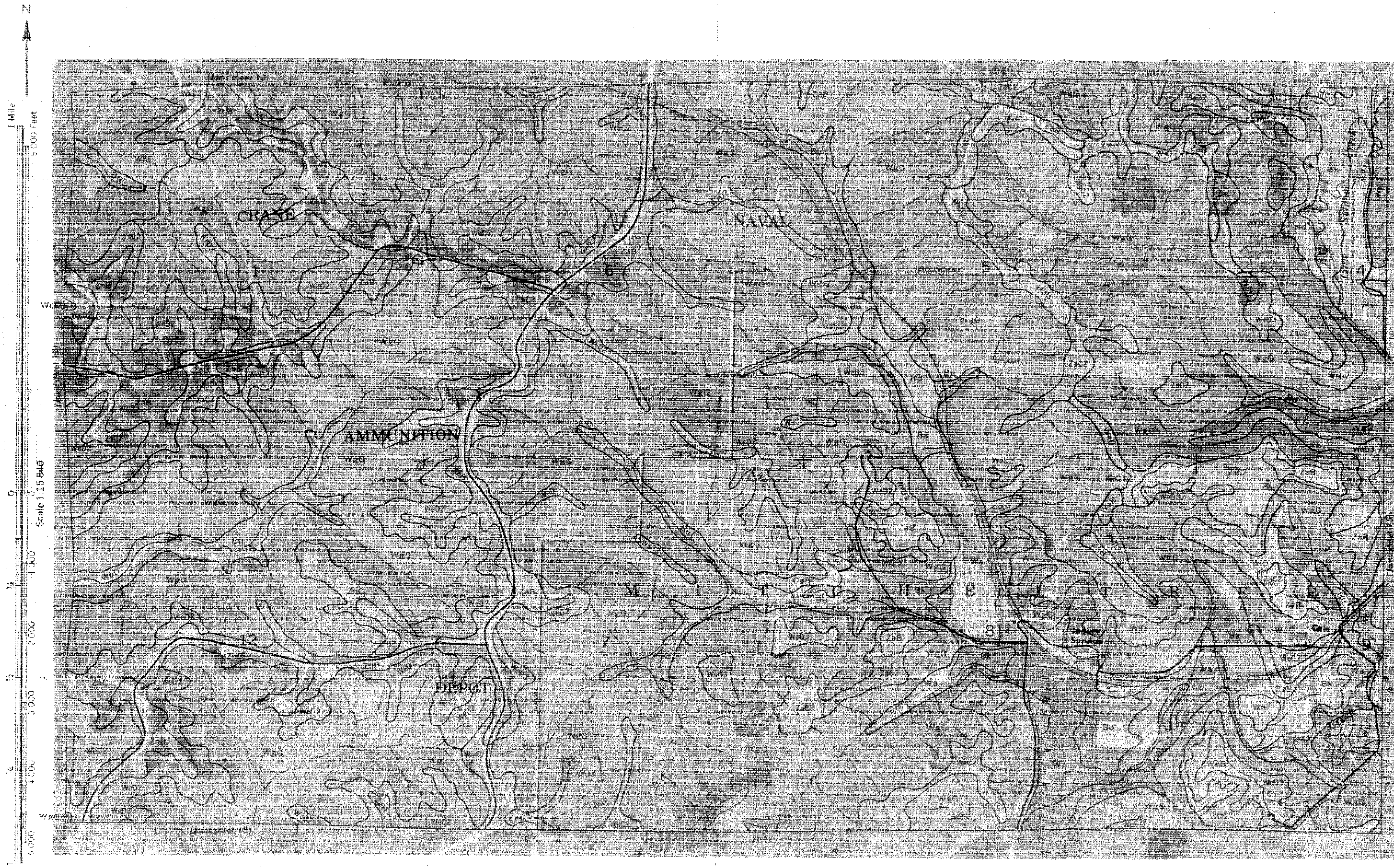
R. 4 W.
R. 3 W.
(Joins sheet 9)
(Joins sheet 11)
(Joins sheet 14)
CRANE
NAVAL
AMMUNITION
DEPOT
JOHNSON
HOLLOW
Turkey
Creek
Sulphur
NAVAL
RESERVATION
BOUNDARY
MITCHELTREE
25
30
29
28
36
31
32
33
T. 5 N.


11
N
(Joins sheet 7)
(Joins sheet 15)
(Joins sheet 10)
R. 3 W.
T. 5 N.
CRANE
NAVAL
AMMUNITION
DEPOT
NAVAL
BOUNDARY
RESERVATION
M I T C H E L T R E E
MARTIN
COUNTY
STATE
FOREST
LAWRENCE
COUNTY
Sulphur
Creek
