DEPARTMENT OF THE NAVY
CRANE DIVISION
NAVAL SURFACE WARFARE CENTER
300 HIGHWAY 361
CRANE, INDIANA 47522-5001

IN REPLY REFER TO
5090
Ser 095/U5057
3 MAR 1995

U.S. Environmental Protection Agency, Region V
Region V Waste Management Division
Attn: Ms. Carol Witt-Smith (HRP-8J)
77 West Jackson Blvd.
Chicago, IL 60604

Dear Ms. Witt-Smith:

Enclosure (1) contains two copies of the revised draft Interim Measures workplan. This revised draft is submitted as partial response to the Interim Measures Notice of Deficiency (NOD) letter from the U.S. EPA dated December 2, 1994. A summary of responses is provided in enclosure (2). Enclosure (3) is the required certification statement.

Crane Division, Naval Surface Warfare Center (NAVSURFWARCENDIV Crane) has selected a site for the bioremediation unit for treatment of explosives contaminated soils. Maps and a description of the location are found as enclosure (4). The tentatively approved location is not one of the locations originally discussed in the Corrective Action Management Unit Permit dated September 28, 1994. Considerations of land use, explosive arcs, and haul distances from the contaminated sites were critical in the selection of the site.

NAVSURFWARCENDIV Crane point of contact is Mr. Thomas J. Brent, Code 09510, telephone 812-854-1130.

Sincerely,

[illegible]
[illegible] Public Works Director
[illegible]

Encl:
(1) Revised Draft Workplan for Interim Measures, Selected SWMUs.
(2) Certification Statement.
(3) Summary of NOD Responses.
(4) Bioremediation Unit Location

Copy to: w/o encl
SOUTHNAVFACENGCOM, (CODE 1864)
COMNAVSEASYSCOM (SEA 07E)
USAE-WES, BILL MURPHY (GG-YH)

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

SIGNATURE

TITLE

21 MAR 1995

DATE

Enclosure (2)

SUMMARY OF NOD RESPONSES

The revised draft workplan fully addresses the NOD specific comments 2, 3a, 3b, and 3d. NOD specific comments 1 and 3c are partially addressed.

1. Dye Burial Grounds

Comment: *Details on the design of the cap and construction must be given. Including Construction Quality Assurance Plans.*

Response: Pages 16-18, §3.5, of the revised draft workplan describes considerations for design and construction of the cap. The Army Corps of Engineers has only been tasked to develop performance criteria. A separate plan by the Remedial Action Contractor (RAC) will develop a detailed design, including the Construction Quality Assurance Plans (CQAP) upon receipt of the performance criteria. The detailed design and CQAP should be available July 1995.

2. Ammunition Burning Grounds

Comment: a. *Details on the pump test must be given. Rates, length, equipment, variabilities, water sampling, etc.*

Response: See pages 13-14, §3.2 in the revised draft workplan.

Comment: b. *The pump test plan must include a discussion about how the karst features may impact the test; and how the seasonal fluctuations of flow will affect the results that will be used in the design of the pump and treat system.*

Response: See page 14, §3.2 in the revised draft workplan.

Comment: c. *The water from the pump test must either be collected in tanks or containers, tested and disposed of; or discharged through an NPDES permitted discharge on-site. Placement on the ground or discharge to the creek without a permit is not allowed.*

Response: See page 11, §3.1.0 and page 14 §3.2 in the revised draft workplan.

Comment: d. *In the pump and treat system, will 4 wells be sufficient to adequately capture the entire plume, and will the design take into consideration of seasonal fluxes in the ground water flow do* (sic) *to the karst conditions. Also, do you anticipate any changes in the flow of the springs because of the system, creating an impact to the creek?*

Response: See page 14, §3.2 in the revised draft workplan.

3. Bench Scale Test

Comment: a. *Describe the chemical testing that will be performed before, after, and during the test to see what kind of biodegradation is occurring.*

Response: See pages 19-20, §3.6.1 in the revised draft workplan.

Comment: b. *Make sure that testing and evaluations discuss what daughter products may be created from the composting, and their potential toxicity problems.*

Response: See page 20, §3.6.1, and figure 5.

Comment: c. *Will the bench scale test for Rockeye and the ABG also be used for Mine Fills A and B?*

Response: See p.20, §3.6.1. The focus of the respirometric and bench scale tests is on soils from Rockeye and ABG. The Army Corps of Engineers feels that with some chemical and soils properties analysis, soils from the Mine Fills could be tested in a large scale reactor and then incorporated into the compost operation at a later date. The lack of information on the Mine Fills, as well as the physical layout, hinders the ability to obtain reliable samples and conduct excavations. The problems at the Mine Fills not preclude progress with the studies on the viability of composting for remediating NSWC Crane soils.

Comment: d. *There are no details on where or how the 5 cubic yards of soil will be sampled for the test.*

Response: See page 11, §3.1.0.

4. Other SWMU Interim Measures

Comment: *The background discusses that debris removal is planned at several sites. Will there be another Interim Measures work plan being submitted that will address these units?*

Response: The draft workplan addressed in the Interim Measures Notice of Deficiency applies to work performed by the Army Corps of Engineers. The RAC contractor will develop workplans for specific sites. As these additional plans are developed, they will be submitted to the U.S. EPA for review. A draft General Project Plans should be ready for submission in March, as well as a workplan for the removals at the Lithium Battery Burial Site and the PCB Capacitor Burial Site.

BIOREMEDIATION UNIT LOCATION

The proposed site is located off of H-280, southwest of the Ammunition Burning Grounds (ABG) (see figure (1)). The site was selected for its proximity to ABG and RKI. Transportation cost are expected to be a major cost of operating the bioremediation facility, thus the proposed site was selected to reduce transportation costs.

Along with transportation, other important considerations on site selection were size and impact on magazine storage. Initial project plans required a minimum of four acres for construction of the pads and amendment storage areas. Due to topography and the large volume of explosives storage at NSWC Crane, obtaining an area of this size is difficult. According to explosives safety regulations, the bioremediation cannot be conducted within areas encumbered by explosive arcs. The proposed site is approximately 8 to 10 acres in size (see figure (2)). The boundaries for the site lie outside of the explosive arc for the ABG. Storage capacities for four magazines will need to be reduced, one significantly, in order to conduct the operations outside of the associated explosive arcs (see figure (3)). In evaluating alternative locations, this site is preferable, because is has sufficient level, open acreage to accommodate the operations and will have minimal impact to magazine storage.

The site is a broad flat ridge located east of magazine 828. Specifically, the site is located in the NE¼ of Section 29, Indian Springs Quadrangle, Township 5N, Range 3W. Access is via an existing gravel road originally constructed for timbering and later used for groundwater monitoring well installations. The site will be cleared and graded so as to control run-on and run-off. All contaminated soils will be kept on the north side of the road so that any incidental run-off (which should not occur due to coverage structures and other run-off controls) will not impact a designated natural area to the south. The south side of the road may be used for storage of amendments and an office trailer. If necessary, the project will include construction of a wetland or conservation pond of similar size and type to the one located near the proposed operations, should the operations require removal of the existing wetland pond. Drilling of a well will probably be necessary to meet the water requirements for the biological treatment process.

Currently, NSWC Crane is seeking site approval from Southern Division, Naval Facilities Engineering Command. Final acceptance of the site will depend on Southern Division's explosives safety certification, and approval by the U.S. EPA.

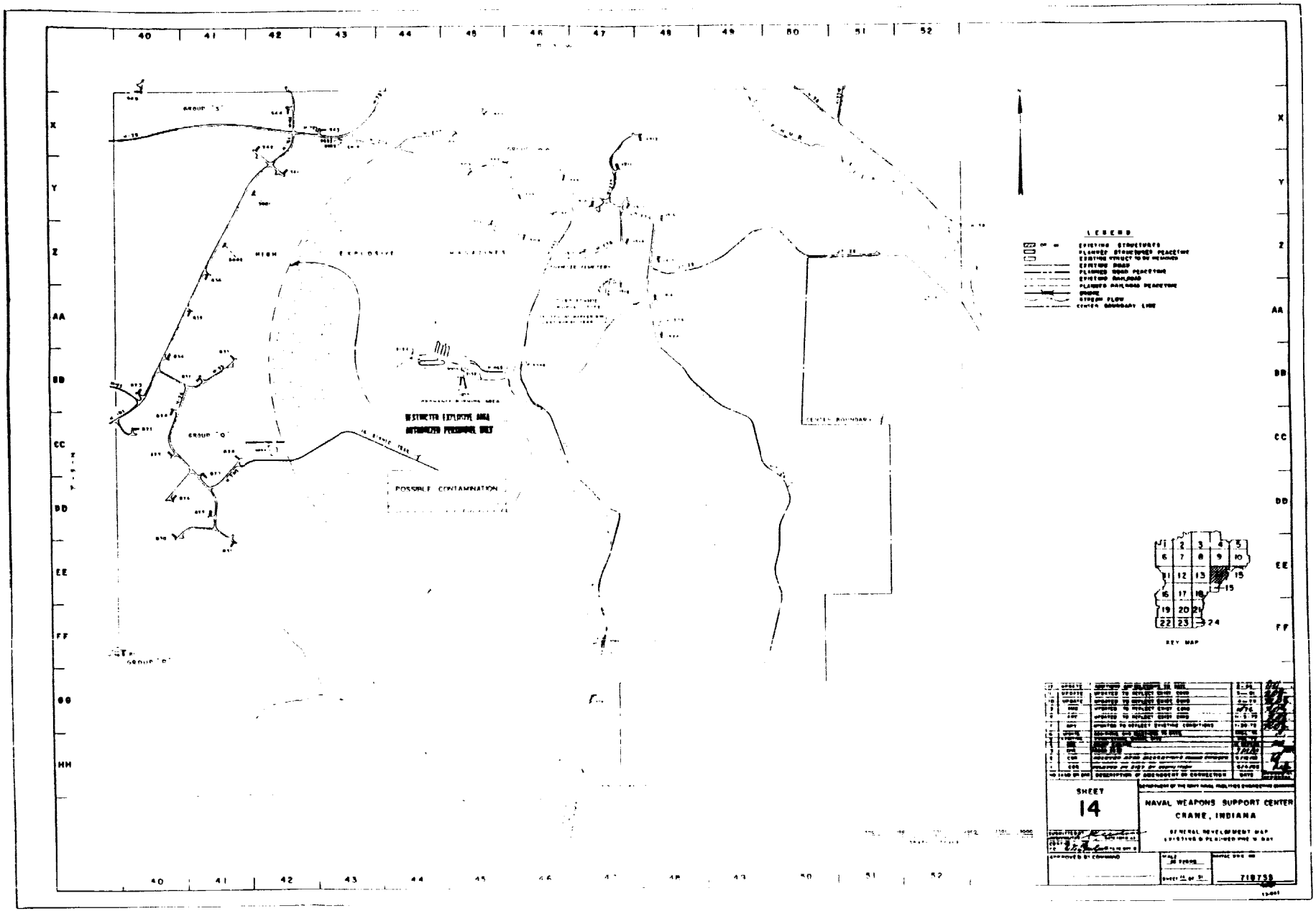
LEGEND
EXISTING STRUCTURES
PLANNED STRUCTURES PERSPECTIVE
EXISTING STRUCT TO BE REMOVED
EXISTING ROADS
PLANNED ROAD PERSPECTIVE
EXISTING RAILROAD
PLANNED RAILROAD PERSPECTIVE
STREAM FLOW
CENTER BOUNDARY LINE
Rrestricted explosive area
authorized personnel only
POSSIBLE CONTAMINATION
HIGH EXPLOSIVE
REY MAP
SHEET
14
NAVAL WEAPONS SUPPORT CENTER
CRANE, INDIANA
GENERAL DEVELOPMENT MAP
EXISTING & PLANNED PIPE & BAY
APPROVED BY COMMAND
718735

Figure (1)

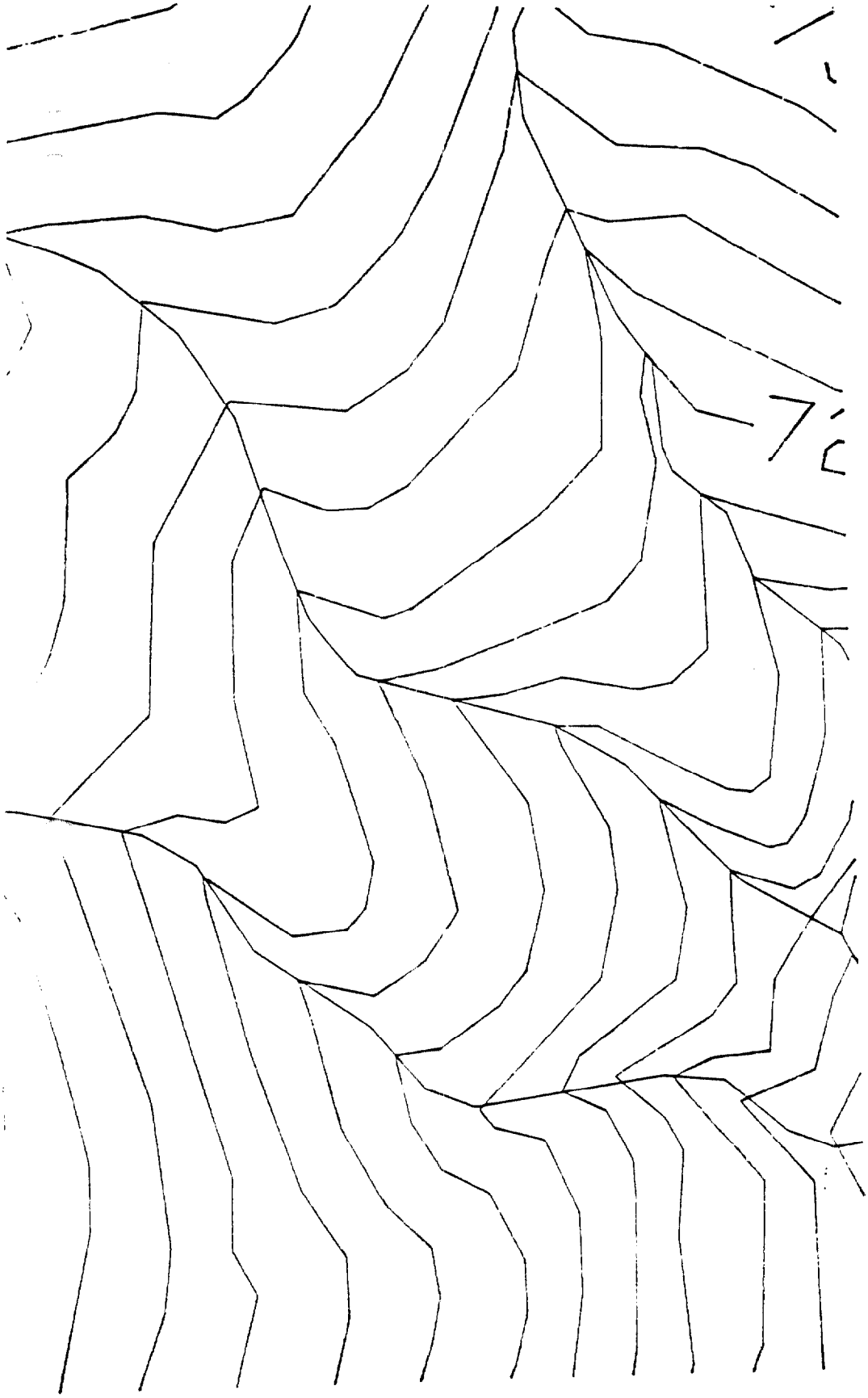

Figure (2)

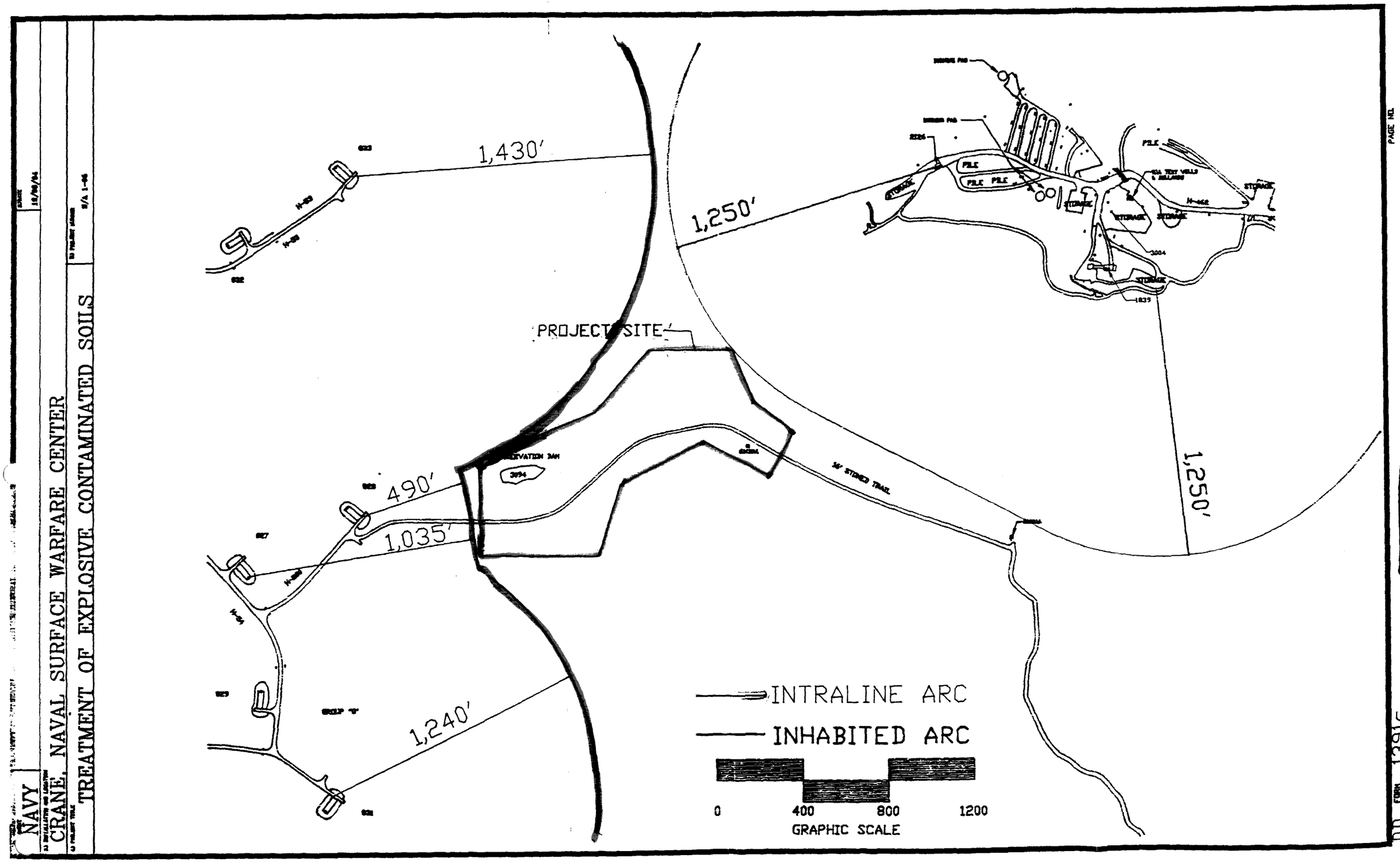
NAVY
CRANE, NAVAL SURFACE WARFARE CENTER
TREATMENT OF EXPLOSIVE CONTAMINATED SOILS
1,430'
1,250'
PROJECT SITE
490'
1,035'
1,240'
1,250'
INTRALINE ARC
INHABITED ARC
0
400
800
1200
GRAPHIC SCALE

Figure (3)

REVISED DRAFT[1] Workplan for Interim Measures, Selected SWMUs, Naval Surface Warfare Center, Crane Division, Crane, Indiana

by

U.S. Army Corps of Engineers
Waterways Experiment Station
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Prepared for Naval Facilities Engineering Command

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[1] Revised 14 February 1995

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1.0 INTRODUCTION

1.1 Background

A sequence of remedial investigations and corrective actions has been performed at the Crane Division, Naval Surface Warfare Center (NSWC Crane). Investigations began after the initial discovery in early 1981 of a potential hazardous substance release from the Center. The investigations have proceeded since 1981 and continue at the time of this writing. In April 1981 the U.S. Navy implemented the Navy Assessment and Control of Installation Pollutants (NACIP), now known as the Installation Restoration Program (IRP), to identify and control environmental contamination from past use and disposal of hazardous substances at facilities including the NSWC Crane.

An Initial Assessment Study (IAS) for the NSWC Crane began in April 1981 and was completed in May 1983 by the Naval Energy and Environmental Support Agency (NEESA). Assistance was provided by the Ordnance and Environmental Support Agency and the U.S. Army Corps of Engineers Waterways Experiment Station (WES). The IAS recommended site inspections be performed at 14 sites: 9 ordnance sites and 5 non-ordnance sites. On 19 May 1980, the United States Environmental Protection Agency (USEPA) finalized Phase I of the RCRA hazardous waste regulatory program, which became effective 19 November 1980. By that date the NSWC Crane had to comply with the codified regulatory sections of the RCRA. In October 1980 the NSWC Crane filed a RCRA Section 3010 notification and a Part A permit application to operate as a treatment, storage or disposal (TSD) facility. The NSWC Crane was qualified for and obtained Part A "interim status", which allowed the facility to legally operate as though it had a permit. Part 265 and Parts 260 through 280 are divided into Subparts which address the general operating requirements for hazardous waste management facilities and the technical standards applicable to specific units.

A groundwater monitoring program began at the NSWC Crane in 1981. Through a Military Interservice Procurement Request, the Navy requested the WES to conduct hydrogeologic investigations at ten sites, eight identified in the IAS and two new sites.