Little
Sulphur
Indian
Creek
28
27
26
25
33
34
35
36
600 000 FEET
610 000 FEET
1 Mile
5 000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000
¼
½
¾


N
1 Mile
5 000 Feet
Scale 1:15 840
DAVIESS COUNTY (Joins sheet 8)
R. 5 W.
R. 4 W.
DAVIESS COUNTY
P E R R Y
CRANE
BOUNDARY
NAVAL
AMMUNITION
DEPOT
Seed Tick Creek
(Joins sheet 16)
(Joins sheet 13)
PIGEON RIDGE


13
N
R. 4 W.
(Joins sheet 9)
(Joins sheet 12)
(Joins sheet 14)
(Joins sheet 17)
CRANE
NAVAL
AMMUNITION
DEPOT
PIGEON RIDGE
Boggs Creek
Turkey Creek
1 Mile
5 000 Feet
Scale 1:15 840

(14)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1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 10)
R. 4 W.
R. 3 W.
CRANE
NAVAL
BOUNDARY
AMMUNITION
RESERVATION
DEPOT
M I T C H E L L T R E E
Indian Springs
Cale
Little Sulphur Creek
Sulphur Creek
(Joins sheet 13)
(Joins sheet 15)
(Joins sheet 18)
T. 4 N.
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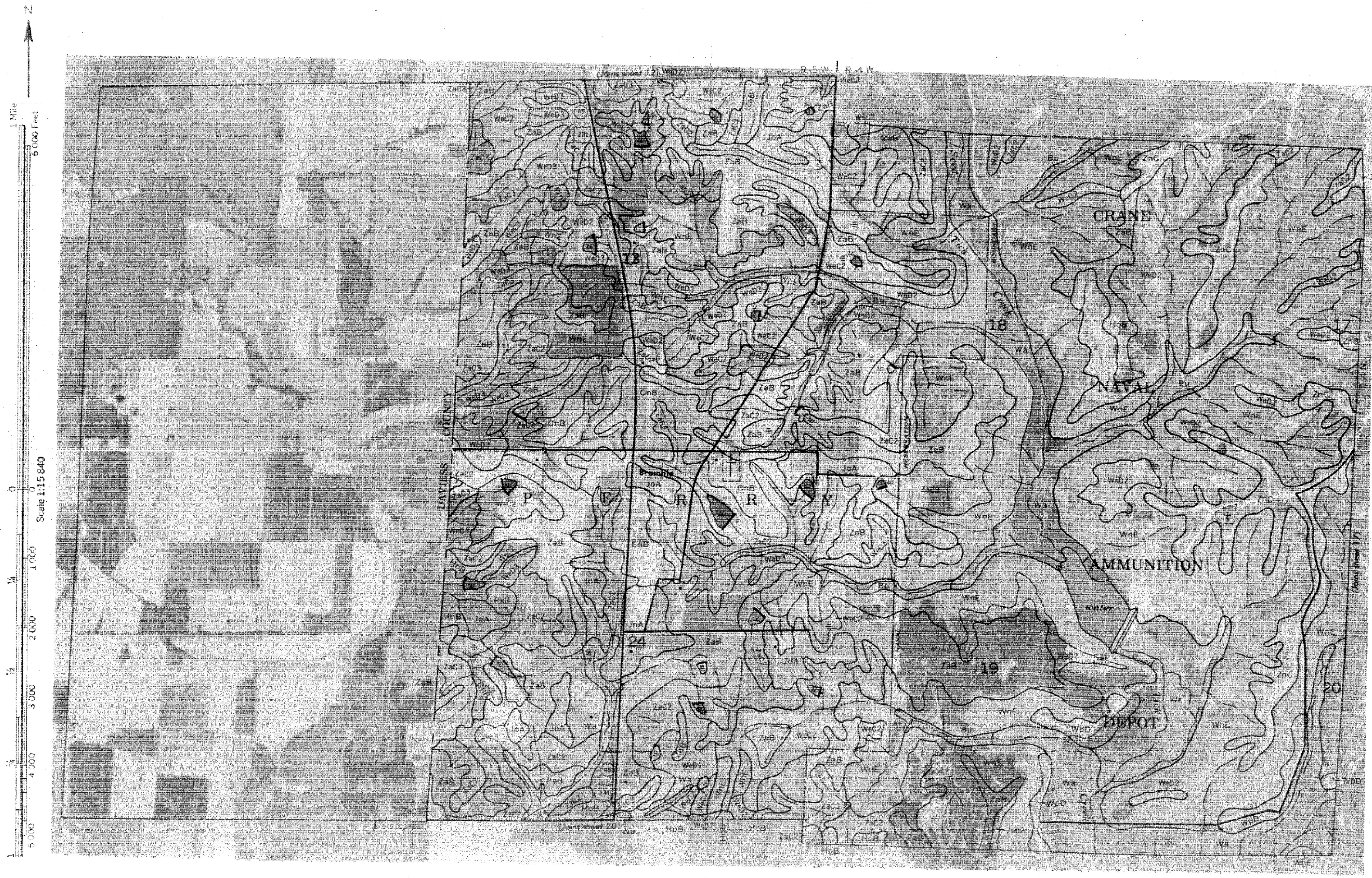
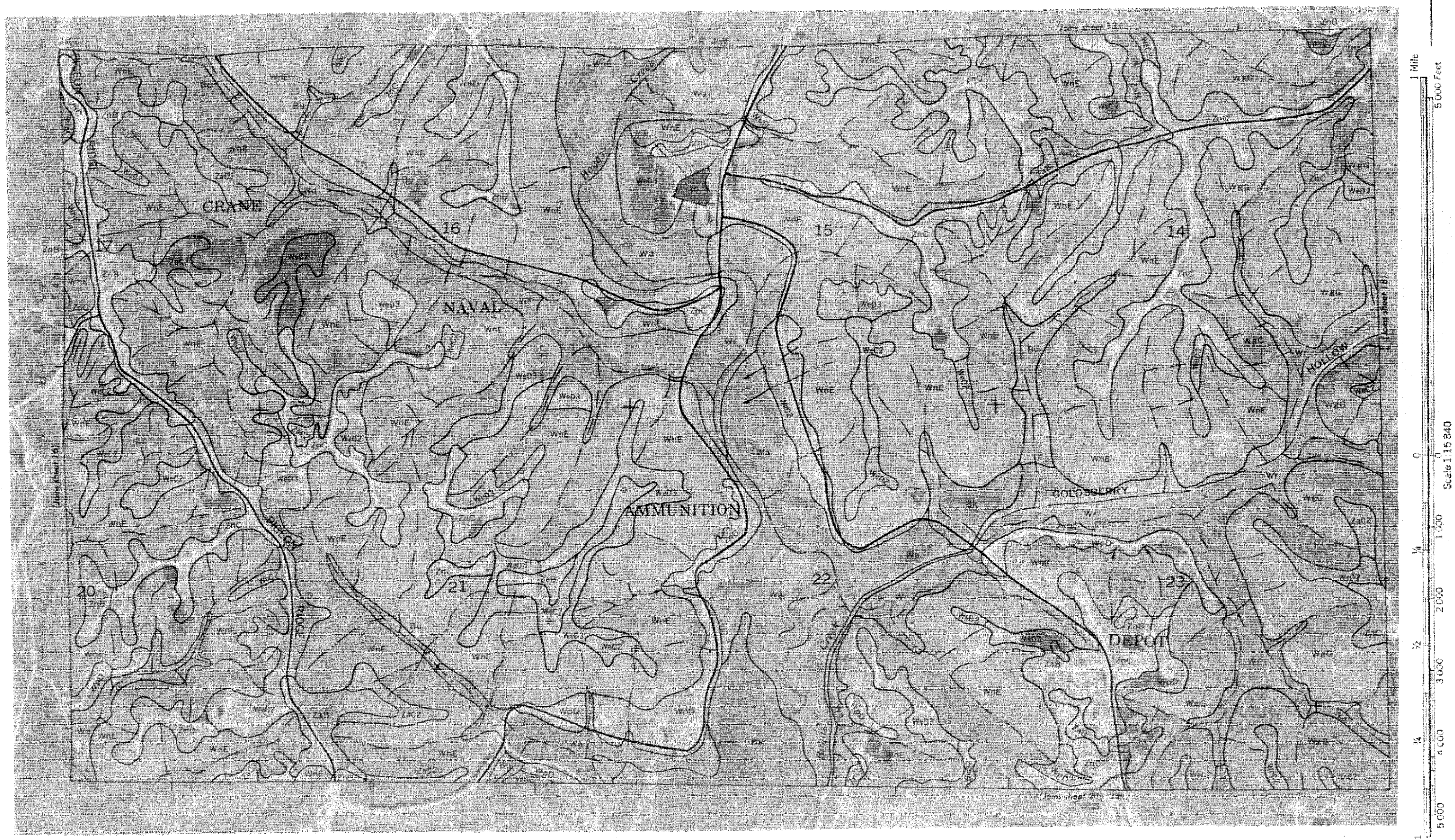
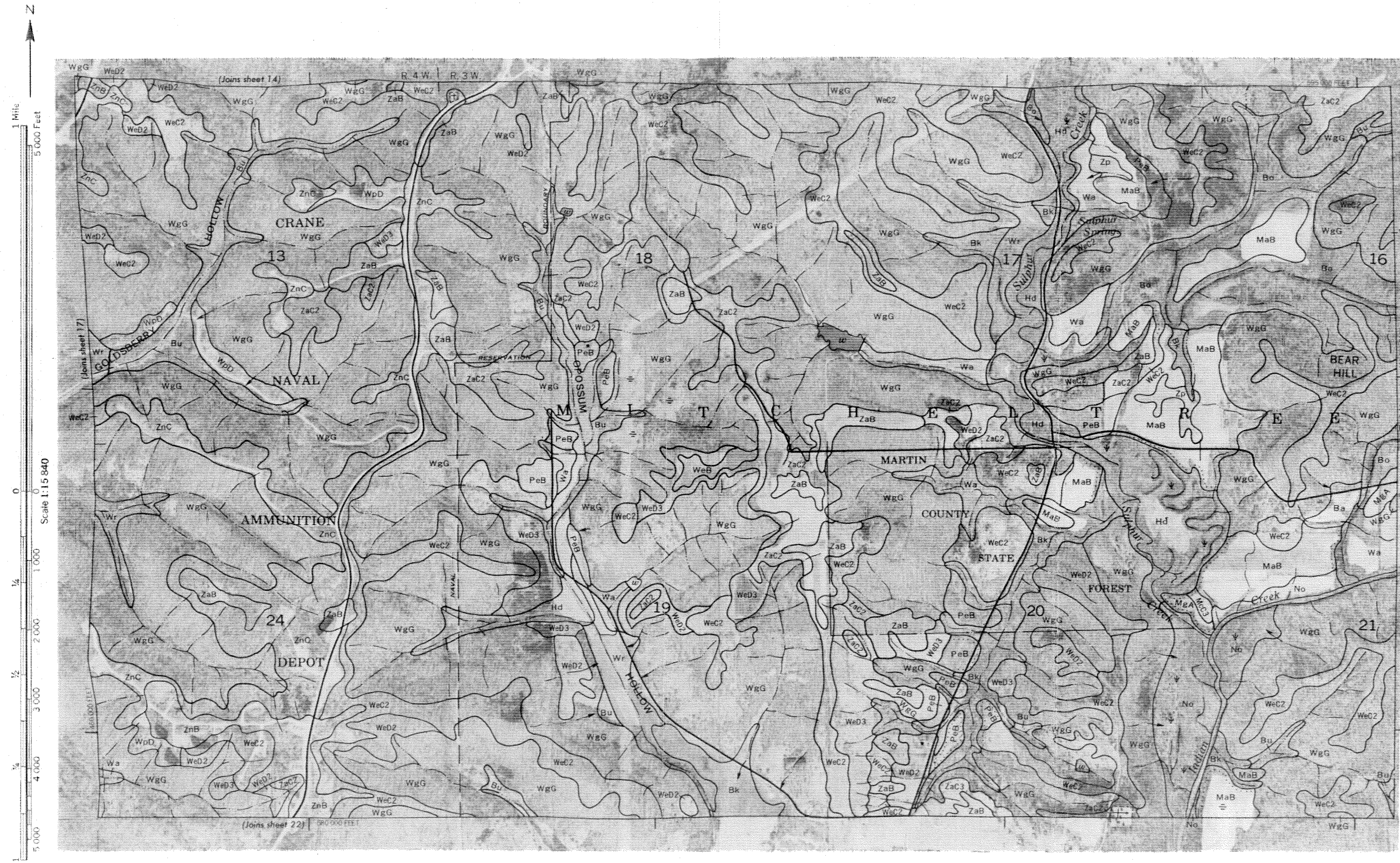
6
5
4
12
7
8
9

MARTIN COUNTY, INDIANA — SHEET NUMBER 16




(Joins sheet 13)
(Joins sheet 16)
(Joins sheet 18)
(Joins sheet 21)
R. 4 W.
T. 4 N.
CRANE
NAVAL
AMMUNITION
DEPOT
PIGEON RIDGE
Boggs Creek
GOLDSBERRY
HOLLOW
14
15
16
17
20
21
22
23
N
1 Mile
5 000 Feet
Scale 1:15 840
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000


18
N
1 Mile
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(Joins sheet 19)
(Joins sheet 22)
R. 4 W.
R. 3 W.
T. 4 N.
CRANE
NAVAL
AMMUNITION
DEPOT
RESERVATION
GOLDSBERRY
HOLLOW
OPOSSUM
HOLLOW
MARTIN
COUNTY
STATE
FOREST
MITCHELL TREE
BEAR
HILL
Sulphur
Creek
Sulphur
Springs
Indian
Creek
13
18
17
16
24
19
20
21


20
N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 16)
(Joins sheet 24)
(Joins sheet 21)