The Hazardous and Solid Waste Amendments (HSWA) of RCRA (Section 3004) established corrective actions programs (CAP) at TSD facilities. The provision required the NSWC Crane to address past releases of hazardous waste or hazardous constituents at solid waste management units (SWMUs) and regulated units. The first step of the CAP required the NSWC Crane to submit a Hazardous Waste Management Report (known as the SWMU report) to the USEPA. The SWMU

report listed all of the IAS-identified hazardous waste sites as SWMUs, and was submitted to the USEPA in January 1985 (Hazardous Materials Technical Center, 1985).

A joint RCRA storage permit was issued to the U.S. Navy by the USEPA and the State of Indiana. The Federal portion of the RCRA Permit, dated 20 December 1989, established the HSWA Corrective Action Requirements and Compliance Schedules (RCRA Section 3004). The compliance schedules obligated the NSWC Crane to perform RCRA Facility Investigations (RFI) at 30 SWMUs, and if contamination were found, to conduct Corrective Measures Studies (CMS) and implement corrective measures if needed. The State of Indiana obtained pre-HSWA authorization and issued the State portion of the permit.

Comprehensive soil and groundwater release assessment and release characterization investigations have been completed and technical reports submitted for several SWMUs within NSWC Crane. NSWC Crane reviewed all of the facility's 30 SWMUs to determine which ones had characteristics that suggest they may be amenable to accelerated interim measures. The Navy decided in the summer of 1993 to implement remedial action through interim measures at those SWMUs for which sufficient site assessment and characterization data were available. Proposed remedial actions include interim corrective measures at selected SWMUs:

- Geophysical surveying, confirmation sampling, and long-term monitoring at SWMU 14 (lithium battery removal), SWMU 17 (PCB capacitor removal, and SWMU 24 (sludge drying beds).
- Composting of explosives contaminated soils at SWMU 03 Ammunition Burning Ground and SWMU 10 Rockeye. Composting may also be applied to the Minefills A and B (SWMUs 12/13 and 12/14, respectively) at a later date.
- Design and installation of groundwater pump-and-treat system for SWMU 03.
- Design and installation of RCRA cap for SWMU 02 Dye Burial Grounds.
- Debris removal at SWMUs 23 (Battery Shop), 25 (Highway 58 Dump Site A), and 26 (Highway 58 Dump Site B).

The WES was assigned the following tasks for the remedial action work:

- Conduct the geophysical surveying at SWMUs 14 and 17.
- Conduct bench scale testing to evaluate and design composting technology for SWMUs 03 and 10.
- Design and install wells and pumps for pump-and-treat system at SWMU 03.
- Design of RCRA cap for SWMU 02 Dye Burial Grounds.

1.2 Site Descriptions and History of Site Operations

1.2.1 Naval Surface Warfare Center, Crane (NSWC Crane). The NSWC Crane is located in southwest Indiana approximately 75 miles southwest of Indianapolis and 71 miles northwest of Louisville, Kentucky (Figure 1). The NSWC Crane occupies 62,463 acres (approximately 100 square miles) of the northern portion of Martin County and small portions of neighboring Greene, Daviess, and Lawrence Counties. NSWC Crane provides materiel, technical, and logistic support to the Navy for equipment, weapons systems and expendable and nonexpendable ordnance items. The facility was opened in 1941 as the Naval Ammunition Depot, Burns City to serve as an inland munition production and storage center. The name became Naval Weapons Support Center in 1975 and was changed to Naval Surface Warfare Center Crane in 1992. The Department of Defense (DOD) ammunition procurement responsibility was transferred to the Army in 1977. The Army has assumed ordnance production, storage, and related reponsibilities under the single service management directive. All environmental activities on the installation, including permitting activities, remained the responsibility of the Navy.

1.2.2 Lithium battery site. The Crane landfill (SWMU 14) is located near the western boundary of NSWC Crane about a mile south of Burns City and just south of the Crane golf course, immediately west of Highway 161 (Figure 2). The 65 acre active sanitary landfill began operations in 1972. Excavated trenches are filled with refuse, compacted, and covered with impervious soil. The landfill receives refuse from production operations and residential and food preparation areas. NSWC Crane installed a leachate collection system and a gas venting system in the early 1980's. The Indiana State Board of Health granted special approval to the Navy in 1981 to bury neutralized lithium batteries at the landfill. The batteries were placed in the northeast corner of the landfill in trenches, and covered.

1.2.3 PCB burial site. The PCB burial site (the "pole yard") is located in the northwest quarter of NSWC Crane near Highway 45 (Figure 2). Three electrical capacitors containing PCB oils were buried at the pole yard in 1977. The capacitors reportedly were hermetically sealed prior to burial. The State of Indiana stated that the Navy was not required to remove capacitors buried prior to 19 February 1978. The precise locations of the capacitors within the pole yard are not known.

1.2.4 Ammunition Burning Ground (SWMU 03). The Ammunition Burning Ground (ABG) is located near the eastern boundary of NSWC Crane (Figure 2). The ABG lies near the head of the valley of Little Sulphur Creek. The site is approximately 2,000 ft long by 1,000 ft wide with the long axis oriented east-west. Surface drainage flows into the site from the west and northwest, and flows out of the site to the east. Little Sulphur Creek turns south at the east end of the site and continues off the NSWC Crane boundary 1-1/2 miles south of the ABG. The Ammunition Burning Ground has been used extensively since the 1940's for the destruction of materials contaminated with explosives, rocket motors, candles, flares, solvents, red phosphorus, small detonators and fuse materials. The largest quantities were destroyed between 1956 and 1960, when 15,000 pounds per day of smokeless powder and 48,000 pounds per day of high explosives (H-6 and Composition B) were burned. The area also is used for flashing (burning) of the residue from bombs and projectiles after they have been subjected to melt out or drill out operations to remove the bulk of the explosives. From 1970 to 1981, over 10,000 major weapons were destroyed.

Solid explosives residues not in containers or bombs were formerly spread out on burning pads or in flash pits and ignited, or flashed. Flashing today is done in clay-lined steel pans. There are 29 pans currently in operation at the ABG. Bulk propellants typically are poured into the burning pans to a depth of a few inches, primed and remotely initiated. A summary of pan operations is as follows:

The primer pit and incendiary cage are used for thermal treatment of ammunition components (for example small impact-sensitive primers) and pyrotechnic munitions.

Three burn pads are used for suspected explosives-contaminated material such as paper and wooden boxes and one ash inspection pan. The three burn pads are concrete-lined and are equipped with run-on/run-off controls. The ash inspection pan is used by ABG to cool the ash from the primer pit to allow personnel to segregate metal parts from the ash.

An ash pile consisting of approximately 12,290 pounds of burn residue accumulated near the incinerator pit. The ash pile was removed between July 1986 and February 1987. Hazardous waste ash from the burning operations now is stored in two large roll-off boxes. The ash is stored until sent to an off-site secured landfill.

Three surface impoundments (ponds) were constructed for the purpose of removing liquids from otherwise combustible sludges resulting from the blending and loading of munitions. In 1982 the impoundments were modified to include a liner and leachate collection system for each one. Each of the impoundments is approximately 40 feet in diameter. Two ponds held TNT, RDX and breakdown compounds in water from the Rockeye and other locations within NSWC Crane. The

other pond held phosphorus compounds. The three ponds have been replaced by the sludge burn pads. The ponds are now empty and scheduled for closure. Two empty underground storage tanks (UST), scheduled for closure, were used to store runoff and leachate from the three ponds. The USTs are near the pink water tanks. Another tank holds explosives wastes contaminated with pink water.

Phase III soils and groundwater release characterization studies have been performed at the ABG by WES. A Phase III, Part 1 draft report for soils was submitted for review on 7 January 1993. A Part 2 report is in preparation. A release to soils of explosives, metals, and perhaps organic contaminants has occurred. A Phase III final report for groundwater was published in May of 1994. A release to groundwater of explosives, certain volatile organics, and possibly metals has occurred.

A Phase II release assessment for surface water was conducted for the ABG and a draft report submitted for review on 6 April 1994. A release to surface water and stream sediment of explosives, metals, and organics has occurred.

1.2.5 Rockeye (SWMU 10). Rockeye is a 40-acre tract located in the north central portion of the NSWC Crane (see Figure 2). The area is located on Highway 45, approximately two miles south of the main gate. It is situated on a flattened ridge crest which separates the headwater drainages of Sulphur Creek, First Creek, and Turkey Creek. Drainage to the north and east flows into Sulphur Creek, drainage to the south flows into Turkey Creek, and drainage to the west flows into First Creek and thence into Lake Greenwood.

The Rockeye Facility began operation in the mid-1950's as a press loading operation for 3-inch projectiles using Composition A-3 explosive (RDX and wax). In 1967-68, the Rockeye Facility was converted to a case-filling operation in order to produce the MK20 series anti-tank Rockeye cluster bomb. The explosive material in Rockeye bombs is Octol Compound B (RDX, HMX, TNT, and wax) high explosive. As part of the loading operation, the system generates a large volume of wastewater, primarily from bomblet and tray washdown and from melt and pour operations in Buildings 2731 and 2734. The wastewater was collected in four sumps which were periodically pumped. After pumping, the remaining residue was sent to the Ammunition Burning Grounds for disposal. Prior to 1978, explosive-contaminated waters were discharged, from full sumps, directly into local surface drainage pathways. Red-colored "pink water" from washdown operations was observed in drainageway surface waters in 1977, prior to installation of a treatment facility. On the north side of the facility, the waters were released to a headwater branch of Sulphur Creek. On the south side, the waters were released to a headwater branch of Turkey

Creek. Discharges with TNT concentrations as high as 50 ppm have been detected at these discharge points. In the Spring of 1978, an activated carbon water treatment facility, located in building 3044, was brought into operation to purify the wastewater for recycled usage. In addition to a water treatment system, a scrubber system to remove contaminated particles in the steam-fed tray wash area was designed and installed. In the tray wash area, explosive contaminated trays are steam cleaned. Before the scrubber was installed, emissions were discharged directly to the atmosphere. With the installation of the pollution abatement equipment, the release of explosive contaminated waters has declined.

Groundwater contaminant release characterization and soil contaminant release assessment studies at Rockeye detected explosives contamination in a few groundwater monitoring wells in the northeast drainage way of the site and in soils located in the central and northeast quarter of the site. A draft report, Phase II for soils was submitted for review in July 1992. An internal draft report of the Phase III RFI for groundwater was completed and submitted for review in December 1993.

1.2.6 Dye Burial Grounds (SWMU 02). The Dye Burial Grounds (DBG) are located in the eastern section of the NSWC Crane, adjacent to the Ammunition Burning Ground (Figure 2). The operational history of the DBG is poorly documented. The IAS study team reported in 1984 that an estimated 50,000 lbs of dyes and dye-contaminated materials were deposited in open trenches at the DBG between 1952 and 1964. Materials reportedly included magnesium, boxes, and rags contaminated with dyes, and about 60 open drums of dye. The three open trenches were each 10 feet wide, 6 feet deep, and 50 feet long, apparently aligned end to end, and situated atop a ridge. The trenches reportedly were backfilled to the ground surface with soil in 1972, but were not permanently capped. The NSWC Crane placed crushed rock along a roadway immediately north of the trench area in 1987 to facilitate access by well drilling vehicles.

The WES began RFI Phase II groundwater assessment at the DBG in January 1987 by installing additional monitoring well clusters (33 wells). The WES Environmental Laboratory (EL) sampled 26 of the 33 wells, and a seep near the DBG, for priority pollutants in June 1988. The WES Geotechnical Laboratory (GL) prepared a Draft Report of the Phase II Groundwater Assessment of the Dye Burial Grounds and submitted it to NSWC Crane on 16 January 1991. NSWC Crane submitted the Draft Report to the USEPA on 4 March 1991. The WES began an RFI Phase III groundwater release characterization in October 1990 with the addition of three monitoring wells near the DBG. The WES EL conducted four rounds of Phase III groundwater sampling and analysis for Appendix IX compounds and explosives in 44 DBG wells from March

1991 to March 1992. A Phase III internal draft report was submitted on 1 June 1994. Investigations indicated possible contamination of the groundwater by metals.

The WES GL conducted an RFI Interim Measures Geophysical Investigation at the DBG in January 1991 to delineate the boundaries of the burial trenches and identify buried anomalies. A Draft report was prepared and submitted to NSWC Crane on 31 May 1991 and to USEPA on 14 June 1991.

1.3 Objectives and Scope of This Work Plan.

The Work Plan describes the sites to be investigated in the Interim measures work, the rationale for procedures to be implemented, the quality control methods needed to assure defensible conclusions and precautions to be taken to protect the health and safety of personnel. The Work Plan applies to tasks to be implemented at the five described SWMUs at NSWC Crane. The work plan is comprised of an introduction, a project management plan, a description of field and laboratory procedures to be implemented, a data mangagement plan, and a health and safety plan.

2.0 PROJECT MANAGEMENT PLAN

2.1 Project Objectives

The Interim measures efforts at NSWC Crane are designed to reduce or eliminate releases to the environment of hazardous constituents produced, contained, or treated at the described SWMU's, specifically:

2.1.1 Geophysical surveys of lithium battery and PCP capacitor burial sites. Surface geophysical techniques will be used to locate and map the burial areas. Several techniques will be used. The depth of burial of the objects will also be determined if possible. The geophysical survey results will assist NSWC Crane in subsequent soil screening and possible exhumation of the objects.

2.1.2 Evaluation of composting at Ammunition Burning Ground and Rockeye SWMU's. The objectives are: (1) to evaluate the application of compost treatment technology to explosives-contaminated soils by using combinations of soil concentrations, amendments, and composting conditions; (2) to evaluate the reduction in toxicity resulting from bench scale composting of NSWC Crane soils in the laboratory; (3) to determine *an* optimal set of operating conditions required to degrade target explosive contaminants; (4) to develop a basis for preliminary cost estimates for an implementation scheme, pilot and/or preliminary full-scale treatment system; (5) to generate specific information for commercial vendors or other agencies for providing cost estimates and system performance standards.

2.1.3 Design and installation of pump-and-treat extraction wells at Ammunition Burning Ground. The WES will design and install groundwater extraction wells in clusters of one or two wells each near existing small-diameter monitoring wells within the Ammunition Burning Ground. The wells will be operated as part of the groundwater treatment system to be designed and implemented by a commercial contractor. The wells will be screened in the primary aquifer (the Big Clifty sandstone/Beech Creek limestone), which has a maximum saturated thickness at the proposed locations of about 30 ft. A pump test will be conducted in each open hole prior to setting the pump and well screen to determine the expected well yield. An all-weather access road will be constructed to each well site.

2.1.4 Design of RCRA cap for Dye Burial Grounds trenches. The objective will be to develop and evaluate alternative cover schemes to prevent release to the environment or access to dye contaminated materials within the burial trenches.

2.2 Project Management

2.2.1. Management responsibilities. WES is the prime agency for the Remediation Tasks described above in Section 2.1. Overall project management and oversight will be provided by William L. (Bill) Murphy of the Earthquake Engineering and Geosciences Division (EEGD), Geotechnical Laboratory (GL). Mr. Jose Llopis of EEGD will be responsible for the geophysical surveying and analysis of the lithium battery and PCB capacitor sites. Mr. Mark Vispi of EEGD and Mr. Murphy will be responsible for the design and installation of the pump-and-treat extraction wells at the ABG. Mr. David Bennett of the Soil and Rock Mechanics Division of GL will be the principal investigator and manager of the DBG cap design. Dr. Kurt Preston and Mr. Roy Wade of the Environmental Engineering Division of the Environmental Laboratory (EL) will have responsibility for execution and management of the composting evaluation work.

2.2.2 Project schedule. All of the tasks described in Sections 2.1 and discussed in later sections of this Work Plan are scheduled to be completed before the end of FY 95. Work Plan preparation and organizational meetings will be completed in the summer of 1994. Many of the tasks, including well design and installation, preliminary laboratory work for the composting, and cap design considerations, will be initiated before the end of FY 94. The geophysical field work is tentatively scheduled to begin in October of 1994.

3.0 FIELD AND LABORATORY PROCEDURES

3.1 Drilling and Sampling Procedures

3.1.0 Required sampling. Sampling of soil and rock at NSWC Crane SWMUs will be required in some of the remedial action work. Planned sampling activities are as follows:

(1) The composting evaluation will require collection of shallow soil samples from SWMUs 03 and 10. Confirmation samples of the surface soils in suspected areas of explosives contamination will be collected and transported to WES for chemical analysis. Confirmation samples will consist of five, 0.1 cu ft portions. A full evaluation sample, consisting of *a 1 cu. yd.* portion of soil, will be collected and returned to WES once explosives contamination has been confirmed. *The cubic yard of sample will come from two locations. Approximately 1/2 cubic yard will come from an area near the center of the burn pit of ABG (approx. latitude 32°12.78' N, longitude 90°53.20'W) in a location of previous soil sampling. Another 1/2 cubic yard sample will come from an area between the last two rows of burn pans (approx latitude 32°53.55'N, longitude 86°45.85'W). The samples will be grab samples collected with a shovel to a maximum depth of 18 inches.*

(2) Design of the RCRA cap for SWMU 02 will require boring and sampling of site soils for field tests and for laboratory testing of soil physical properties. Borings are expected to be less than 15 ft deep. Boring locations and specifications will be determined through field reconnaissance at the initiation of the project.

(3) Design and installation of groundwater pump-and-treat wells at SWMU 03 will require *four* borings of 4- to 12-inch diameter and 55 to 100 ft deep, penetrating both soil and rock. The aquifer portion of each boring will be cored with a diamond-bit core barrel and retained on-site for evaluation. Pump testing of the well borings will extract several gallons to hundreds of gallons of groundwater from each boring. Current plans are to *collect and retain the water discharged by the pumping test in large transportable containers to await proper disposition.*

3.1.1 Soil sampling.

Surface samples will be collected by removing sod and topsoil to a depth of approximately 3 inches below the ground surface. Soil samples will be taken using a pre-cleaned sampling trowel or spade and placed in 8-oz wide-mouth jars for shipment to the laboratory as explained in the following paragraph.

Soil borings will be drilled using a truck-mounted drilling rig. Samples will be taken at

specified depths required by the task. A Shelby sampler will be used to collect the soil samples. The sampler will be advanced through a hollow stem auger or other suitable device, which will minimize cross contamination of samples. As the auger advances into the soil, protective casing is advanced which prevents the hole from caving. At the surface, samples destined for laboratory chemical analysis will be extracted, peeled, and bottled in the shortest time possible. Peeling is the process that removes and discards the portion of the sample which is in direct contact with the sampler. Ends of the sample will not be used. All samples will be extruded into 8-oz. wide-mouth glass jars or other containers with minimal disturbance of the sample. Stainless steel or plastic tools will be used to place the peeled samples into the containers. The sample jars or bottles will then be sealed and placed in sealed plastic packages. Following collection, soil samples will be placed in locked ice chests (coolers with ice) for storage at a temperature of 4 degrees C. Preservatives will not be required for the soil samples. The coolers containing the samples and accompanying chain of custody forms will be transported to the analytical lab for analysis. Transport will be by air freight with an overnight carrier service. A seal will be placed on each cooler to ensure that the samples have not been disturbed during transport to the laboratory.

Sample borings will be back-filled using grout and bentonite cement. Anticipated soil borings will be in non-contaminated areas of NSWC Crane for delineation of borrow materials. Soil cuttings not retained as samples will be spread evenly on the ground surrounding the boring site.

3.1.2 Rock sampling. Rock borings will be drilled with a rotary drilling rig. Soil overburden will be penetrated and sampled to refusal depth (top of rock) using a 10-inch flight auger. Rock will then be drilled and sampled using an HQ wireline core barrel. The HQ wireline core barrel retrieves a 2-1/2 inch diameter core and produces a 3-25/32 inch diameter borehole. Uncored sections of rock borings will be advanced with roller rock bits. Core samples will be placed, in order of removal, into plywood boxes for further evaluation, and detailed geologic logs will be prepared.

Casing consisting of *8-inch or* 10-inch PVC pipe will be installed in the open boring through the surface overburden soils and weathered rock to stabilize the upper portion of the hole. The casing will be cemented into competent rock and the annulus sealed to the ground surface with cement-bentonite mix to prevent infiltration of surface materials into the subsurface.

3.2 Well Construction Procedures.

Four wells will be installed in the Big Clifty sandstone/Beech Creek limestone formations for the pump-and-treat system. One well will be installed at each of the four extraction sites. The length of intake screen *installed at each site will be such that the entire saturated thickness of the aquifer will be screened. Final well diameter will be determined from results of aquifer tests, but WES anticipates that 4-inch to 6-inch diameter screen will be used in each well.* Anticipated well dimensions are as follows:

Well Site	*Well No.*	*Approx. Total Depth (ft)*	*Approx. Screen Length (ft)*	*Approx. Riser Length (ft)*
03C03	*03PMP03*	*65*	*30*	*37*
03C08A	*03PMP08*	*100*	*30*	*72*
03C11	*03PMP11*	*57*	*20*	*39*
03C20	*03PMP20*	*116*	*30*	*88*

Figure 3 shows the locations of the proposed well installation sites at the Ammunition Burning Ground.

At each well site, the well boring will be drilled to final depth and pump tested after installation of the protective surface casing. A pump test will be performed in the open borehole to determine the maximum yield of the borehole and to verify that the assumed well diameter of 4- to 6- inches is large enough to accommodate the size pump requiired to produce the maximum yield. The borehole for the well will be overdrilled to a depth of three to four feet below the base of the aquifer so that the intake screen of the pump can be placed at the bottom of the aquifer. The test will be conducted using an electric motor-driven submersible pump. During the test, the drawdown depth will be monitored continuously and adjusted, by means of a valve on the pump discharge line, to maintain the free water surface in the borehole at or very near the bottom of the aquifer. The rate of flow required to maintain this drawdown in a steady state condition will be measured by either an in-line flow meter installed in the pump discharge line or, in the case of extremely low flows, a calibrated drum. The length of the test depends on the amount of time required to reach steady state at the desired drawdown and is not anticipated to be longer than four hours. Preliminary bail tests conducted on two boreholes in the treatment area indicate that flows

in the neighborhood of less than five gallons per minute can be expected.

Karstic conditions, in the form of solution cavities and conduits, exist in the subsurface in the Beech Creek limestone and lower part of the Big Clifty sandstone within the southeast portion of the Ammunition Burning Ground. The wells proposed for pump-and-treat operations are upgradient (west) of the karstic portion of the site and will be installed in non-karstic zones. Flow of groundwater in the proposed pumping zones is through intergranular pores, bedding planes, and joints in the rock. The karst conditions east of the pumping areas is not expected to affect pumping operations. Observations of surface and spring flows and water levels in wells penetrating the karst in and below the Burning Ground have shown that seasonal flow through the karst conduits can vary significantly. Water levels in the wells upgradient in the non-karst zones, however, remain relatively constant throughout the year. Seasonal variations, therefore, are expected to be insignificant in pump testing and pump-and-treat operations. All water pumped during the yield test will be collected and stored in tanks at the site to await proper disposition pending chemical characterization of the water.

The interim measures proposed are designed to treat known contaminated portions of the aquifer in areas of slow groundwater movement. The wells are not intended to capture and retain the entire flow through the Burning Ground or to treat the entire contaminant "plume", but rather are intended to remove and treat contaminated groundwater in that portion of the aquifer shown by the existing monitoring wells to be most highly contaminated. Treatment of the groundwater in these areas of low flow should help eliminate slow but persistent discharge of contaminants to the east toward the subsurface karstic zones where groundwater can be rapidly transported to the southeast through the Little Sulphur Creek valley system. The overall flow of groundwater through the aquifer will not be interrupted or contained and the effect on flow volumes through springs or through Little Sulphur Creek should be minimal.

At the conclusion of the testing, water will be bailed from the well boring, allowed to recover, and the level of the piezometric surface determined. A well capable of discharging at the rate determined by the pump test will be designed. The boring will be reamed to the required diameter and PVC continuous-slot screen and PVC riser installed. A stainless steel, electric motor-driven submersible pump of the required capacity will be installed within the screened section of the well. A riser consisting of PVC pipe will be connected to the pump and will extend to the surface. After the screen and riser pipe have been installed in the boring, the screened section and the entire aquifer zone will be packed with a siliceous sand filter material purchased in prepackaged bags. The filter material will be tremied from the top slowly and checked for depth periodically with a tape measure. The filter pack will be brought up to the next higher shale zone

in order to obtain a good seal above the aquifer and to prevent clogging of the aquifer by annular grout. A 3 to 5 foot thickness of bentonite pellets will be installed to insure a seal above the filter pack in each well. The bentonite will be allowed to set 30 minutes to 1 hour for swelling time, and the well will be grouted to the surface above the bentonite. The grout will consist of a cement-bentonite mixture and will be pumped in from the bottom through a 1-in diameter pipe.

The procedure for developing the wells will consist of bailing well water, alternated with periods of surging. The surge tool will consist of a steel rod with rubber washers attached at each end. The well will be surged for several hours or until the water forced out at the top becomes relatively clear. The developing tools will be flushed with clean water between each well setup.

3.3 Soil Composting Sampling and Identification of Local Resources.

Soils from the Ammunition Burning Ground and/or Rockeye facility will be collected and transported to WES for initial chemical analysis. Specific locations having documented analytic data of long-term explosive contamination will be selected with the assistance of the NSWC Crane Environmental Management Department.

The utilization of composting technology for the remediation of explosives-contaminated soil is economically advantageous only if inexpensive amendments are available in adequate quantities. A WES representative will conduct a reconnaissance of locally available composting resources and amendments in and around NSWC Crane.

3.4 Geophysical Surveys.

The WES will conduct magnetic, electromagnetic (EM), and ground penetrating radar (GPR) surveys of the lithium battery (SWMU 14) and PCB capacitor (SWMU 17) burial areas. Magnetic and EM data will be collected on a proposed 10-ft square grid for subsequent contouring and analysis. The grid node spacing and configuration will be adjusted as necessary to accommodate site conditions. Magnetic and EM methods are designed to delineate the boundaries of the buried items and of the burial excavations. The GPR will attempt to determine the depths of burial and to provide additional information on boundary locations. GPR survey lines will be limited to areas of anomalies identified with the magnetic and EM methods. Appendix A describes the three geophysical methods to be used.

3.5 Field Reconnaissance and Testing at Dye Burial Grounds.

3.5.1. Layout and topography of the DBG. The boundaries of the three individual dye burial trenches have been determined through reconnaissance surveys and geophysical surveys (Llopis, 1991) to sufficient accuracy to permit design and construction of an interim cap. The approximate trench boundaries are shown on Figure 4 with respect to nearby monitoring wells and other landmarks.

The topography of the site is generally flat. The ground surface above the trenches is level with, to slightly below (0.5 to 1 ft) the surrounding terrain. A low narrow crest or ridge, that appears to be man-made, rises from ground surface near the north end of the site to a maximum of five ft above the surrounding terrain near the south end of the site, and flanks the southeast boundary of the trench site. Young trees, from 1 inch diameter saplings to 12 to 14 inch diameter trees, also flank the south, west, and southwest boundaries of the trench site and extend for some distance in the directions noted. Trees also flank the north, east, and northeast boundaries of the site. However, these trees begin on the opposite (north and east) side of the site access road from the trenches. These trees are not expected to interfere with trench construction, except at the north end where the access road is in close proximity to the trenches. At this location, the access road will require relocation northward to allow room for cap construction. Road relocation will, in turn, require removal of some trees that are up to 12 to 14 inches in diameter.

3.5.2 Soil and groundwater conditions at the DBG. General soil conditions in the area of the site were described by Dunbar (1982) and Murphy (1991) as lean silty clay (CL) to silty sands (SM) from the ground surface to top of rock based on borings near the DBG (including wells 02-01, 02-06, 02-07 and 02-08 of Figure 4). Top of rock is 6 to 10 ft below ground surface, as determined by refusal of a split spoon sampler. The water table is at 12 to 30 ft below ground surface or 6 to 14 ft below the bottoms of the trenches.

Reconnaissance surveys by WES in October and December, 1994 provided additional information about soils in the immediate vicinity of the DBG. These surveys confirmed that natural soils surrounding the trenches were generally medium to stiff to hard silt and silty clay. The soils overlying the apparent trench locations are generally brown to gray silts and silty clays of very soft to soft consistency. Shallow puddles of standing water approximately six inches deep were observed in two locations. Cattails were present in one location, suggesting that wet soil conditions had existed for some time at this site. Monkey grass, caney vegetation, and other vegetation generally associated with wet soil conditions were observed in two other locations.

3.5.3. Implications for interim cap design and construction. The original internal draft work plan submitted by WES in August 1994 envisioned design and construction of a "RCRA equivalent" cap as an interim remediation measure at DBG. The rationale for this approach was that a "RCRA equivalent" cap, designed and constructed as an interim remedial measure, would offer a high level of protection to human health and the environment, regulatory approval would perhaps be more easily obtainable than for alternative recommendations for interim measures with less extensive performance documentation histories, and the interim cap would have a high probability of successfully being approved and incorporated into the long-term remedial measures for the DBG. This approach remains a viable option, with some qualifications. Specifically, the reconnaissance survey has clearly shown that the soils overlying the DBG trenches are much softer and wetter than adjacent natural soils. This situation could lead to long-term performance problems caused by differential settlement and subsidence, and must be addressed. In addition, as mentioned previously, some trees will require removal prior to construction of the cover. Roots and stumps, if left in place, would eventually decay and lead to subsidence of cover layers. Conversely, holes left as a result of excavating roots and stumps would require careful backfilling to minimize the potential for subsidence or differential settlement. Any in situ soils or other materials brought to the surface as a result of activities associated with site preparation or cap construction would require sampling, testing, and analysis, prior to disposition. In light of these conditions the following recommendations are offered with regard to revising the work plan for the DBG Interim Cap.

3.5.4. Recommended approach for design and construction of interim DBG cap. An interim cap will be designed to provide satisfactory levels of protection to humans and the environment. Depending on the results of analysis of expected performance the recommended cap may include only those elements of a traditional RCRA style cap that are considered essential for interim protection. Available site information, complemented by laboratory soils tests as needed, will be used to evaluate the expected range of settlements. If undisturbed samples cannot be obtained for consolidation testing, judgement and available data will be used to estimate settlements based on properties of disturbed representative soil samples. The estimated total and differential settlements will be used to evaluate whether satisfactory performance can be reasonably expected of the traditional RCRA cap elements, individually and as an integrated cap system. Multiple thin layers, flexible membrane liners (FMLs) and filter fabrics may be inappropriate as elements of the interim cap if estimated settlements would damage or impair performance of such features. In this case, a cap comprised of only one to three thick soil layers could be designed for satisfactory interim

performance. This simplified, adaptable design should be able to accommodate larger settlements without cracking, rupture, or loss of function. A relatively thick, properly designed interim cover would promote and accelerate consolidation settlements, and could be incorporated into the final cap design. Settlements could be monitored and the final cap could be constructed after most settlement had occurred to minimize the potential for damage and loss of function of the other elements of the final cap.

In this approach the following steps would be required to develop interim remedial measures that would satisfy interim protection requirements and promote long-term protection as well.

3.5.5 *DBG interim measures work plan tasks.*

1. *Develop a simplified conceptual model of site-near surface soil conditions from available data, with focus on deformations and stability.*

2. *Estimate surcharge loads caused by cover construction, and estimate range of total and differential settlements within the trench boundaries and adjacent areas.*

3. *Determine impact of estimated settlements on performance of typical cover components or features, and on the performance of the cover system*

4. *Develop recommendations for interim cover, including:*
   - *Design criteria and performance*
   - *Cover components (layers, properties, thickness)*
   - *Layout and geometry (length, width, thickness, side slopes)*
   - *Surface protection treatment*
   - *Construction methods*
   - *Acceptance test methods, values, and frequencies for construction QA/QC*
   - *Recommendations for dealing with outliers (QA/QC test values outside range of acceptable values)*
   - *Recommendations for monitoring and evaluating performance*
   - *Recommendations for incorporating elements of interim cap into final cover*

3.6 Laboratory Procedures.

3.6.1 Soil composting analysis and testing. Laboratory work will consist of analyzing soils from the SWMUs for characterization of explosives contamination, respirometric investigations of soil amendments, bench scale adiabatic composting, and toxicity testing of unaltered and composted soils.

All chemical analysis will be performed by the Environmental Chemistry Branch (ECB), Environmental Engineering Division of the Environmental Laboratory (EL) of WES. The quality assurance plan for the analytical laboratory of the ECB is provided as Appendix D. Analytical results will be presented in the WES format, which is similar to the format used in USEPA's Contract Laboratory Program (CLP). Appropriate QA/QC will be maintained because of the regulatory implications of the study. Analysis for explosives contamination in soil and compost will be performed using EPA Method 8330 for the examination of nitro aromatics and nitramines by high performance liquid chromatography (HPLC) in water, soil or sediment matrices.

A preliminary respirometric investigation will be performed to investigate eight of the most promising amendment/soil mixtures. An oxygen sensing respirometer will be used as an isothermic compost reactor to determine optimal substrate utilization of a series of eight compost mixtures. The compost mixtures will then be tested for explosives degradation. The respirometric tests will be operated at *40* °C, *the maximum operating temperature of the respirometer.*

A bench-scale composting reactor will be used to perform a follow-on investigation of the two most promising compost recipes from the initial respirometric investigation. The advantage of the bench-scale composting system is that the system is design to allow for self-heating of the test mixtures. As a result, these systems provide a closer analogy to pilot and field compost conditions. Also, these systems produce a volume of material large enough for leach tests and toxicity testing.

Genotoxicity and acute toxicity tests will be performed on the unaltered soil, the soil/compost mixture at the start of the compost run, and the soil/compost mixture at the end of the compost run. Toxicity testing is necessary to insure at the earliest point of consideration that the compost technology is accomplishing the intended goal of toxicity reduction in the soil matrix. Genotoxicity testing will be by Mutatox assay testing followed by Ames testing and TA-100 (base-pair mutations) for confirmation. Acute toxicity testing will be conducted with *Daphnia magna* according to standard procedures.

The chemical tests for both the respirometric mixture screening tests and the bench-scale composting reactor will include volatile solids for an approximation of total carbon content, total Kjeldal-Nitrogen (TKN) for an approximation of total nitrogen content, pH, percent moisture and

explosive associated compounds (Table 1). Tests will be performed in on grab samples of the bulk mixtures at the beginning and end of the experiments.

Table 1 - Explosive Associated Compounds (XACs)

2,4,6 - trinitrotoluene (TNT)
2,4 - dinitrotoluene(2,4-DNT)
2,6 - dinitrotoluene (2,6-DNT)
1,3,5 - trinitrobenzene (TNB)
1,3-dinitobenzene (DNB)
2-amino-4,6-dintirotoluene (2A-DNT)
4-amino-2,6-dintirotoluene(4A-DNT)
hexahydro-1,3,5-trinitro1,3,5-triazine (RDX)
Octohydro-1,3,5,7-tetranitro1,3,5,7-tetrazocine (HMX)
N,2,4,6-tetranitro-N-methylaniline (Tetryl)

Studies by U.S. Army Natick Laboratory (Kaplan and Kaplan 1982) outline the possible daughter compounds asociated with the biotransformations associated with degradation of soils contaminated with explosives compounds (Figure 5). All the daughter compounds portrayed will be evaluated with the exception of the azo-compounds. Analytic techniques for the azo-compounds are the subject of intense, current research, and even analytic standards are difficult to obtain. Consequently, toxicity problems must be addressed head-on by the use of toxicity evaluations. In this study, toxicity evaluations of the compost material from the bench-scale composting reactors will be examined for both genotoxicity and acute magna, respectively. The approach will be similar to that conducted by Greist et al (1993)[2].

It has not yet been determined whether results of bench scale testing for the ABG and Rockeye soils will be applicable to soils at Mine Fills A and B.

3.6.2 Physical soils testing for RCRA cover evaluation. Soils derived from field sampling of the SWMU area and cover borrow areas will be characterized in the WES GL Soils Testing Facility using standard soil property tests including grain size distribution by sieve and hydrometer analysis, liquid and plastic (Atterberg) limits, water content, density and USCS classification.

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[2]Kaplan, D.L. and Kaplan, A.M. (1982). "Composting Industrial Wastes - Biochemical Consideration," BioCycle 21(3): 42-44.
Greist, W.H. et al (1993). "Chemical and Toxicological Testing of Composted Explosive-Contaminated Soil." Environmental Toxicology and Chemistry, Vol. 12, pp. 1105-1116.

Laboratory determination of the permeability of compacted soils and compaction (Proctor) tests will also be performed.

3.6.3 Computer modeling. The Hydrologic Evaluation of Landfill Performance (HELP) computer model[3] will be incorporated into the evaluation of alternative cover schemes for the Dye Burial Grounds. HELP was developed to assist designers and regulators of hazardous waste landfills to evaluate the hydrologic performance of proposed landfill designs. HELP is described as a "quasi-two dimensional, deterministic water-budget model", and was adapted from percolation and runoff and erosion models produced by USEPA and US Agricultural Research Service, respectively. The HELP model computes daily runoff, evapotranspiration, percolation, and lateral drainage for the landfill, including the cap, from daily climatological data.

The HELP model requires daily climatologic data, soil characteristics data, and design specificaitons to perform the analysis. Daily rainfall data may be input by the user, generated stochastically (mathematically randomly generated), or taken from the model's historical data base. Daily temperature and solar radiation data are generated stochastically. Requisite soil data include porosity, field capacity, wilting point, hydraulic conductivity, evaporation coefficient, and Soil Conservation Service runoff curve number. Design specifications include such things as the maximum drainage distance for lateral drainage layers, surface cover characteristics and information on synthetic membranes.

3.7 Decontamination and Disposal of Wastes

3.7.1 Personnel. Laboratory analysis of soil and groundwater samples obtained at the subject SWMUs at NSWC Crane have shown only low levels of contamination. Disposal of garments and equipment used in the proposed remedial action tasks will, in general, not be necessary. Reusable rubber or neoprene boots and Tyvek-type protective garments will be rinsed before leaving the work areas. Field personnel will wash and dry their hands before leaving the work area. Rags, paper towels and other disposable cleaning supplies will not be left on-site but will be discarded in disposal bags for subsequent disposal in a suitable container such as a NSWC Crane dumpster.

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[3]Schroeder, P.R. et al., April, 1992. "Hydrologic Evaluation of Landfill Performance (HELP) Model, Volume IV: Documentation for Version 2", Internal Working Document EL-92-1, Environmental Laboratory, Department of the Army, Waterways Experiment Station, Vicksburg, MS.

3.7.2 Drilling operations. Prior to the start of drilling and between set-ups at each of the boring sites thereafter, the drill rig and drilling tools will be steam-cleaned to prevent cross-contamination of borings and wells. Drilling will be conducted with clean water obtained from the water treatment plant at NSWC Crane. No other drilling fluids or additives will be introduced into the borings. The drill cuttings will be removed by circulating clean water in a steel mud pan sealed around the boring top. During drilling operations the mud pan will be cleaned and refilled with new water when conditions warrant. In some borings, the drilling water will be lost in the more porous and jointed aquifer zones. When water loss occurs, the mud pan will be replenished with a continuous flow of clean water.

3.7.3 Sampling devices. All sampling devices, including shelby-tube, sampling trowel, hollow-stem auger, and bailers, will be scrubbed with a non-phosphate detergent and rinsed with potable water after use. The equipment will then be rinsed with deionized water and air dried. Core barrels and split-spoon samplers will be steam-cleaned during decontamination of the drilling rig and appurtenances.

3.7.4 Investigation-derived wastes. The site manager, using best professional judgement, will render a waste as hazardous or non-hazardous. Non-hazardous wastes will be disposed of at the SWMU. Drill cuttings and soils from borings will be thin-spread around the borings. Liquids from the decontamination operations will be discharged to the ground surface in a non-nuisance manner. Groundwater derived from purging, well-development, and pumping tests will be discharged to the ground surface or surface stream near the well location but sufficiently removed as not to recharge the well.

3.8 Sample Documentation Procedures

Field derived parameters will be recorded in field notebooks. Samples will be labeled by site name, sample number, date and time of sample collection, sample type, and sampling location and depth, if appropriate. Samples destined for shipment to WES for laboratory analysis will be accompanied by a chain-of-custody record and chain-of-custody tag.

Field logs of sample borings will be made by the geologist or other inspector at the time of sampling. Figures *6 and 7* are examples of log forms that may be used to record soil and rock boring/sampling activities. Field logs provide information on soil and rock description and classification, sampling intervals, drilling and sampling procedures, boring location and

responsible personnel, depths and/or elevations of stratum changes, sampling methods, and other information as required.

4.0 DATA MANAGEMENT PLAN

The Data Management Plan explains the movement of the data into final report form. Chemical and physical data will be converted from raw form into final form by the laboratory personnel and remedial action principal investigators. The final data will then be incorporated into the technical reports. WES anticipates that a technical report will be prepared for each remedial action task described in this work plan. The data will be presented in various text, tabular, and graphic formats. Recorded data will consist of boring and sampling descriptions, locations, procedures, and results, results of field and laboratory testing, and analysis of results. Locations of SWMUs, borings and sampling stations will be recorded on maps as figures or plates.

Chemical and physical laboratory results will be presented as computer-generated tables prepared by the analyzing laboratory and will include parameters such as the sample number, parameter measured, amount detected, date analyzed, units used, a lab ID number for each sample, duplicates, and results of analysis of blanks. Much of the data will be presented in appendixes to the draft and final reports.

Graphical displays will include base maps of the NSWC Crane and SWMUs, photographs of field activities, site conditions and testing and sampling equipment, schematic drawings of testing equipment and field constructions and/or excavations, and planimetric and cross-sectional plots of data.

Technical reports will be prepared in Internal Draft, Draft, and Final formats. The Internal Draft Report will be reviewed at WES and by NSWC Crane Environmental Department and Southern Division NAVFAC (Charleston). Comments and suggestions will be incorporated into a Draft version, which will be distributed to the same agencies and to USEPA Region V for additional comments. All comments will then be addressed and incorporated into a Final Report for distribution as approved by Southern Division, NAVFAC.

5.0 SAFETY, HEALTH, EMERGENCY RESPONSE AND ACCIDENT PREVENTION PLAN.

5.1 Introduction.

The Health and Safety Plan establishes procedures that are to be followed to protect Corps of Engineers employees and the public from potential safety and health hazards associated with the proposed Interim measures work to be performed at NSWC Crane. All project activities will be conducted in a manner that minimizes the probability of injury, accident, or contaminant releases. Although the plan focuses on the specific work activities proposed for the Interim measures, the plan must remain flexible because of the varied and complex nature of the work. Conditions may change and unforeseen situations may arise that require departure from the original plan.

5.2 Facility Location and Description.

The NSWC Crane is located in the northern half of Martin County in southwestern Indiana, approximately 75 miles southwest of Indianapolis. The nearest major metropolitan area is Bloomington, IN, approximately 40 miles northeast on state Highways 45 and 37. NSWC Crane occupies approximately 100 square miles (62,463 acres), which includes 1,006 acres of improved grounds, 49,611 acres of unimproved grounds, and 800 acres of water. The area is divided into facility operations, safety buffer and security zones, and is surrounded by farmland. The facility is relatively isolated and is not accessible to the unescorted public. Descriptions of the Interim measures SWMUs were presented in Section 1.2.

5.3 Climate.

The climate in southwest Indiana is temperate with broad seasonal variations. The mean temperature for January is 26 °F and for July is 89 °F. The average annual precipitation is approximately 44 inches, with 42 inches of rainfall and 15 inches of snowfall. The humidity ranges from 40 to 90 % in the summer and 60 to 90 % in the winter. Heat stress, cold stress, and severe weather with thunderstorms and lightning are significant potential hazards.