R. 5 W.
R. 4 W.
DAVIESS COUNTY
CRANE
NAVAL
AMMUNITION
DEPOT
RESERVATION
BOUNDARY
F E R R Y
Seed Tick Creek
25
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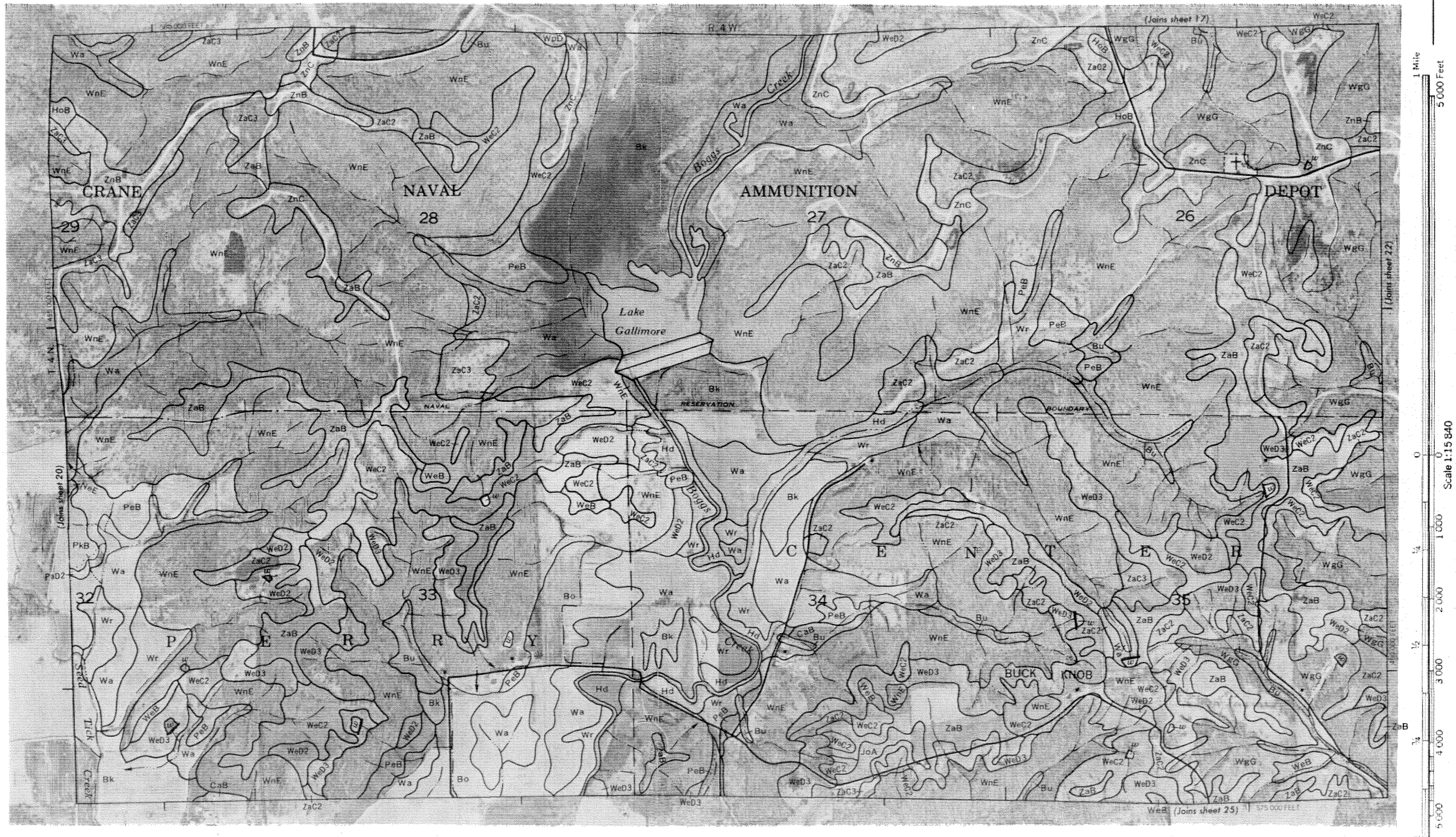
29
36
31
32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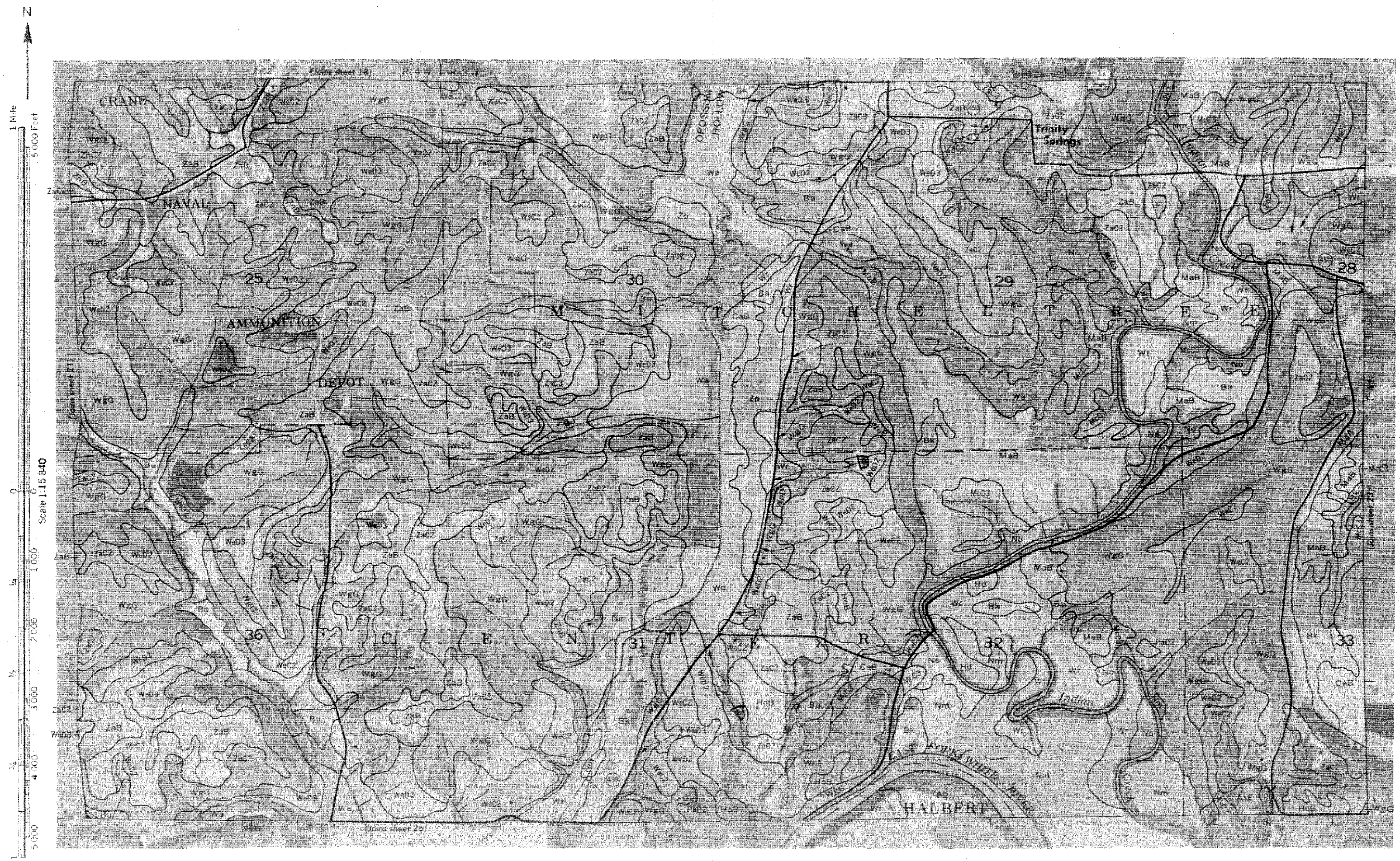
(Joins sheet 25)
(Joins sheet 20)
R. 4 W.
T. 4 N.
CRANE
NAVAL
AMMUNITION
DEPOT
NAVAL RESERVATION BOUNDARY
Lake Gallimore
Boggs Creek
BUCK KNOB
Tick Creek
P E R R Y
C E N T E R
28
27
26
29
32
33
34
35
N
1 Mile
5 000 Feet
Scale 1:15 840


N
1 Mile
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Scale 1:15 840
(Joins sheet 18)
R. 4 W. | R. 3 W.
(Joins sheet 21)
(Joins sheet 23)
(Joins sheet 26)
CRANE
NAVAL
AMMUNITION
DEPOT
OPOSSUM HOLLOW
Trinity Springs
M I T C H E L T R E E
C E N T E R
HALBERT
EAST FORK WHITE RIVER
Indian Creek
25
30
29
28
36
31
32
33