5.4 Task Specific Risk Assessment.

5.4.1 Drilling and Sampling. Drilling of surface and subsurface soil and rock will be performed at some SWMUs to collect samples and to install wells. Some of the borings will penetrate material known or suspected to contain potentially hazardous constituents. The drilling

and sampling will have limited potential for exposing employees to low levels (parts per million or parts per billion) levels of organic compounds, carcinogens, and heavy metals. Primary exposure routes during drilling operations will be skin absorption, ingestion, and inhalation of contaminated liquids and vapors from the drill cuttings, circulating water, and soil and water samples. Health risks associated with drilling and sampling of the low-level contaminants are considered low.

All work shall comply with all Federal, State, and local health and safety requirements, including the Occupational Safety and Health Administration's (OSHA) requirements (29 CFR 1910 and 1926), the USEPA's hazardous waste requirements (40 CFR 260-270), the US Army Corps of Engineers' Safety and Health Manual (EM 385-1-1, April 1981, revised October 1987) and all NSWC Crane and US Army Corps of Engineers safety directives and policies.

All drilling sites will be cleared with the NSWC Crane Public Works Department for the presence of underground and overhead utilities prior to commencement of drilling activities.

5.4.2 Surface soils sampling for composting evaluation. Collection of 5 cu ft samples of explosives contaminated soils at the Ammunition Burning Grounds and the Rockeye facility will expose field personnel to levels of explosives contamination potentially as high as 10,000 mg/kg (ppm). Sampling personnel will wear protective clothing to minimize direct contact with the contaminated soils.

5.4.3 Site reconnaissance and surveying. Personnel engaged in site reconnaissance and survey activities will be exposed to a number of potential hazards, including but not limited to manmade and natural debris on the ground surface, rail and highway traffic, facility operations and activities, hazardous footing on slopes, poisonous snakes, and stinging or biting insects, spiders and ticks.

5.4.4 Laboratory testing and analysis. Laboratory personnel will be subject to hazards associated with operating heavy laboratory equipment, equipment with potential shock or burn risks, and toxic, flammable, caustic or other hazardous chemicals. Laboratory personnel will operate under health and safety precautions established for each laboratory.

5.5 Site Safety Coordinator.

The Site Safety Coordinator will be responsible for enforcing health and safety requirements for the various Interim measures tasks. The principal investigator or supervisor on-site for each task will serve as the Site Safety Coordinator.

5.6 Employee Safety Responsibility.

Each employee is responsible for his or her personal safety as well as the safety and well being of others in the work area. The employee will use all equipment provided in a safe, appropriate, and responsible manner. All personnel will follow the policies set forth in this Health and Safety Plan.

5.7 Job Hazard Assessment.

5.7.1 Chemical. A summary of contaminants found in water and soil at the Interim measures SWMUs during previous investigations is presented in Appendix B.

5.7.2 Radiological. Contact with radiological contaminants is not anticipated, based on the results of previous investigations.

5.7.3 Heat stress. The combination of warm ambient temperature and protective clothing increase the potential for heat stress. Symptoms of heat stress include skin rash, heat cramps, heat exhaustion, and heat stroke. Recognition and prevention of heat stress are covered in the 40-hr and 8-hr OSHA Hazardous and Toxic Waste Workers Training courses. Workers are encouraged to increase consumption of water. During periods of high heat stress potential, more frequent breaks and rest periods should be allowed and, if necessary, work hours can be modified to exclude the hottest times of the day. Means of recognizing and treating the different levels of heat stress are:

* Heat rash: A condition caused by blocked sweat ducts resulting in a reddish skin condition that can be complicated by infection. Heat rash can be treated by resting in a cool place and can be prevented by good personal hygiene and drying the skin.

* Heat cramps: Caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:

- muscle spasms
- pain in the hands, feet, and abdomen

* Heat exhaustion: Occurs from increased stress on various body organs including blood circulation due to cardio-vascular insufficiency or dehydration. Signs and symptoms include:

- pale, cool, moist skin
- heavy sweating
- dizziness

- nausea
- fainting

* Heat stroke: The most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury or death occurs. Competent medical help must be obtained. Signs and symptoms:

- red, hot usually dry skin
- lack of or reduced perspiration
- nausea
- dizziness and confusion
- strong, rapid pulse
- coma

5.7.4 Exposure to cold. The potential for hypothermia and frostbite exists when outdoor work occurs in the winter months. Protective clothing greatly reduces the possibility of hypothermia in workers. Employees should be allowed to stop work to obtain more clothing if needed. Employees should also be advised to change into dry clothes if their clothing becomes wet. The potential for frostbite is greatest in body extremities. Personnel should pay particular attention to hands, feet and any exposed skin when dressing. Symptoms of cold stress, including severe shivering, excessive fatigue, drowsiness, irritability, or euphoria necessitate immediate return to a warm shelter.

5.7.5 Physical hazards. The USACE has developed standard safety protocols in Safety and Health Manual EM 385-1-1, which will be followed at all times. All USACE personnel are familiar with the field activities that will be conducted for the Interim measures. They are trained to work safely under various field conditions. The Site Safety Coordinator will observe the general work practices of crew members and equipment operators, and enforce safe procedures to minimize physical hazards. Hard hats, safety glasses and steel-toed safety shoes/boots are considered standard equipment at all work sites. Truck-mounted drilling operations present inherent noise and equipment hazards. A job hazard analysis for drilling operations is presented as Appendix C.

5.8 Work Site Precautions.

Eating, drinking chewing gum or tobacco, or any practice that increases the probability of hand to mouth transfer and ingestion of contaminated materials is prohibited at the work site.

Hands and face must be washed upon leaving the work site and before eating, drinking, chewing gum or tobacco. *Smoking and the use of open flame outdoors is strictly forbidden at NSWC Crane.*

A buddy system will be used. During site operations, each worker will consider himself/herself a safety backup to his/her partner. Visual contact will be maintained between buddies on-site when performing hazardous duties.

No personnel will be admitted to the work site without the proper safety equipment, training, and medical surveillance certification.

All personnel must comply with established safety procedures.

5.9 Personal Protective Equipment (PPE).

This section addresses the levels of personal protective equipment that may be required for Interim measures work at NSWC Crane. USACE employees will be trained in the use of all PPE. Past experience at the SWMUs scheduled for Interim measures indicates that Level D or Modified Level D PPE will be required.

5.9.1 Anticipated protection levels. The following levels of PPE are recommended for the proposed Interim measures work at NSWC Crane:

Geophysical surveying tasks.	Level D
Sampling of soils for composting.	Modified Level D
Installation of wells for pump-and-treat	Level D/Modified Level D
Site recon and sampling for DBG cap design	Level D

5.9.2 Level D. Level D PPE consists of the following:

safety glasses with side shields,

hard hat,

steel-toed work shoes/boots,

protective coveralls and additional clothing as prescribed by weather conditions.

5.9.3 Modified Level D. Modified Level D PPE consists of the following:

safety glasses with side shields,

hard hat,

steel-toed work shoes/boots,

nitrile, neoprene, or PVC overboots or vinyl booties,

outer nitrile, neoprene, or PVC gloves over latex sample gloves,

face shield (when projectiles or splashes pose a hazard),

Tyvex coverall,

hearing protection.

5.10 Decontamination Procedures.

All personnel, clothing, and equipment must be decontaminated before leaving a contaminated work site.

5.10.1 Personnel decontamination. The following steps will be taken to decontaminate personnel and clothing:

1. Deposit contaminated equipment (tools, sampling devices and containers) on plastic drop cloths.
2. Scrub outer boots, outer gloves, and splash suit with detergent water and rinse thoroughly with water.
3. Remove outer boots and gloves and deposit them in a container with a plastic liner.
4. Wash hands and face thoroughly.

5.10.2 Equipment decontamination. A separate area will be designated at the work site for equipment decontamination. The USACE will provide in this area steam cleaning equipment capable of adequately cleaning site equipment. The following steps will be taken to decontaminate equipment:

1. Remove any solid particles from the equipment with a high-pressure water hose and brush.
2. Wash sampling equipment and containers with a detergent solution and rinse with tap water and then distilled water.
3. Steam clean all drilling equipment and appurtenances and allow to air dry before leaving the work site.

5.11 Air Monitoring.

Air monitoring for the presence of combustible gas/organic vapors will be implemented at work sites requiring subsurface drilling and sampling. All of the proposed work sites for the Interim measures have previously been drilled and sampled, and no problems with combustible gases/organic vapors have been encountered. However, combustible gas meters and organic vapor analyzers will be maintained on site and operated as needed. Combustible gas meters will

monitor the concentration of vapors present and record them as a percent of the lower explosive limit (LEL). The LEL of a combustible gas is the lowest concentration by volume in air which will explode, ignite, or burn when there is an ignition source. Organic vapor analyzers measure the concentration of organic vapors present in the air.

The plans of action for combustible gas and organic vapor monitoring to be followed are:

Monitoring Device	Action Level	Action
Combustible gas meter	10% LEL	Continue monitoring, and if increase continues, evacuate
Organic vapor analyzer	> 5 ppm unknowns	Evacuate, assess problem

5.11.1 Combustible gas meter. The site safety coordinator will monitor the work area during drilling to detect and measure any explosive concentrations of vapors emanating from the borehole. Explosion potential measurements will be made using a combination combustible gas/oxygen (LEL) meter such as the Neotronics meter or the Exotox Model 40-OFH. Readings one foot above a source showing > 10% LEL requires an immediate shut down of operations and evacuation of the area until the problem can be assessed or suppressed. The potential for oxygen-deficient atmosphere is unlikely for the work to be performed for the Interim measures.

5.11.2 Organic vapor analyzer. The site safety coordinator will use a photoionization type detector (PID) such as the HNu Systems Model 101 or the Foxboro OVA Model 128 to monitor the levels of ionizable vapors at the work site. Measurements will be made at the bore hole or top of casing and, if vapors are present, at ground level and at the workers' breathing zone. The PID/OVA will be calibrated relative to benzene. If a detected level of organic vapor exceeds 5 ppm in the breathing zone, all personnel will evacuate the work site until the problem can be assessed and/or suppressed.

5.12 Contingency Plan and Emergency Response.

5.12.1 Locations of emergency response facilities. Prior to commencement of field activities, the site safety coordinator will plan emergency egress routes and discuss them with all field personnel. A map showing routes from the four Interim measures SWMUs to the NSWC Crane emergency response facilities is presented as Figure B1. Figure B2 is a map of the inset region of Figure B1 showing the location of the Fire Department and Dispensary, which are

located in the Administration Area of NSWC Crane.

5.12.2 Emergency telephone numbers and routes to civilian hospitals. The following list of emergency telephone numbers and emergency response routes will be available to all site personnel:

USEPA Environmental Response Team	(201)321-6460
NSWC Crane Environmental Management Department,	
Jim Hunsicker or Tom Brent	(812)854-6160
Fire Department (NSWC Crane)	(812)854-1235 or -1333
Police/Security Department (NSWC Crane)	(812)854-3300
Indiana State Police	(812)332-4411
Hospital (NSWC Crane)	(812)854-1220
Hospital (Bedford Medical Center)	(812)275-1200
Ambulance (NSWC Crane, on-site)	(812)854-1100
Ambulance (Lawrence County, off-site)	(812)279-6545
Poison Control Center	1 (800)382-9097

Address: Bedford Medical Center 2900 West 16th Street
Bedford, IN 47432

Route: exit NSWC Crane at Main Gate, east on Hiway 58 to city of Bedford, left onto 16th Street. Distance to hospital approx 20 miles. Telephone (812)275-1200.

5.13 Training and Medical Surveillance Requirements.

All personnel engaged in Interim measures activities at NSWC Crane SWMU's must have completed the 40 hour hazardous and toxic waste site workers training course or the 8 hour refresher within the past year, and must have in their possession a training course identification card or certificate.

All personnel engaged in the Interim measures activities must have undergone, within the last year, an annual health screening designed to monitor the accumulation of site-associated contaminants within the body and other bodily functions.

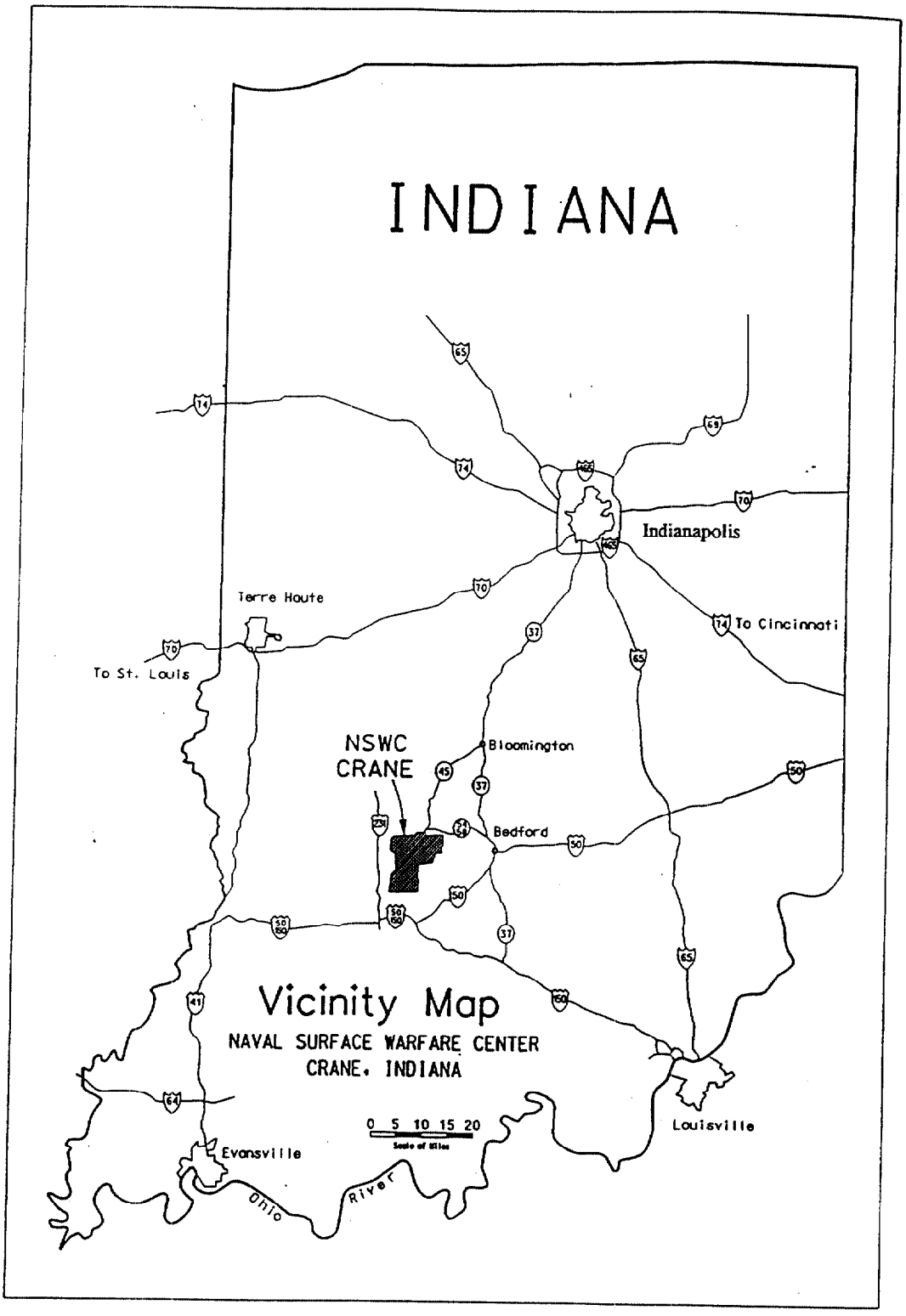

Figure 1. Location of Naval Surface Warfare Center, Crane, Indiana

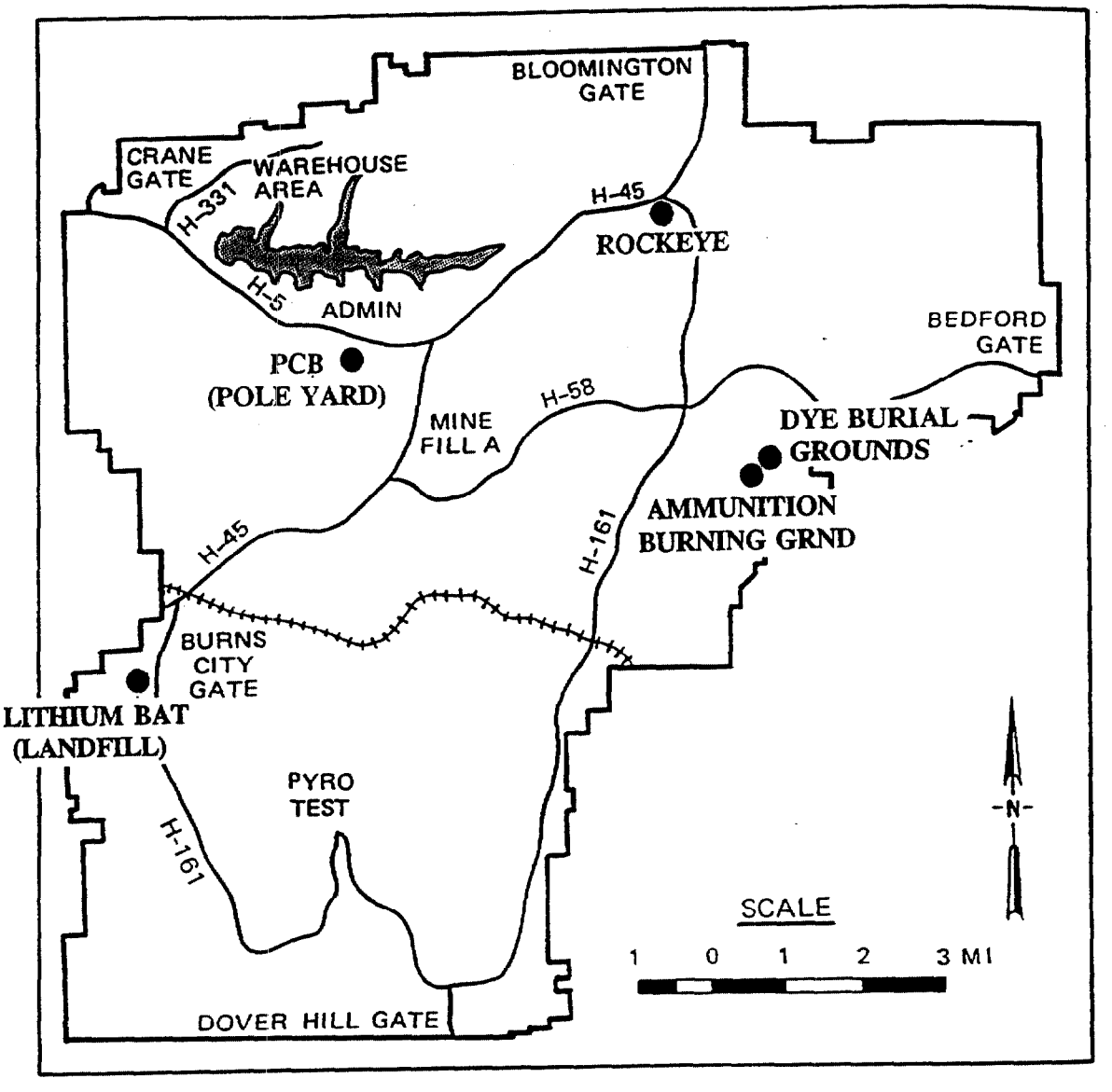

Figure 2. Location of the Rockeye Facility at the Naval Surface Warfare Center Crane, Indiana.

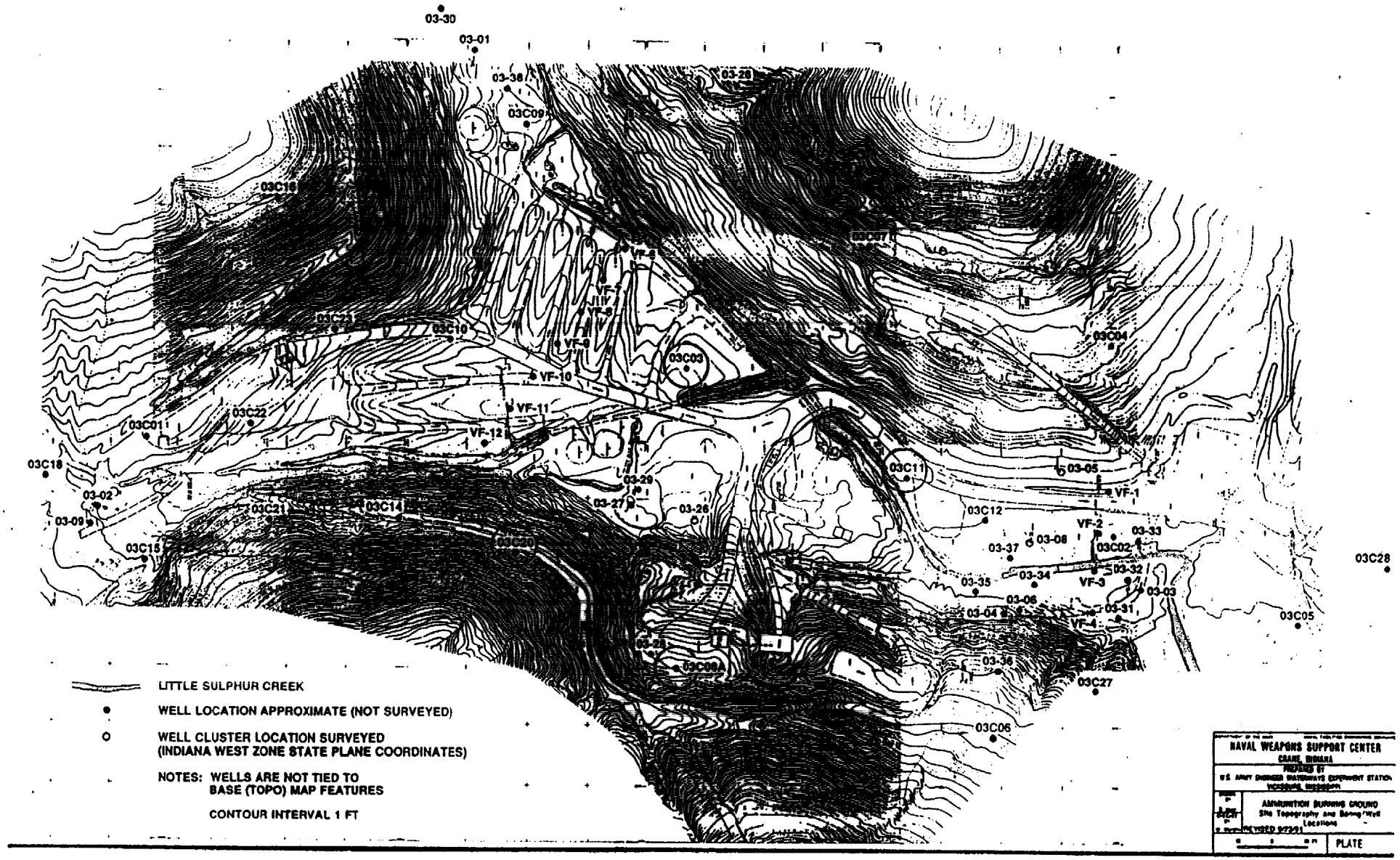

Figure 3. Proposed sites (circled) for pump-and-treat wells, Ammunition Burning Ground.

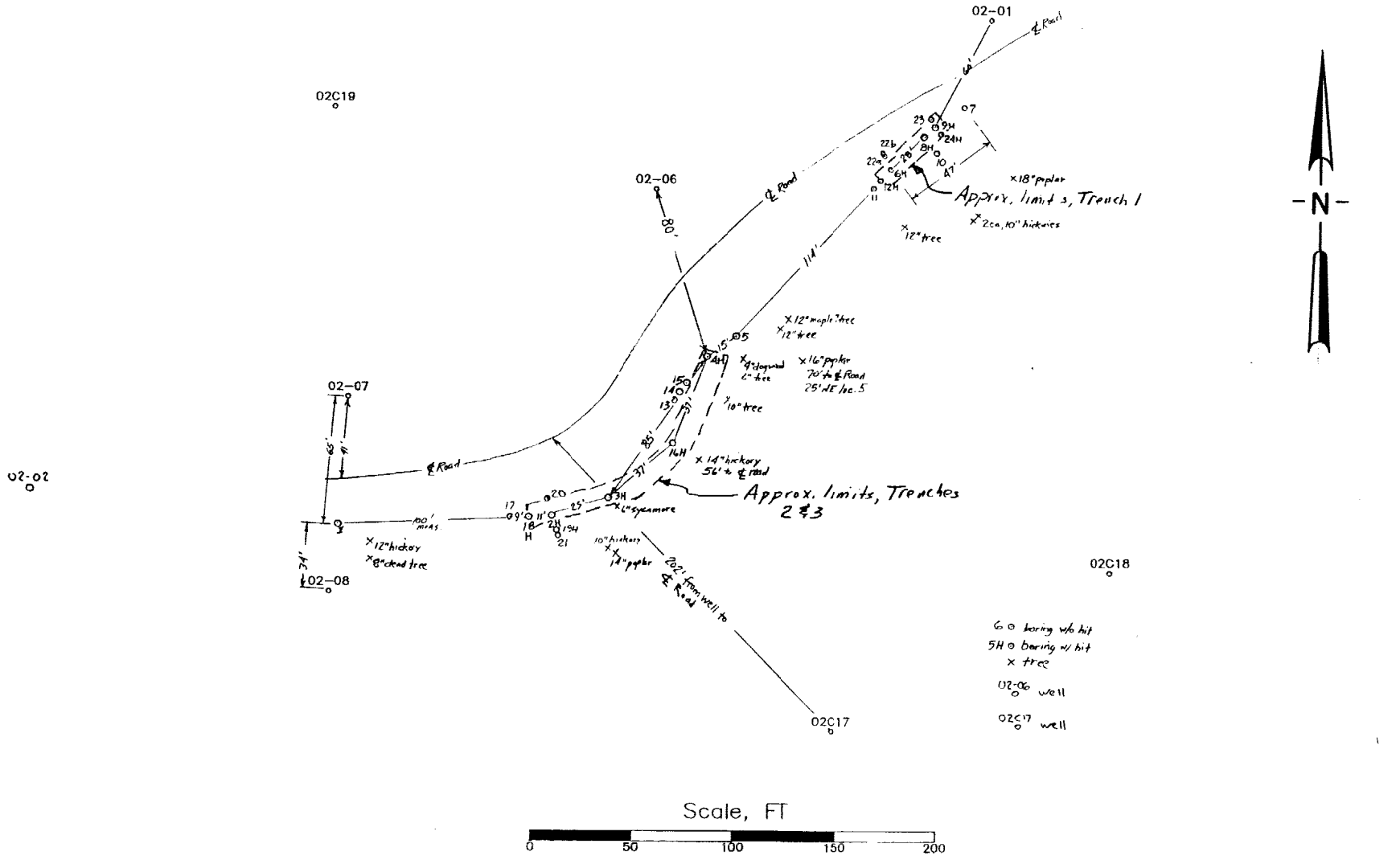

PLATE 1 Field Map 1 of 2

Figure 4. Field reconnaissance map of Dye Burial Grounds trenches and other features.

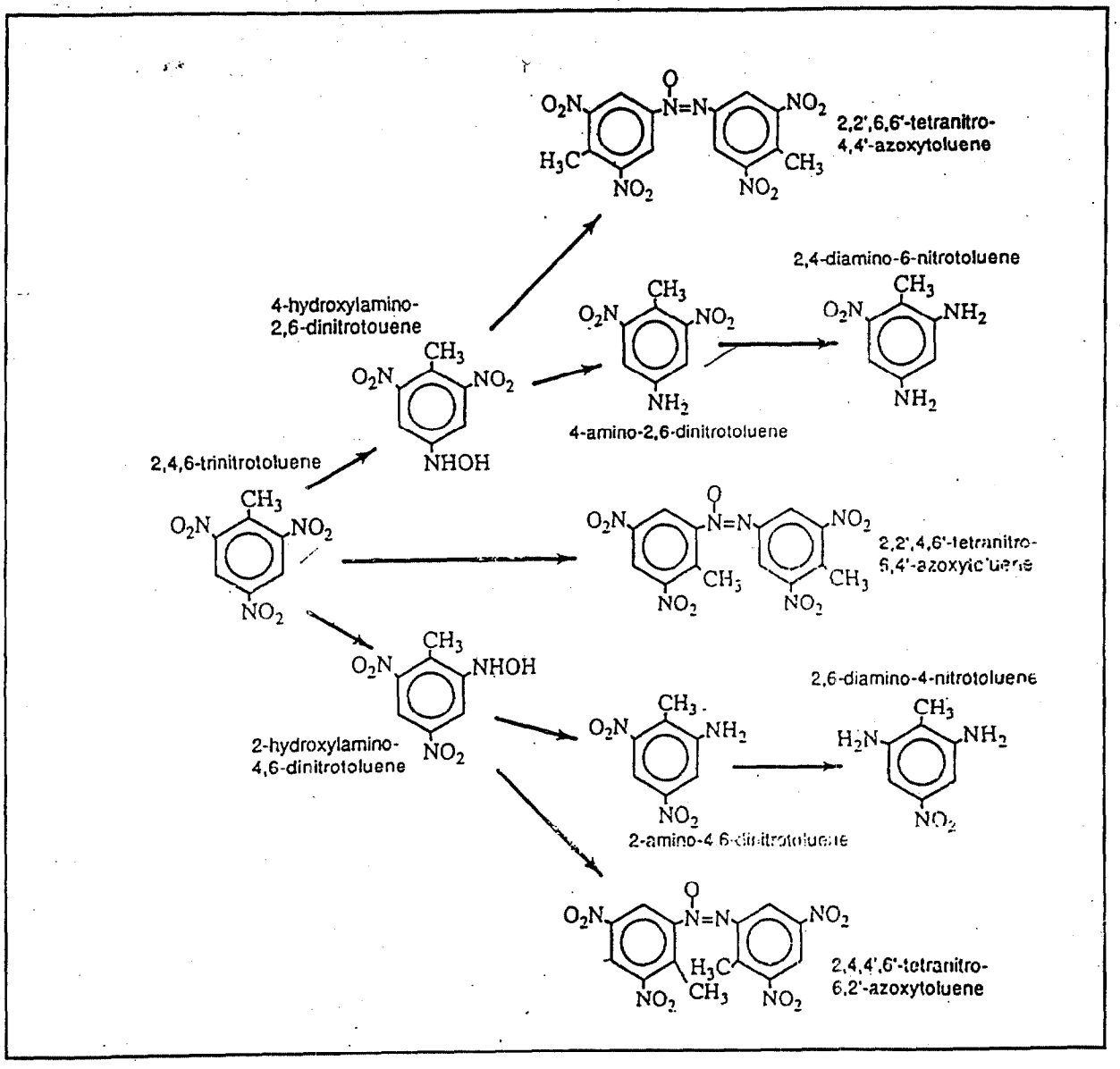

Figure 5. Proposed degradative pathway for TNT (Kaplan and Kaplan 1982).

Hole No.

DRILLING LOG	DIVISION	INSTALLATION	SHEET OF SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
	15. ELEVATION GROUND WATER
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	16. DATE HOLE — STARTED — COMPLETED
	17. ELEVATION TOP OF HOLE
7. THICKNESS OF OVERBURDEN	18. TOTAL CORE RECOVERY FOR BORING %
8. DEPTH DRILLED INTO ROCK	19. SIGNATURE OF INSPECTOR
9. TOTAL DEPTH OF HOLE	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT | HOLE NO.

Figure 6. Soil and rock boring log form (reproduced at 64 percent).

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. _____

SAMPLE NUMBER	DATE TAKEN	STRATUM		DRIVE		SAMPLE		TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		FROM	TO	FROM	TO	FROM	TO				

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Sheet _____ of _____ Sheets

Figure 7. Soil and rock boring log form (reproduced at 78 percent).

Appendix A. Descriptions of Geophysical Methods

A1. Electromagnetic (EM) surveys.

The EM technique measures differences in terrain electrical conductivity. Electrical conductivity is affected by differences in soil and rock porosity, water content, chemical nature of the groundwater and soil, and the physical nature of the soil and rock. Variations in measured values or patterns of measured values of conductivity can be used to deduce properties of the subsurface materials or to identify anomalous areas. The EM technique has certain advantages over other kinds of electrical surveying methods, including not requiring contact with the ground, smaller crew size, and rapid acquisition of data.

The WES EM system consists of transmitter and receiver coils set a fixed distance apart on a survey pole. The transmitter coil is energized with an alternating current at an audio frequency (kHz range) to produce a time-varying magnetic field which induces small currents in the ground. These currents generate a secondary magnetic field that is sensed, together with the primary field, by the receiver coil. The measured units of conductivity are millimhos per meter (mmho/m) or, in the SI system, in millisiemens per meter (mS/m). The EM data are presented in profile plots or as contours if data are obtained on a grid.

There are two components of the induced magnetic field measured by the EM. The first is the quadrature-phase component, which measures the ground conductivity. The second is the in-phase component, which is used primarily for calibration. However, the in-phase component is significantly more sensitive to large metallic objects and hence very useful for sensing large buried metal containers.

Geonics Models EM-31 and EM-38 ground conductivity meters, or similar systems, will be used to survey the NSWCC sites. The EM-31 has an intercoil spacing of 12 ft and has an effective depth of exploration of about 20 ft. The EM-31 reads a weighted average of the earth's conductivity as a function of depth. A thorough investigation to a depth of 12 ft is usually possible, but below that depth conductive anomalies are more difficult to distinguish. The EM-31, when carried at the usual height of about 3 ft, is most sensitive to features at a depth of about 1 ft. Half of the instrument's readings result from features shallower than about 9 ft and half from below that depth. The instrument can be operated in a continuous or a discrete mode. The EM-38 has an intercoil spacing of 3 ft allowing for maximum depth of investigaton of approximately 6 ft. The EM-38 has a correspondingly greater horizontal resolution than the EM-31.

A2. Magnetic surveys.

Magnetic surveys measure local disturbances (anomalies) of the earth's magnetic field. WES will use a Scintrex Model MP-3/4, or similar model, proton-precession magnetometer. The instrument measures the total intensity of the local magnetic field. The local magnetic field is the vector sum (the total field) of the field of the local magnetized materials (the local disturbance) and the ambient (the undisturbed) magnetic field. The units of measurement are nanoTeslas (nT). The magnetometer has dual sensors allowing measurement of the gradient of the total magnetic field. The gradient is taken by measuring the total field at the two sensors, which are fixed a small distance apart. The difference between the two sensor readings, divided by their separation distance, approximates the gradient measured at the midpoint of the sensor array. Two advantages of using the magnetic gradient are that the regional magnetic gradient is filtered out, permitting better definition of local anomalies, and that diurnal (daily) magnetic variations and effects of magnetic storms are essentially

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removed. The magnetometer has an absolute accuracy of ± 1 nT (the Earth's magnetic field varies from about 60,000 nT at the poles to about 30,000 nT at the equator).

A magnetic anomaly represents a local disturbance in the earth's magnetic field arising from a localized change in magnetization. The observed anomaly expresses the net effect of the induced (temporary) and remanent (permanent) magnetization and the earth's ambient magnetic field. The depth of detection of a localized subsurface feature depends on its mass, magnetization, shape and orientation, and state of deterioration.

A3. Ground Penetrating Radar (GPR).

GPR is a geophysical subsurface exploration method using high frequency electromagnetic (EM) radiation. The GPR consists of a transmitting and a receiving antenna. The transmitting antenna continuously transmits an EM signal into the ground and is reflected back to the receiving antenna by materials having contrasting electrical properties . The reflected signals are amplified, processed and recorded to provide a continuous profile of the subsurface. The transmitted EM waves respond to soil and rock conditions having sufficiently different electrical properties such as those caused by clay content, soil moisture or groundwater, water salinity, cementation of soil and rock particles, man-made objects, and voids. The depth of exploration is limited by the electrical properties of the soil or rock and by the power of the transmitting antenna. A GSSI System 8 or a sensors and software GPR system will be used by WES.

The primary disadvantage to GPR is its extremely site-specific applicability. The presence of high-clay content soils in the shallow subsurface will generally defeat the applicaton of GPR. High water contents in the shallow subsurface and shallow water tables can also limit the applicability of GPR. GPR effectiveness is generally limited to depths of less than 50 ft.

Appendix B.
Potential contaminants at Remedial Action SWMUs, NSWCC

The following paragraphs summarize the status of soil, groundwater, and surface water contamination at SWMUs scheduled for Remedial Action at NSWCC and at which exposure of workers to potentially contaminated media is likely. The evaluations of status of contamination were determined from RCRA Facility Investigations (RFI) conducted over the past several years. The summaries are presented for each affected SWMU for media for which data are available.

SWMU 03 Ammunition Burning Ground

Groundwater. Groundwater contamination has occurred in aquifers beneath the Ammunition Burning Ground (ABG). Principle contaminants identified through sampling and analysis of water from monitoring wells are military explosives compounds RDX, TNT and HMX and the volatile organic trichloroethylene (TCE). Trace metals (heavy metals) also occur.

Occurrence of the principle contaminants is limited, with one exception, to monitoring wells within the ABG proper and to springs A and C south of the ABG in the valley of Little Sulphur Creek.

The Beech Creek limestone is the primary receptor of contaminants originating from activities within the ABG. Contaminated runoff from the ground surface infiltrates into the Beech Creek limestone through the Big Clifty sandstone where the sandstone is exposed in the axis of the valley of Little Sulphur Creek in the ABG. Water within the Beech Creek then moves through the formation, primarily in solution conduits, southeastward along the valley of Little Sulphur Creek. In periods of very high rainfall, surface runoff within the ABG proceeds into Little Sulphur Creek and remains as surface flow downstream of the ABG.

Spring A, located on the west valley wall approximately a mile-and-a-half south of the ABG, is the primary outlet of Beech Creek formation groundwater. Water issuing from Spring A feeds Little Sulphur Creek. Travel time for groundwater in the Beech Creek system from the ABG to the mouth of Spring A is estimated at roughly two miles per day.

Spring C, located on the east valley wall of Little Sulphur Creek about one mile below the ABG, is an outlet of Beech Creek groundwater only at high flow. Spring B, located south of Spring A, is possibly an outlet under even more restrictive conditions. No other springs mapped in the study area have been shown unequivocally to be hydraulically connected to the ABG site.

The Golconda/Haney limestone, the uppermost aquifer monitored at the ABG, is considered contaminated with TCE. Some heavy metals were also detected. The Golconda/Haney is of limited lateral extent at the ABG. Waters in the Golconda/Haney infiltrate eastward and northward (toward the valley axis) and ultimately become part of the Beech Creek aquifer system before leaving the ABG.

The highest detected level of RDX was 0.709 mg/l in well 03C03P2 near the center of the ABG in the Big Clifty/Beech Creek aquifer. Well 03C03P2 also recorded levels of RDX greater than 0.1 mg/l on 11 other occasions (detection limit for RDX was 0.02 mg/l and there is no MCL). Big Clifty/Beech Creek aquifer wells 03C08AP2 and 03C20 also recorded relatively high levels of RDX (0.1 to 0.3 mg/l) on several occasions. The background well, 03C17, recorded no detectable levels of RDX.

The highest detected level of TCE was 17.840 mg/l in well 03C20. Well 03C20 had detected levels of TCE greater than 1 mg/l in 11 sampling periods (detection limit for TCE was 0.001 mg/l and the MCL is 0.005 mg/l). Well 03C11 recorded levels of TCE greater

than 1 mg/l on several occasions. Other wells with TCE levels greater than 0.1 mg/l were 03C03P2 and 03C09P2. All of these wells are Big Clifty/Beech Creek wells and all are located near the center of the ABG. The background well 03C17 had detectable but relatively low levels (0.002 and 0.009 mg/l) of TCE on two occasions. One well sampled in a group of wells south of the ABG in Little Sulphur Creek, along a "jeep trail", had detected levels of TCE as high as 7.1 mg/l.

Barium was the only trace or heavy metal detected in many wells in multiple sampling periods. Barium was detected in a total of 52 wells in many of the seven sampling periods available. The highest value of barium detected was 0.36 mg/l in well 03C01P2. Barium was also detected in several wells on multiple occasions south of the ABG and in the boundary alluvial wells. The detection limit for barium was 0.05 mg/l and the MCL is 2 mg/l. Other heavy metals detected in more than one well but in only one sampling period each were cadmium, lead and mercury.

Distribution maps of RDX, TCE and barium in the Big Clifty/Beech Creek aquifer wells indicate that RDX and TCE are most highly concentrated in the central and south central portion of the ABG. The wells showing the highest levels of RDX and TCE are near potential sources of explosives and solvent contaminants, respectively. The compounds were generally absent in wells outside the ABG. RDX occurred outside the ABG only in Spring A. Barium occurred within the ABG similarly to RDX and TCE but also was prevalent in wells immediately south of the ABG and in wells in the alluvium of Little Sulphur Creek near the NSWCC boundary south of the ABG. The distribution of barium in the groundwater, its absence in some wells, including, except in one sampling period, the background well, and the fact that barium is a component of some pyrotechnics indicate that barium was an operations contaminant for the ABG and not a naturally occurring compound.

The distribution of groundwater contaminants (RDX and TCE) within ABG wells is roughly correlative with the position of the Big Clifty sandstone exposed near the east and central portion of the ABG, indicating that the absence of the Indian Springs shale there permits infiltration of surface runoff into the Beech Creek aquifer through the Big Clifty sandstone. The distribution of contaminants also corroborates Hunt's interpretation that the Indian Springs shale is an effective aquiclude to vertical infiltration into the Big Clifty/Beech Creek aquifer in the western part of the ABG.

Spring A recorded levels of RDX on five of the seven sampling periods, and TNT once, confirming dye trace results linking it hydraulically to the ABG subsurface.

Contamination of the groundwater in the Big Clifty/Beech Creek aquifer by selected explosives, organics and heavy metals originating at the ABG is prevalent within the ABG proper but exists south of the ABG at least one mile. The discharge of Spring A, and under certain conditions, Spring C, into the valley of Little Sulphur Creek and surface waters carried by Little Sulphur Creek have transported contaminants to the south. Contamination of the valley south of the ABG appears to be selective, with different contaminants accumulating in the groundwater, the surface water and the stream sediments.

Surface water and stream bottom sediment. (see Figure B3)

Consensus of surface water contamination. Certain metals, three explosives, nitrates and a semivolatile organic were present at measurable levels in the surface water of Little Sulphur Creek in at least one of the two rounds of sampling conducted in 1992. All of the detected metals were above background levels at at least one sampling site. Sampling sites ABGW-7 and ABGW-8, located immediately below and about 1/4 mile downstream of the ABG, respectively, showed higher levels or more frequent occurrences of aluminum, barium, lead, manganese, zinc, nitrates, and explosives than the other sampling sites. Site ABGW-7 also had occurrences of cadmium, chromium and copper. All sampling sites had detected

levels of nitrates in at least one sampling round. No site had detectable levels of nitrites that were not attributable to sampling artifacts. Explosives present in the surface water included HMX, RDX, and 2,4-DNT. The semivolatile compound bis(2-ethylhexyl)phthalate was the only organic other than explosives present in the surface water, and was limited essentially to one site.

Metals, nitrates, and explosives occurred somewhat more frequently or at higher levels in the water in Round 2 than in Round 1. Several factors were considered to explain the apparent increase from the spring (Round 1) to the summer (Round 2) sampling periods.

A major precipitation event, or a prolonged period of precipitation, prior to the July (Round 2) sampling event could have flushed contaminants into the stream and temporarily elevated levels in the water. Precipitation data are not available for the period in question.

Another potential factor was the effect of higher values of field-measured water properties during the Round 2 event. The discussion of field measurements of pH, conductivity, and temperature presented earlier in this report showed that both conductivity and temperature increased in Round 2 (see Table 1). Temperature increased dramatically, between 2 and 3 times the Round 1 value, which would be expected in the mid-summer conditions of Round 2. Warmer water increases the solubility of some compounds,. particularly the explosives monitored in this investigation. For example, HMX has a reported solubility of 1.2 mg/l at 10° C and 2.6 mg/l at 20 °C (ALG, 1994). Reported solubilities of RDX double with a temperature increase from 10 °C to 20°C. TNT solubility increases somewhat less dramatically with temperature. Solubilities of metals depend on the formulation of the particular metal compound and are difficult to generalize. The much greater water temperatures experienced in Round 2 compared to Round 1 may have influenced the measured levels of some monitored parameters.

A third factor is random occurrence. Only two rounds of sampling were conducted, and it is possible that the apparent general increase in levels in Round 2 is purely coincidental.

Consensus of bottom sediment contamination. Apparent contamination of bottom sediments occurred at more sites and for more constituents than contamination of the surface water in Little Sulphur Creek.

Comparison of levels of metals detected in downstream sampling sites with levels in the background site ABGS-1 indicates that barium, cadmium, copper, lead, and zinc are potential site-related contaminants at all sampling sites. Aluminum, antimony, arsenic, chromium, nickel, magnesium, manganese, mercury, silver, thallium, and vanadium are potential site-related contaminants at four or fewer sites. Those metals underlined were not detected at all in the surface water samples.

Nitrites and nitrates were reported in the sediments at all sites except the background site. Nitrites are conservatively presumed to be sediment contaminants, although the evidence is inconclusive. Nitrates are believed to be site-related contaminants at all sites downstream of the background site.

Five explosives were detected in the sediments, compared to three in the surface water. RDX and HMX were found both in the sediment and in the water, but there was little correlation of occurrences. HMX occurred at sites ABGS/W-7 and ABGS/W-8 in both water and sediment, but occurred at other sediment sites (ABGS-3 and -6) at higher levels, and did not occur at those sites in the water. 2,4-DNT occurred in site ABGS/W-7 in both sediment and water in Round 2. TNT was common in the sediment below site ABGS-5 in both rounds, but did not occur in the water of any site.

Other organics probably present in the sediments (probably not attributable to field or laboratory contamination) included chloroform, 111-trichloroethane, bromodichloromethane, dibutylphthalate, 2,4-dinitrotoluene (semivolatile), PPDDE, heptachlor, dieldrin, and A-BHC.

Methylene chloride is a suspected contaminant at one site.

Soils. (see Figures B4 and B5)

Soil samples extracted at the surface and from shallow borings at the ABG were analyzed for Appendix IX constituents and explosives. Soils from test borings were compared to soils from background borings (borings 1, 2, and 3). The results of the analyses are summarized below.

Metals and other inorganics. Ammunition burning and thermal treatment activities at the ABG have released residues of antimony, cadmium, chromium, copper, lead, mercury, nickel, silver, zinc, aluminum, barium, magnesium, manganese, tin, sodium, and phosphorus to soils. Soil samples from borings 7, 9, and 12 had particularly high concentrations of metal constituents when compared to background soils as well as when compared to soils from the other test borings. Borings 4, 5, 6, 8, 10, and 11 also produced soil samples with metals concentrations that were higher than those determined for the background borings but generally not as high as those reported for borings 7, 9, and 12.

Explosives compounds. Explosives compounds were found in soils from all ABG borings except the background borings. A release of explosives to the soil has occurred. Seven explosives compounds were monitored. Borings 11, 10, and 8 each had total explosives concentrations for all seven compounds of less than 2 mg/kg. Borings 9 and 6 each had total concentrations of less than 11 mg/kg. Borings 12 and 7 each had total concentrations of less than 100 mg/kg. Borings 4 and 5 had total explosives concentrations exceeding 1000 mg/kg. A TNT concentration of 1640 mg/kg measured in Boring 4 was the highest explosives concentration found in ABG soil samples. An RDX concentration of 1070 mg/kg was measured in Boring 5.

Volatile organics. Several volatile organic compounds were found in the ABG soils. However, only levels of trichloroethene (TCE) and tetrachloroethene from the vicinity of the waste unit (Borings 7 and 12) were not conditioned by the presence of volatiles in the equipment rinses or the method blanks. The maximum concentrations measured for the two compounds were 2.9 μg/kg TCE and 1.3 μg/kg tetrachloroethene.

Semivolatile organics. Borings 12, 11, 9, 8 , 7, 6, and 5 yielded soils with semivolatile organic analytes in sub-mg/kg concentrations. The most frequent type of semivolatile organics present were PAH's. All semivolatiles, with the exception of 2,4-dinitrotoluene in borings 5 and 6, were below 1.0 mg/kg and were at "J" (estimated) levels. The highest concentrations of 2,4-dinitrotoluene reported for borings 5 and 6 were 1.20 and 7.20 mg/kg, resp.

Pesticides, herbicides, and PCB's. All pesticides and herbicides were at levels in the soil below 1.0 mg/kg except methoxychlor in Boring 12, which was detected at a level of 1.4 mg/kg. No PCB's were detected in any of the ABG soils.

SWMU 02 Dye Burial Grounds. (see Figure B6).

Results of groundwater sampling and analysis at and in the vicinity of the Dye Burial Grounds are summarized below.

Analysis of four rounds of groundwater sampling in DBG monitoring wells indicated that only inorganic compounds, particularly metals, were present in significant and verifiable amounts. The inorganics were detected in all four aquifers monitored in the DBG study area.

Metals occurred most frequently and at generally higher levels in the lower Pennsylvanian sandstone aquifer. Significant primary MCL metals in the aquifer were nickel, beryllium, cadmium, lead, and manganese, with nickel consistently above MCL. Secondary metals included aluminum, calcium, cobalt, and magnesium. The greater frequency and

levels of detection of metals occurred in wells 02C11P3 and 02-04 on the southwest end of the DBG and in well 02-06 on the northeast end, but also in well 02C22P3, which is located more than a thousand feet to the southeast of the DBG near an access road.

Maps were prepared showing contours of levels of mean concentration of each metal computed over the four sampling periods for each well. The maps emphasized the preference of higher concentrations of most metals in wells in 02C11P3, 02-04, 02-06, and 02C22P3. The first three of these wells are located within or very near the burial trenches and are susceptible to infiltration of leachate from the trenches. Well 02C22P3 is separated from the burial grounds by a considerable distance, as stated above. A piezometric surface contour map for the lower Pennsylvanian aquifer indicated that well 02C22P3 is not downgradient of the burial trenches. If the dye burial trenches are the source of metals contaminants within the lower Pennsylvanian aquifer, it is difficult to explain the relatively high levels in well 02C22P3 unless there exists a condition of anisotropy in the rock that would allow groundwater to flow locally counter to the average gradient. Such an anisotropy might take the form of natural fractures within the rock.

It is also difficult to explain the presence of metals contaminants, particularly the high levels of nickel, for example, in the dye burial trenches because the detected metals are not known to be components of the materials buried. The dyes presumed to be buried are complex mixtures of organic compounds. Some metals comprise portions of the smoke materials used in munitions, but it is not known that the smoke materials were buried at the DBG. A geophysical survey conducted at the Dye Burial Grounds in 1991 identified several anomalies attributable to metallic objects, suspected to consist in part of steel drums, below ground in the vicinity of the burial grounds. The presumed metallic anomalies may be contributing to the presence of elevated metals in the groundwater.

The second most frequent significant occurrences of metals occurred in the Golconda/Haney limestone aquifer, which underlies the lower Pennsylvanian sandstone. Nickel occurred at levels slightly above MCL in all four sampling periods in well 02C11P2, which is vertically beneath well 02C11P3 of the lower Pennsylvanian sandstone and which was well above MCL for nickel on four occasions. The only other primary MCL metal occurring in the Golconda/Haney was selenium in well 02C13, which is located north and upgradient of the DBG.

Metals contamination probably does not extend as deep as the Beech Creek limestone beneath the DBG. The consensus is that groundwater contamination at the DBG consists only of metals and is most pronounced in the shallow lower Pennsylvanian water table (unconfined) aquifer. Groundwater contours within the lower Pennsylvanian aquifer indicate that flow should be to the southwest, toward Little Sulphur Creek. The presence of elevated metals in well 02C22P3, however, suggests that there may be a component of flow to the southeast, at least locally.

There is some uncertainty in linking the presence of metals in the groundwater to activities at the Dye Burial Grounds. Acidic pH in some wells that were also high in certain metals may have exacerbated the presence of metals. Acidic pH in the sandstones is probably a natural phenomenon, but some of the metals, like nickel, are not known to be naturally occurring in the rock beneath the NSWC Crane. Finally, the distribution of metals within the aquifers is not necessarily coincident with the proximity of the wells to the dye burial trenches.

SWMU 10 Rockeye. (see Figures B7 and B8)

Groundwater. Personnel involved in the proposed Remedial Action tasks at the Rockeye facility will not likely contact groundwater. However, a summary of results of

groundwater sampling and analysis conducted for Rockeye is provided here. Figure B7 shows the locations of monitoring wells emplaced at Rockeye for the groundwater evaluation program. Four rounds of groundwater sampling and analysis for Appendix IX compounds and explosives were conducted at Rockeye.

Explosives and nitrogen. The explosives HMX, RDX, and TNT occurred regularly in wells of the uppermost aquifer within the drainageway exiting the Rockeye Facility to the northeast. All detected levels of explosives were below 1.0 mg/l. The compounds 2,4-DNT and TNB occurred at detected levels only in one well. Other monitored explosives were not detected. Well 10-17 had the highest levels and the highest number of detected levels of HMX, RDX, and TNT. Explosives in the groundwater of the Rockeye site are concluded to be a result of past releases of wastewater from the operations buildings 2731 and 2734 (located near the center of the facility). The presence and distribution of explosives in the groundwater is consistent with the results of the Phase II RFI for soils conducted earlier. Explosives contamination in the groundwater is limited to the vicinity of the northeast drainageway as far downslope (east) as Crane Hiway 165. Nitrates and nitrites were detected in Rockeye wells but at levels many times lower than the MCLs. There was no apparent correlation between distribution of nitrates and nitrites and the distribution of explosives.

Metals. Metals occurred in the groundwater of many wells in all three aquifers. Anomalously low pH in some wells or areas of the aquifers biased the level of several metals detected in those areas. Relatively high levels of the metals aluminum, beryllium, cobalt, lead, nickel, zinc, chromium and perhaps arsenic and cadmium corresponded directly to low pH. Barium was the only statistically significant metal not affected by the low pH factor that showed a distribution similar to that of explosives. All of the anomalously high metals occurrences except barium were probably natural phenomena attributable to the low pH conditions produced by the Pennsylvanian facies comprising the aquifers.

Other parameters. Cyanides were detected in only a few wells and well below the MCL. Sulfides were detected in most wells. The field parameter pH was anomalously low in certain wells of all three aquifers as discussed above. Other organic compounds including volatiles, semi-volatiles, pesticides and PCBs were determined not to be present in detectable amounts.

Soils. Figure B8 shows the locations of surface and subsurface sampling sites from which 115 soil samples were obtained in the Fall of 1990. Analytes included inorganic and organic compounds, including explosives. No explosives were detected inthe soil samples from the background areas (BN of Figure B8). Detectable levels of explosives were not found in soil samples in borings 1, 3, 4, 5, 9, and 13 or in areas A and D. Explosives were found in soil samples from the borings around the sumps (2, 6A, 8, and 10), in the surface drainage ways (7, 11, and 12), and in the surface sampling areas B, E, F, and G. The explosives DNB, DNT, RDX, and HMX were detected. HMX was found in ;moe soil samles and in greater concentrations than any other explosive analyte. Levels of HMX of 1960 mg/kg was detected in one soil sample from Area G (Figure 8), and 42.7 mg/kg in the soil from boring 12. Area E produced the greatest number of explosives contaminated soil samples of any sampling area.

Sampling Area H, behind Building 2734 near the center of the facility, produced samples with levels of TNT, RDX, and HMX of 295, 3350, and 10400 mg/kg, resp. Sampling Area H is bare earth on an otherwise grassed berm, near an exhaust vent of Building 2734. No explosives were detected in any of the QA blanks or rinses. A release to soils of explosives compounds has occurred.

Results of analyses for inorganic compounds, particularly metals, were inconclusive. Inorganic compounds were detected in the soils, but not sufficiently above background levels

to rule out the possibility of natural occurrence.

Concentrations of some volatile organics were detected in Rockeye soils, but some were also detected in QA blanks. A release of volatile organic compounds trans-1,3-dichloropropene, 1,1,2-trichloroethane, t-xylene, and 1,1,1-trichloroethane may have occurred at Rockeye, but concentrations are small (mostly "J",or estimated, values) and are not considered significant.

The most frequently detected semivolatile organics were polycyclic aromatic hydrocarbons (PAH). Only phenanthrene was found in more than one soil sample and at more than one location. The presence of PAH's in the soils could not confidently be linked to sources at the Rockeye facility. No other semivolatile organic compounds were detected at greater than "J" levels.

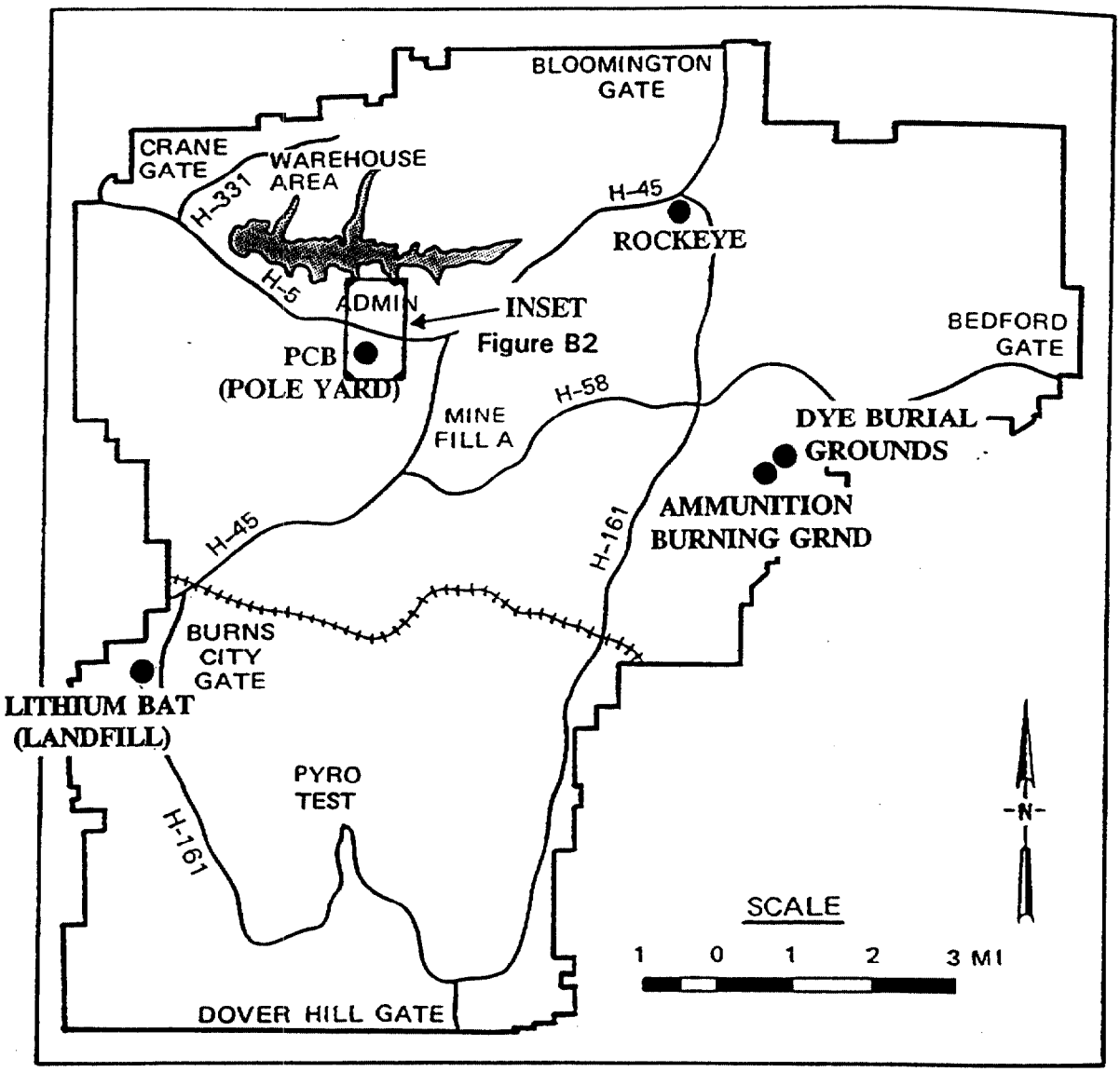


Figure B1. Location of NSWC Crane administration area (Fire Department and Dispensary) and routes from SWMUs.

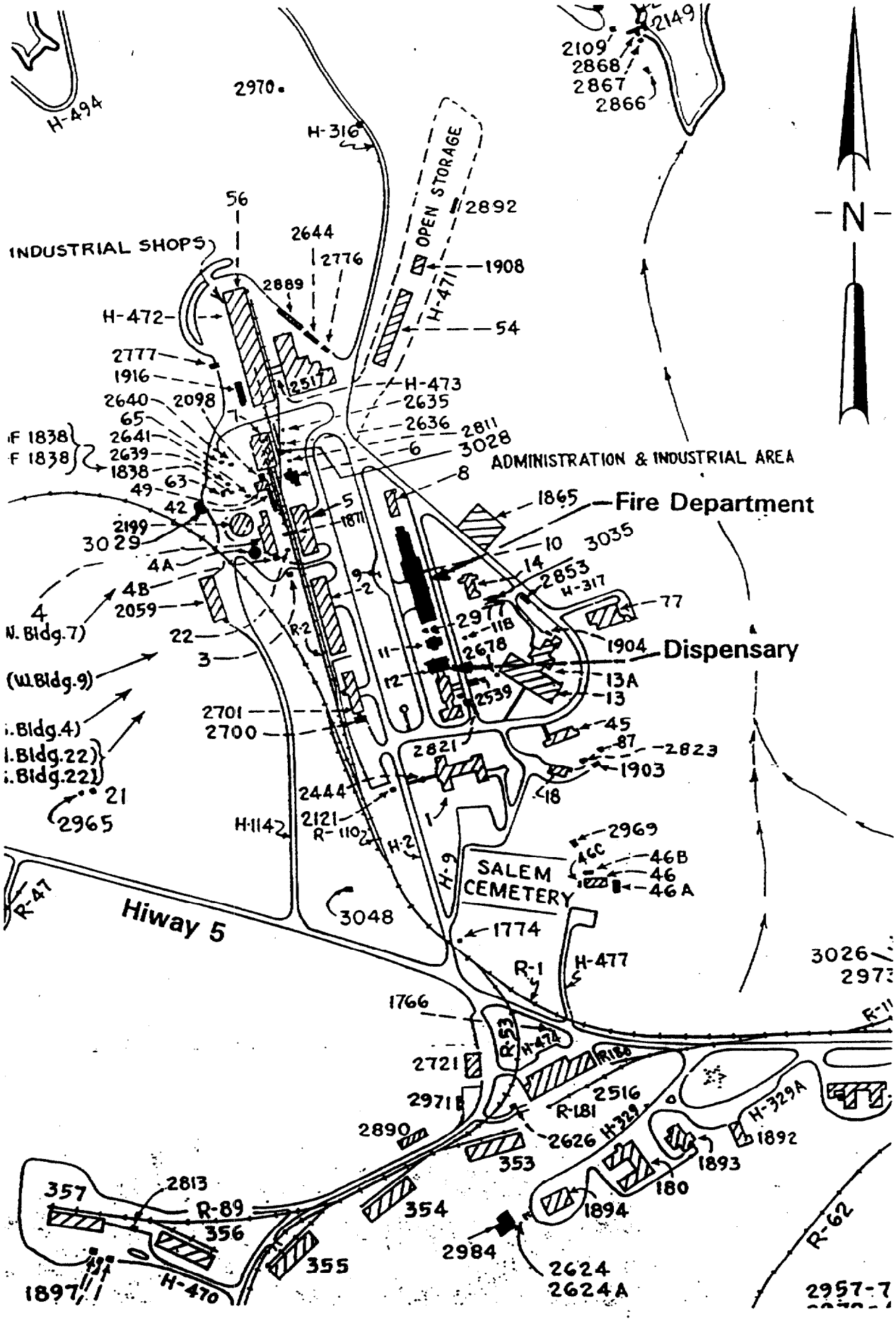


Figure B2. Inset of Figure B1 showing locations of Fire Department and Dispensary, NSWC Crane.

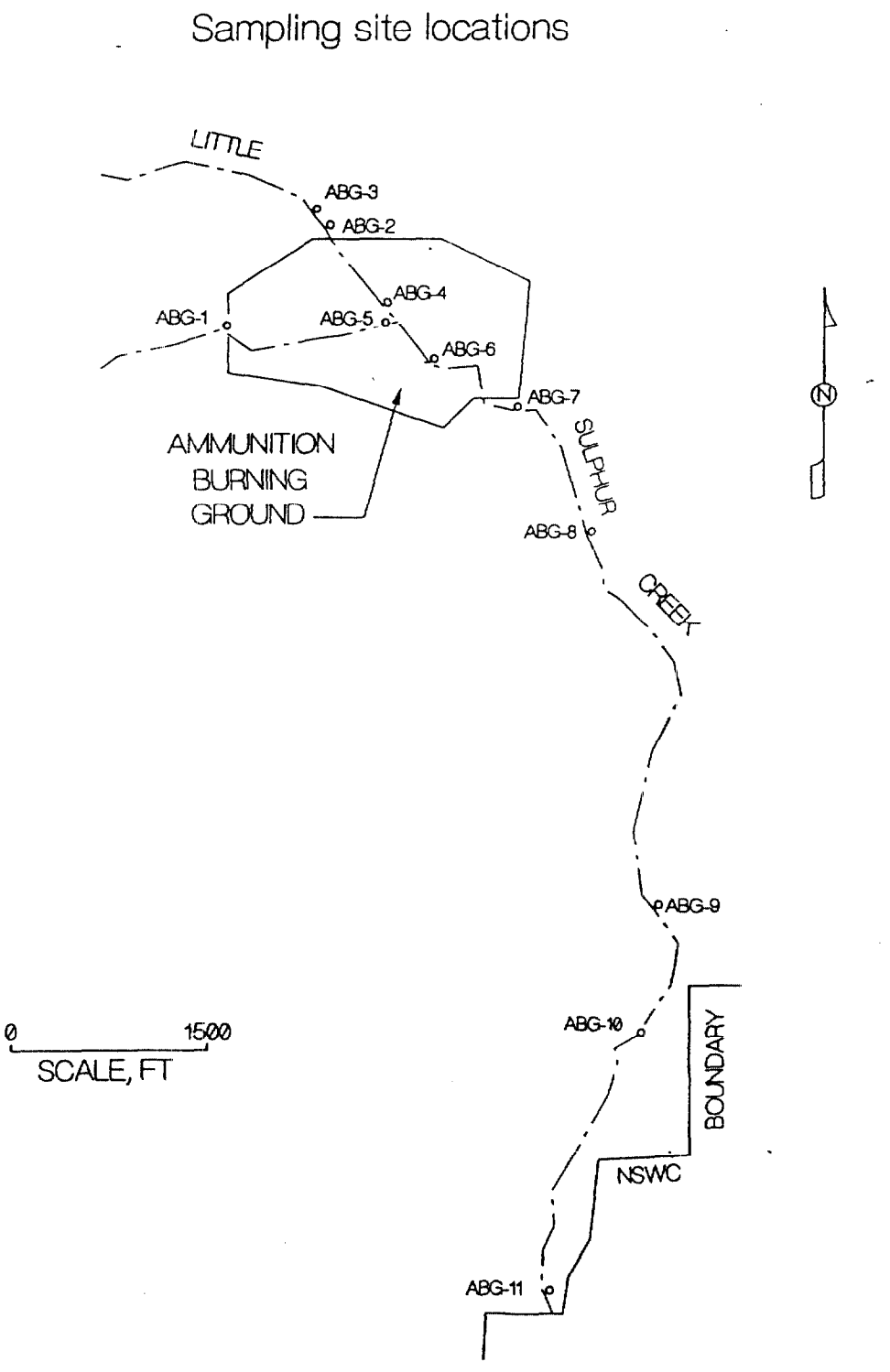


Figure B3. Site map for Surface Water Investigation of Ammunition Burning Ground and Little Sulphur Creek.

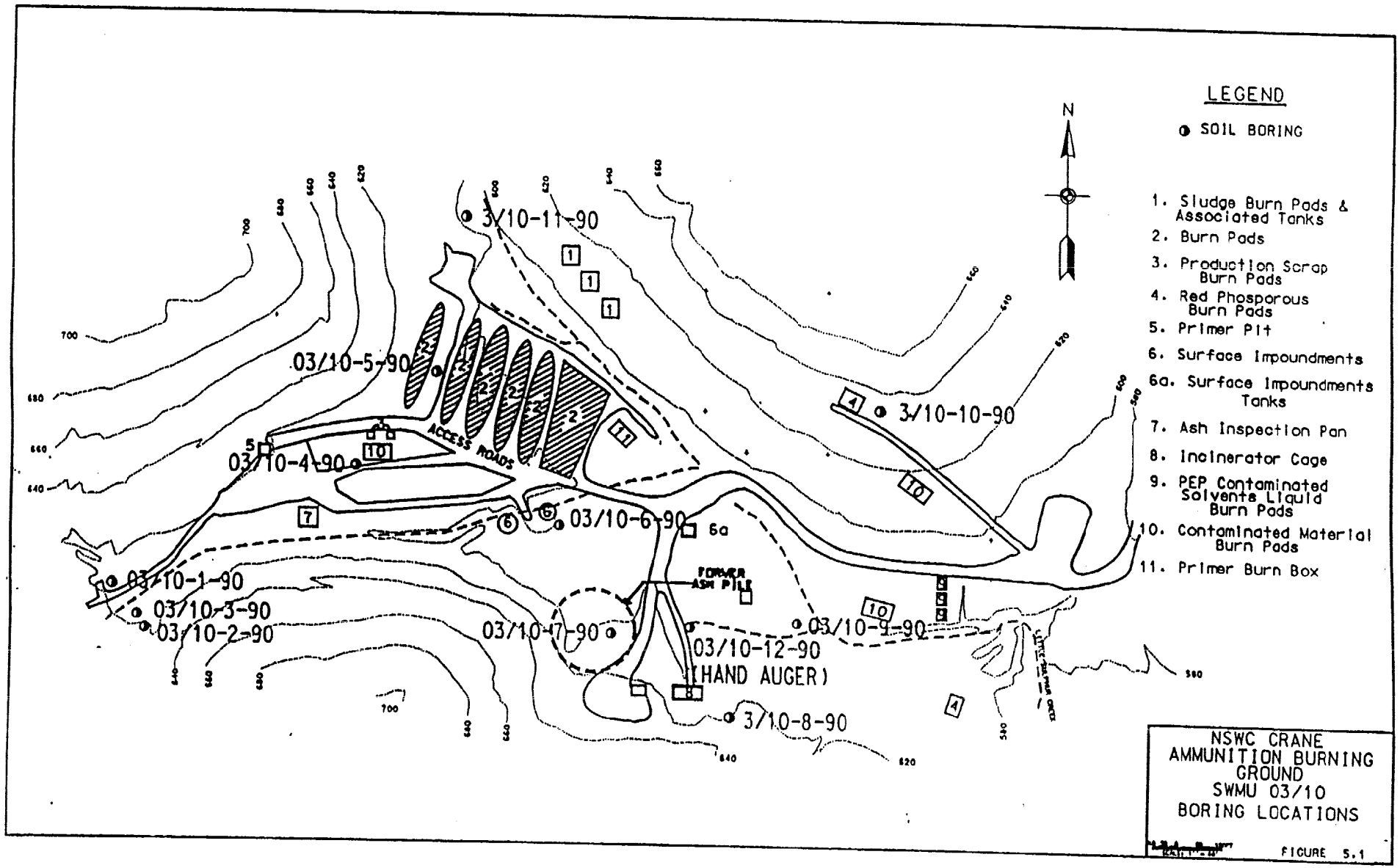
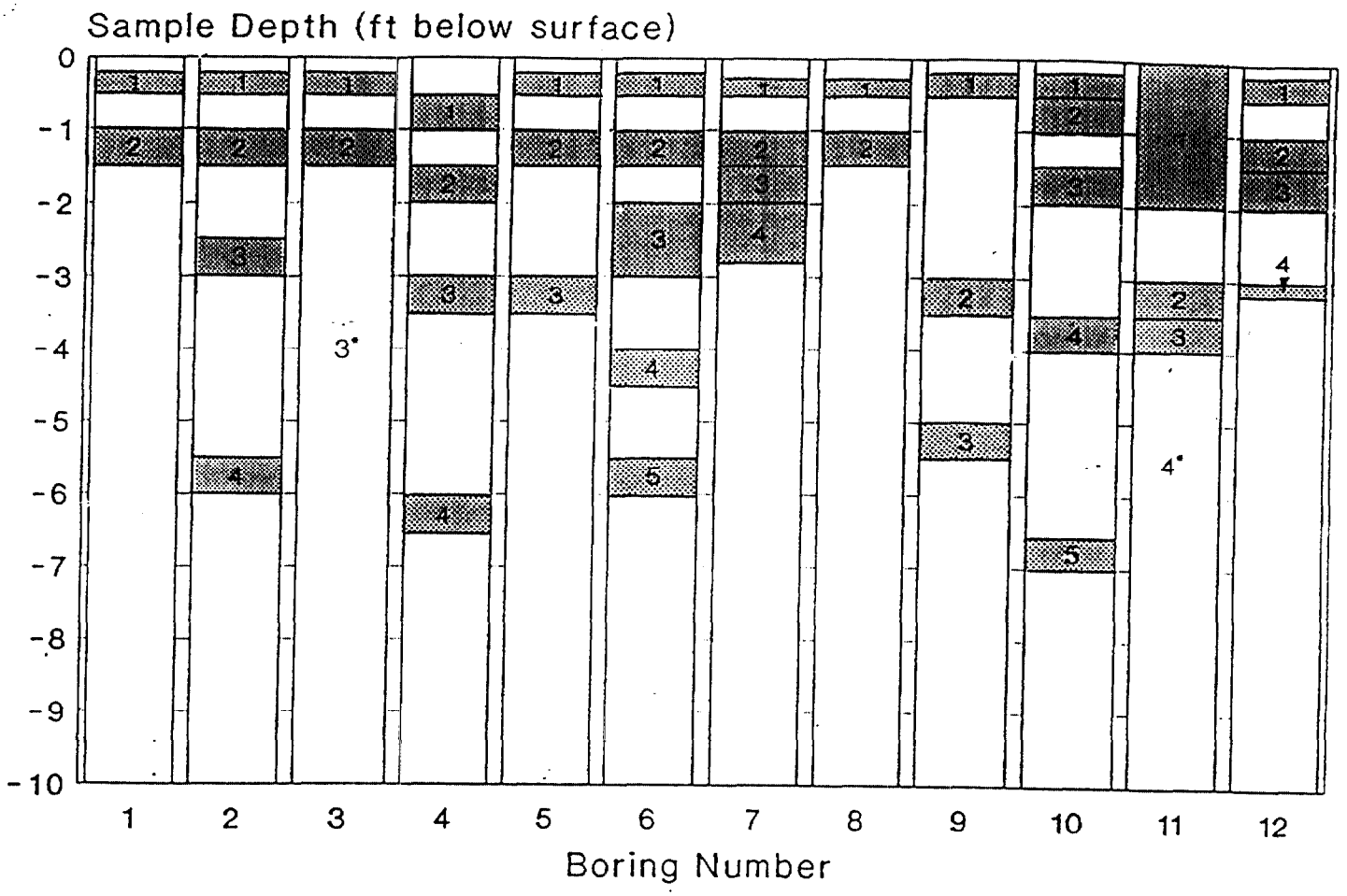

LEGEND
SOIL BORING
1. Sludge Burn Pads & Associated Tanks
2. Burn Pads
3. Production Scrap Burn Pads
4. Red Phosporous Burn Pads
5. Primer Pit
6. Surface Impoundments
6a. Surface Impoundments Tanks
7. Ash Inspection Pan
8. Incinerator Cage
9. PEP Contaminated Solvents Liquid Burn Pads
10. Contaminated Material Burn Pads
11. Primer Burn Box
N
3/10-11-90
03/10-5-90
03/10-4-90
03/10-6-90
3/10-10-90
03/10-1-90
03/10-3-90
03/10-2-90
03/10-7-90
03/10-12-90
(HAND AUGER)
03/10-9-90
3/10-8-90
ACCESS ROADS
FORMER ASH PILE
NSWC CRANE
AMMUNITION BURNING GROUND
SWMU 03/10
BORING LOCATIONS
FIGURE 5.1

Figure B4.

Depth of Soil Samples



Ammunition Burning Ground - NWSC Crane, Indiana
Dates Samples Collected

Boring 1	08 AUG 90	Boring 4	10 AUG 90	Boring 7	17 AUG 90	Boring 10	15 AUG 90
Boring 2	09 AUG 90	Boring 5	11 AUG 90	Boring 8	15 AUG 90	Boring 11	13 AUG 90
Boring 3	09 AUG 90	Boring 6	18 AUG 90	Boring 9	16 AUG 90	Boring 12	20 AUG 90

Note: * - sample depth not identified on boring log.

Figure B5. Ammunition Burning Ground - NWSC Crane, Indiana, SWMU# 03/10. Depth of soil samples and dates of collection. Sample numbers are indicated in shaded areas.

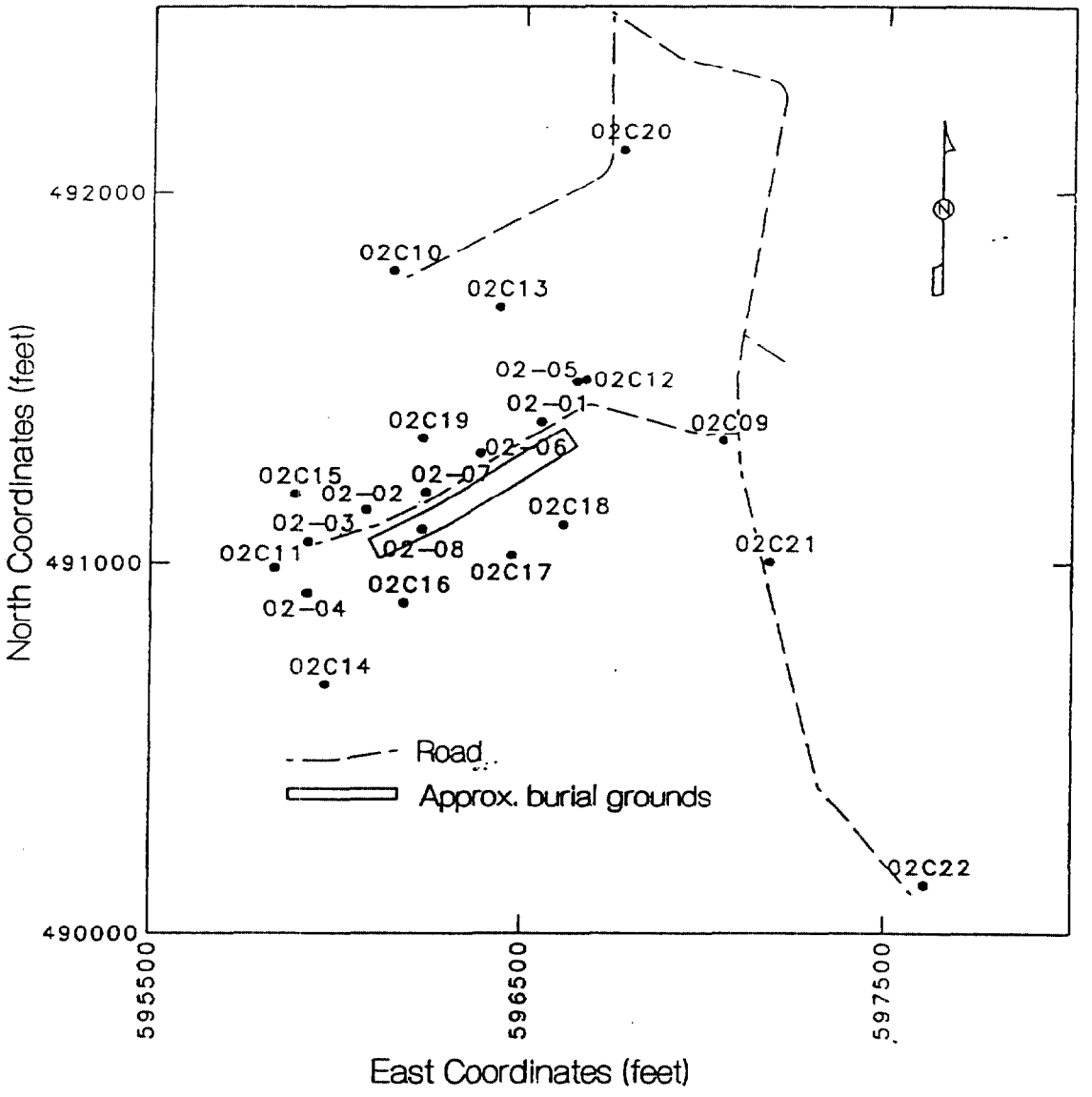


Figure B6. Locations of borings and well clusters for Dye Burial Grounds.

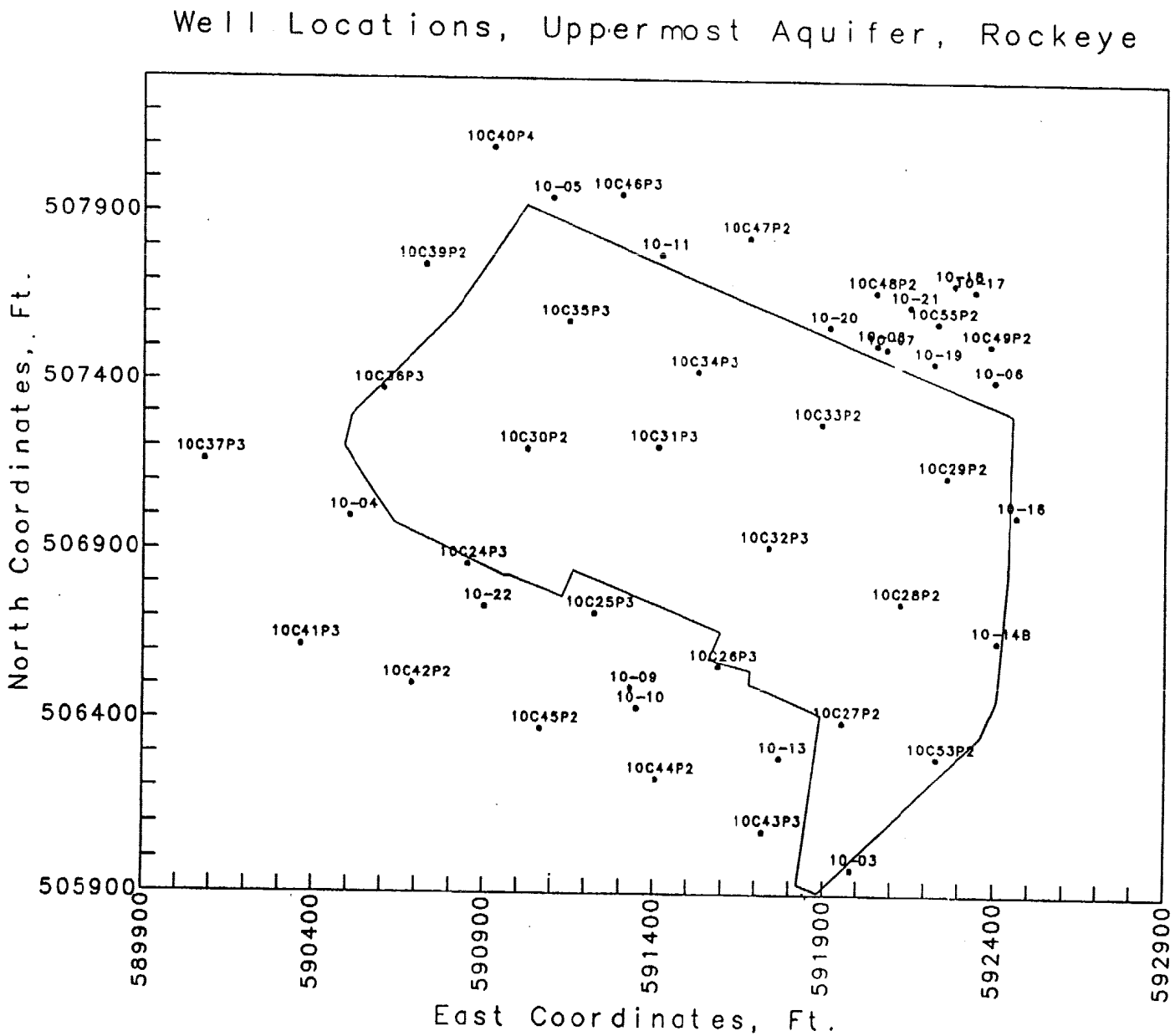


Figure B7. Wells of the uppermost aquifer, Rockeye

Figure B8. Rockeye (Munitions Facility) - NSWC Crane, Indiana, SWMU #10/15. Locations of soil borings and surface sample areas. Soil borings are indicated by numbers 1 through 13 and surface soil scrapes are indicated by letters A through H. Locations marked BN1 through 3 were "background north" surface soil samples. See Figure 5.2 for specific boring information and Figures 5.3 - 5.5 for surface soil scrape sample information. This figure is based on photography taken October 11, 1953. Approximate figure scale is 1:5000.

Appendix C.
Physical Drilling Hazards

ACTIVITY HAZARD ANALYSIS

ACTIVITY Earth drilling operations

ANALYZED BY [illegible] REVIEWED BY [illegible] DATE 31 JAN 92

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

ACTIVITY Earth drilling operations ANALYZED BY REVIEWED BY DATE 5/JAN

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

ACTIVITY Earth drilling operations ANALYZED BY REVIEWED BY DATE 31

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

ACTIVITY Earth drilling operations ANALYZED BY REVIEWED BY DATE 31 JA

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

DRAFT
IN5 170 023 498
21 October 1994

Appendix D.

Quality Assurance Plan for Analytical Laboratory, WES

QUALITY ASSURANCE FOR ENVIRONMENTAL CHEMICAL ANALYSES

Analytical Laboratory Group
Environmental Laboratory
U.S. Army Engineer Waterways Experiment Station
Vicksburg, MS

Ann B. Strong
Chief, Analytical Laboratory Group

29 Oct 91
Date

Karen F. Myers
Quality Assurance Officer

29 Oct 91
Date

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ENVIRONMENTAL LABORATORY

US ARMY ENGINEER WATERWAYS EXPERIMENT STATION

QUALITY ASSURANCE PROGRAM FOR ENVIRONMENTAL CHEMICAL ANALYSIS

1. PURPOSE AND SCOPE

The purpose of this Quality Assurance (QA) program is to ensure the scientific reliability and compatibility of environmental chemistry data at the Environmental Laboratory (EL), US Army Engineer Waterways Experiment Station (WES) by providing QA guidelines for program managers, principal investigators, and analysts in the development and execution of projects.

Any project requiring sample collection, analysis, data reporting and interpretation must be susceptible to QA if it is to be scientifically valid. Obviously, Quality control (QC) measures are more readily applied to routine monitoring than to state-of-the-art research. However this does not prevent the application of QC procedures and it should be realized that different research projects will involve variations of the QA program to meet specific project needs. These requirements are best defined by the principal investigators. The role of the QA officer is to provide recommendations for appropriate and necessary QA methods and plans and to coordinate this effort with the EL staff (managers, investigators, analysts, etc.).

The basic QC measures for analytical testing will be the same for both routine monitoring and Research and Development as long as standard analytical methods are in use. When new procedures must be developed due to matrix interferences, or the Corps of Engineers (CE) improves or develops a new analytical

procedure, these variances must be validated through extensive testing to assure their reliability. The QA officer will be responsible for this validation to maintain the integrity of EL data.

As the CE lead agency for Civil Works Environmental Quality Research, the WES and EL are obligated to support quality assurance if documentable and reliable research results are to be generated. Specific quality control measures must be developed for each project.

2. References

a. ER 1110-1-8100

b. ER 1110-1-261

c. ER 1110-1-263

d. ER 1110-2-244

e. Handbook for Analytical Quality Control in Water and Wastewater Laboratories. EPA 600/4-79-019, March 1979, US Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, OH 45268.

f. Standard Methods for the Examination of Water and Wastewater. (17th Edition) American Public Health Association, 1105 18th St, NW, Washington, DC 20036.

g. Recommended Methods for Water-Data Acquisition. US Geological Survey (1977) US Department of Interior, Reston, VA 22092.

h. Methods for Chemical Analysis of Water and Wastes. EPA 600/4-79-020, March 1979, US Environmental Protection

Agency, Environmental Monitoring and Support Laboratory, Cincinnati, OH.

i. Plumb, R. H., Jr. 1980. "Procedures for Handling and Chemical Analyses of Sediment and Water Samples." EPA/CE 81-1, USEPA/CE Technical Committee on Criteria for Dredged and Fill Material, Environmental Laboratory, US Army Engineer Waterways Experiment Station, 3909 Halls Ferry Rd., Vicksburg, MS 39180.

j. Inhorn, Stanley L., Ed. 1978. Quality Assurance Practices for Health Laboratories, American Public Health Association, 10 Eighteenth St. N.W., Washington, D.C. 20236.

k. Bickering, Charles; Olin, Steven; and King, Peter. 1978. "Procedure for the Evaluation of Environmental Monitoring Laboratories" EPA-600/4-78-017, US Environmental Protection Agency, Cincinnati, OH 45268.

l. Stratton, C. L., and Bonds, J. D. 1979. "Quality Assurance Guidelines for IERL-CI Project Officers" EPA-600/9-79-046, US Environmental Protection Agency, Cincinnati, OH 45268.

m. Sturgis, Thomas C. "Guidance for Contracting Biological and Chemical Evaluations of Dredged Material", TR D-90-10, September 1990, Environmental Laboratory, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

n. Karn, Richard A. and Strong, Ann B. 1989. "Quality Assurance Guidelines for Organic Analysis" TR EL-89-18, Environmental Laboratory, US Army Engineer Waterways

Experiment Station, 3909 Halls Ferry Rd., Vicksburg, MS 39180.

o. Test Methods for Evaluating Solid Waste, SW-846, Third Edition November 1986, US Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C. 20460.

p. Contract Laboratory Program Statement of Work for Organic Analysis, 1990. US Environmental Protection Agency, Washington, D.C. 20460.

q. Contract Laboratory Program Statement of Work for Inorganic Analysis. 1990 US Environmental Protection Agency, Washington, D.C. 20460.

3. Background

QA is defined as the sum of activities that document and maintain the quality of analytical data and quality control (QC) is the routine application of procedures to control the measurement process. The objectives of the WES QA program are to assure that the data generated are scientifically sound, defensible, continuously precise and accurate, and to enhance the overall capability and performance of the laboratory. References 2a, 2b and 2d establish water quality policy for the CE and reference 2c provides the basis for quality assurance activities related to hazardous and toxic waste studies. In addition to its function as a major research and development center for the Corps of Engineers, the WES also serves the Lower Mississippi Valley Division as Division Laboratory and is responsible for ensuring the application of quality control measures.

References 2d, 2e, 2f, 2g and 2n provide detailed procedures to be followed in water quality laboratories. References 2i and 2m apply to dredging operations and references 2c, 2n and 2o have application to hazardous and toxic waste studies.

Water and wastewater monitoring data are collected in response to various Federal regulations and research projects. Included in these regulations:

a. The National Environmental Policy Act (NEPA) of 1969
b. The Federal Water Pollution Control Act (FWPCA) of 1972
c. The Marine Protection Research and Sanctuaries Act (MPRSA) of 1972
d. The Coastal Zone Management Act of 1972
e. The Safe Drinking Water Act of 1974 and 1986
f. The Toxic Substances Control Act of 1976
g. The Resource Conservation and Recovery Act of 1976
h. The Clean Water Act of 1977
i. The Comprehensive Environmental Response, Compensations and Liability Act of 1980 (CERCLA or Superfund)
j. The Defense Environmental Restoration Program (DERP)
k. Superfund Amendments and Reauthorization Act of 1986
l. Hazardous and Solid Waste Amendments of 1984

Much of the preceding legislation requires monitoring programs that fall under the regulatory authority of the Environmental Protection Agency (EPA) and quality control requirements. The program described here does not attempt to describe in detail all of the QC measures to be applied, but is intended to serve as a general guide for projects in developing specific policies,

organizations, objectives, and QC activities to achieve data quality goals.

These regulations may also precipitate research projects that supply data for standards setting, environmental assessments, permit applications, etc. The program classification response to government regulation or research project will determine the types and numbers of samples to be collected and the parameters to be measured (physical, chemical, biological, radiological). The minimum precision and accuracy requirements will be determined by the end use of the data. These factors together will determine the level of QA effort.

4. Quality Assurance Goals

QA goals have been established to:

a. Provide an organizational structure defining the basic concepts of QA at WES in the Environmental Laboratory.

b. Establish guidelines to assist project officers and program managers in the logical development of general and specific QA plans for projects.

c. Provide a means for evaluating projects as to appropriate data requirements.

d. Implement a procedure to review data quality aspects of projects.

e. Encourage the use and development of methods of analysis and data treatment that are capable of meeting the data quality or research quality needs required by the project goals-to assure the use for which the data are intended.

f. Monitor the operational performance through appropriate intralaboratory and interlaboatory QC programs.

g. Ensure that program and project officers and contractors develop protocols with approved QA plans and procedures prior to program initiation and that they adhere to them.

h. Identify data quality problem areas and alert management to them.

5. Organization and Responsibility

The quality of data collected by the Environmental Laboratory lies ultimately with the Chief. In order to provide an organizational structure for QA, a QA officer is designated to develop, coordinate, and direct these activities. QC must be built into a laboratory program to such an extent that it is a routine part of all other laboratory activities. Management Support for QA program must be visible and active. The QA officer is responsible for coordinating a definition of the quality of data required to meet program objectives. Principal investigators or project managers work with the QA officer to implement the QA plan and assure the documentation of QC measures. The WES functional management structure is shown in Figures 1a-c with the QA officer being a part of the Environmental Engineering Division with responsibility to the Chief, EL.

The Analytical Laboratory Group (ALG) at WES supports all studies at WES involving environmental chemical analyses. Resumés of ALG personnel are included in Appendix A.

6. Personnel Training

All professional personnel hired in entry level positions (GS-5, - 7) are in career intern positions. At the time they are hired, a formal training program is set up for the individual based on career goals. Specific formal training courses as well as on-the-job training are included in the program. All training is documented in the employee's personnel file.

In addition, training goals are reviewed each year at performance appraisal time. An individual development plan is prepared for all employees at that time.

Training may be provided by local universities and colleges, by instrument vendors, by professional organizations such as ACS or AOAC, by government sponsored courses or any other contracted mechanisms.

Formalized training for lower grade personnel, comparable to GS-3 to GS-5, is relatively scarce. However, skills can be most efficiently improved at the bench level on a personal informal basis by more experienced analysts working in the same area. Exposure of personnel to pertinent literature is a definite program policy.

Personnel are indoctrinated into QA procedures and their importance to the Corps. Laboratory supervisors periodically review basic techniques and policies with the analysts.

7. Safety Policy

The overall safety policy of the CE is given in a number of Engineering Regulations. At the WES level, specific safety

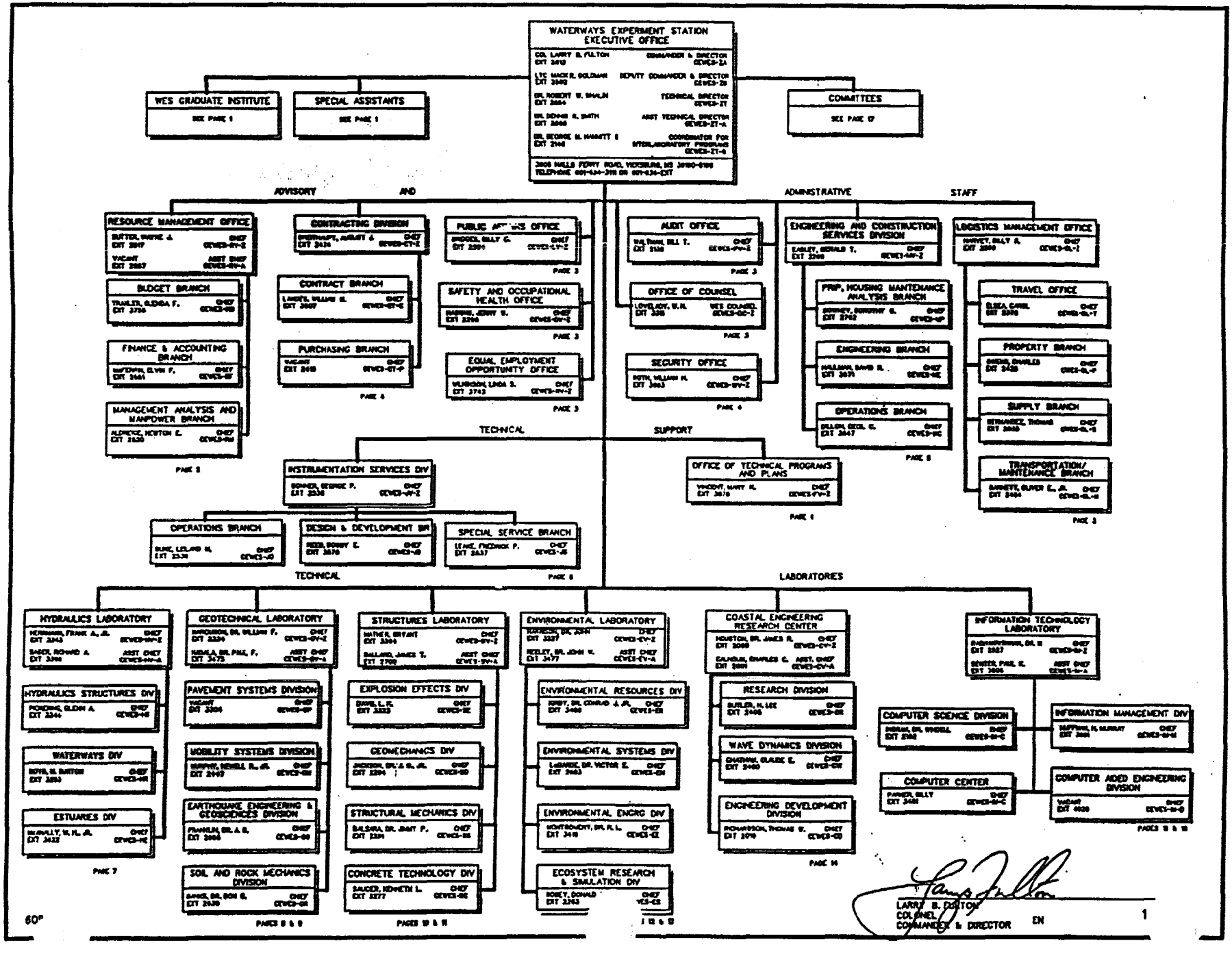

WATERWAYS EXPERIMENT STATION EXECUTIVE OFFICE
COL LARRY B. FULTON
EXT 3010
COMMANDER & DIRECTOR
LTC MACK R. GOLDMAN
EXT 3002
DEPUTY COMMANDER & DIRECTOR
DR. ROBERT W. WHALIN
EXT 3004
TECHNICAL DIRECTOR
DR. DENNIS R. SMITH
EXT 3008
ASST TECHNICAL DIRECTOR
DR. GEORGE M. HAMMITT II
EXT 3140
COORDINATOR FOR INTERLABORATORY PROGRAMS
3909 HALLS FERRY ROAD, VICKSBURG, MS 39180-6199
TELEPHONE 601-634-3111 OR 601-634-EXT
WES GRADUATE INSTITUTE
SEE PAGE 1
SPECIAL ASSISTANTS
SEE PAGE 1
COMMITTEES
SEE PAGE 17
ADVISORY AND ADMINISTRATIVE STAFF
RESOURCE MANAGEMENT OFFICE
BUTLER, WAYNE A.
EXT 3017
CHIEF
GEWES-RM-Z
VACANT
EXT 3007
ASST CHIEF
GEWES-RM-A
BUDGET BRANCH
TRAMLIN, GLENDA F.
EXT 3726
CHIEF
GEWES-RB
FINANCE & ACCOUNTING BRANCH
SMITHWICK, ELVIN F.
EXT 3601
CHIEF
GEWES-RF
MANAGEMENT ANALYSIS AND MANPOWER BRANCH
ALDRICH, NEWTON E.
EXT 3620
CHIEF
GEWES-RM
PAGE 2
CONTRACTING DIVISION
BRENNAFT, AUBREY A.
EXT 3434
CHIEF
GEWES-CT-Z
CONTRACT BRANCH
LANDES, WILLIAM H.
EXT 3007
CHIEF
GEWES-CT-C
PURCHASING BRANCH
VACANT
EXT 3010
CHIEF
GEWES-CT-P
PAGE 4
PUBLIC AFFAIRS OFFICE
BRIDGES, BILLY G.
EXT 3004
CHIEF
GEWES-LV-Z
PAGE 3
SAFETY AND OCCUPATIONAL HEALTH OFFICE
HARRIS, JERRY V.
EXT 3206
CHIEF
GEWES-SH-Z
PAGE 3
EQUAL EMPLOYMENT OPPORTUNITY OFFICE
WILKINSON, LINDA S.
EXT 3743
CHIEF
GEWES-EV-Z
PAGE 3
AUDIT OFFICE
WALTHALL, BILL T.
EXT 3130
CHIEF
GEWES-FV-Z
PAGE 3
OFFICE OF COUNSEL
LOVE, ADV. W.H.
EXT 330
WES COUNSEL
GEWES-OC-Z
PAGE 3
SECURITY OFFICE
ROTH, WILLIAM H.
EXT 3663
CHIEF
GEWES-SV-Z
PAGE 4
ENGINEERING AND CONSTRUCTION SERVICES DIVISION
EARLEY, GERALD T.
EXT 3300
CHIEF
GEWES-MV-Z
PROP. HOUSING MAINTENANCE ANALYSIS BRANCH
SIDNEY, DOROTHY G.
EXT 3742
CHIEF
GEWES-MP
ENGINEERING BRANCH
HALLMAN, DAVID R.
EXT 3671
CHIEF
GEWES-ME
OPERATIONS BRANCH
DILLON, CECIL C.
EXT 3647
CHIEF
GEWES-MC
PAGE 8
LOGISTICS MANAGEMENT OFFICE
HARVEY, BILLY A.
EXT 3000
CHIEF
GEWES-GL-Z
TRAVEL OFFICE
ELSKA, CAROL
EXT 3270
CHIEF
GEWES-GL-T
PROPERTY BRANCH
BRIDGE, CHARLES
EXT 3438
CHIEF
GEWES-GL-P
SUPPLY BRANCH
HERNANDEZ, THOMAS
EXT 3035
CHIEF
GEWES-GL-S
TRANSPORTATION/MAINTENANCE BRANCH
BARNETT, OLIVER E., JR.
EXT 3404
CHIEF
GEWES-GL-M
PAGE 3
TECHNICAL SUPPORT
INSTRUMENTATION SERVICES DIV
BONNER, GEORGE P.
EXT 3534
CHIEF
GEWES-IV-Z
OPERATIONS BRANCH
BLAKE, LELAND M.
EXT 3530
CHIEF
GEWES-IO
DESIGN & DEVELOPMENT BR
REED, BOBBY E.
EXT 3670
CHIEF
GEWES-ID
SPECIAL SERVICE BRANCH
LEAKE, FREDRICK P.
EXT 3437
CHIEF
GEWES-IS
PAGE 6
OFFICE OF TECHNICAL PROGRAMS AND PLANS
VINCENT, HARRY M.
EXT 3670
CHIEF
GEWES-PV-Z
PAGE 1
TECHNICAL LABORATORIES
HYDRAULICS LABORATORY
HERMANN, FRANK A., JR.
EXT 3343
CHIEF
GEWES-HV-Z
BAKER, RICHARD A.
EXT 3300
ASST CHIEF
GEWES-HV-A
HYDRAULICS STRUCTURES DIV
PORTING, GLENN A.
EXT 3344
CHIEF
GEWES-HS
WATERWAYS DIV
BOYD, M. BARTON
EXT 3553
CHIEF
GEWES-HW
ESTUARIES DIV
MCNALLY, W. H., JR.
EXT 3432
CHIEF
GEWES-HE
PAGE 7
GEOTECHNICAL LABORATORY
MARCHAND, DR. WILLIAM F.
EXT 3334
CHIEF
GEWES-GV-Z
KIRKLA, DR. PAUL F.
EXT 3475
ASST CHIEF
GEWES-GV-A
PAVEMENT SYSTEMS DIVISION
VACANT
EXT 3304
CHIEF
GEWES-GP
MOBILITY SYSTEMS DIVISION
MARVIN, HERBERT R., JR.
EXT 3447
CHIEF
GEWES-GM
EARTHQUAKE ENGINEERING & GEOSCIENCES DIVISION
FRANKLIN, DR. A. O.
EXT 3006
CHIEF
GEWES-GE
SOIL AND ROCK MECHANICS DIVISION
DAVIS, DR. DON G.
EXT 3630
CHIEF
GEWES-GS
PAGES 8 & 9
STRUCTURES LABORATORY
MATHER, BRYANT
EXT 3304
CHIEF
GEWES-SV-Z
BALLARD, JAMES T.
EXT 3700
ASST CHIEF
GEWES-SV-A
EXPLOSION EFFECTS DIV
DAVIS, L. R.
EXT 3333
CHIEF
GEWES-SE
GEOMECHANICS DIV
JACKSON, DR. A. G., JR.
EXT 3204
CHIEF
GEWES-SG
STRUCTURAL MECHANICS DIV
BALSARA, DR. JIMMY P.
EXT 3324
CHIEF
GEWES-SS
CONCRETE TECHNOLOGY DIV
SAUCIER, KENNETH L.
EXT 3277
CHIEF
GEWES-SC
PAGES 10 & 11
ENVIRONMENTAL LABORATORY
KARNEY, DR. JOHN
EXT 3327
CHIEF
GEWES-EV-Z
REELY, DR. JOHN W.
EXT 3477
ASST CHIEF
GEWES-EV-A
ENVIRONMENTAL RESOURCES DIV
KIRBY, DR. CONRAD J., JR.
EXT 3400
CHIEF
GEWES-ER
ENVIRONMENTAL SYSTEMS DIV
LAWRENCE, DR. VICTOR E.
EXT 3403
CHIEF
GEWES-ES
ENVIRONMENTAL ENGRG DIV
MONTGOMERY, DR. R. L.
EXT 3410
CHIEF
GEWES-EE
ECOSYSTEM RESEARCH & SIMULATION DIV
ROBEY, DONALD
EXT 3363
CHIEF
GEWES-ER
PAGE 12 & 13
COASTAL ENGINEERING RESEARCH CENTER
HOUSTON, DR. JAMES R.
EXT 3000
CHIEF
GEWES-CV-Z
DALRYMPLE, CHARLES C.
EXT 3301
ASST. CHIEF
GEWES-CV-A
RESEARCH DIVISION
BUTLER, H. LEE
EXT 3406
CHIEF
GEWES-CR
WAVE DYNAMICS DIVISION
CHATHAM, CLARK E.
EXT 3400
CHIEF
GEWES-CW
ENGINEERING DEVELOPMENT DIVISION
RICHARDSON, THOMAS W.
EXT 3700
CHIEF
GEWES-CD
PAGE 14
INFORMATION TECHNOLOGY LABORATORY
BASHAM, DR. H.
EXT 3507
CHIEF
GEWES-IV-Z
BENSTER, PAUL R.
EXT 3006
ASST CHIEF
GEWES-IV-A
COMPUTER SCIENCE DIVISION
INGRAM, DR. VIRGIL
EXT 3102
CHIEF
GEWES-IV-C
INFORMATION MANAGEMENT DIV
HUFFMAN, H. MURRAY
EXT 3600
CHIEF
GEWES-IV-M
COMPUTER CENTER
PARKER, BILLY
EXT 3400
CHIEF
GEWES-IV-C
COMPUTER AIDED ENGINEERING DIVISION
VACANT
EXT 4020
CHIEF
GEWES-IV-D
PAGES 15 & 16
LARRY B. FULTON
COLONEL
COMMANDER & DIRECTOR
EN
1
60°

FIGURE 1A

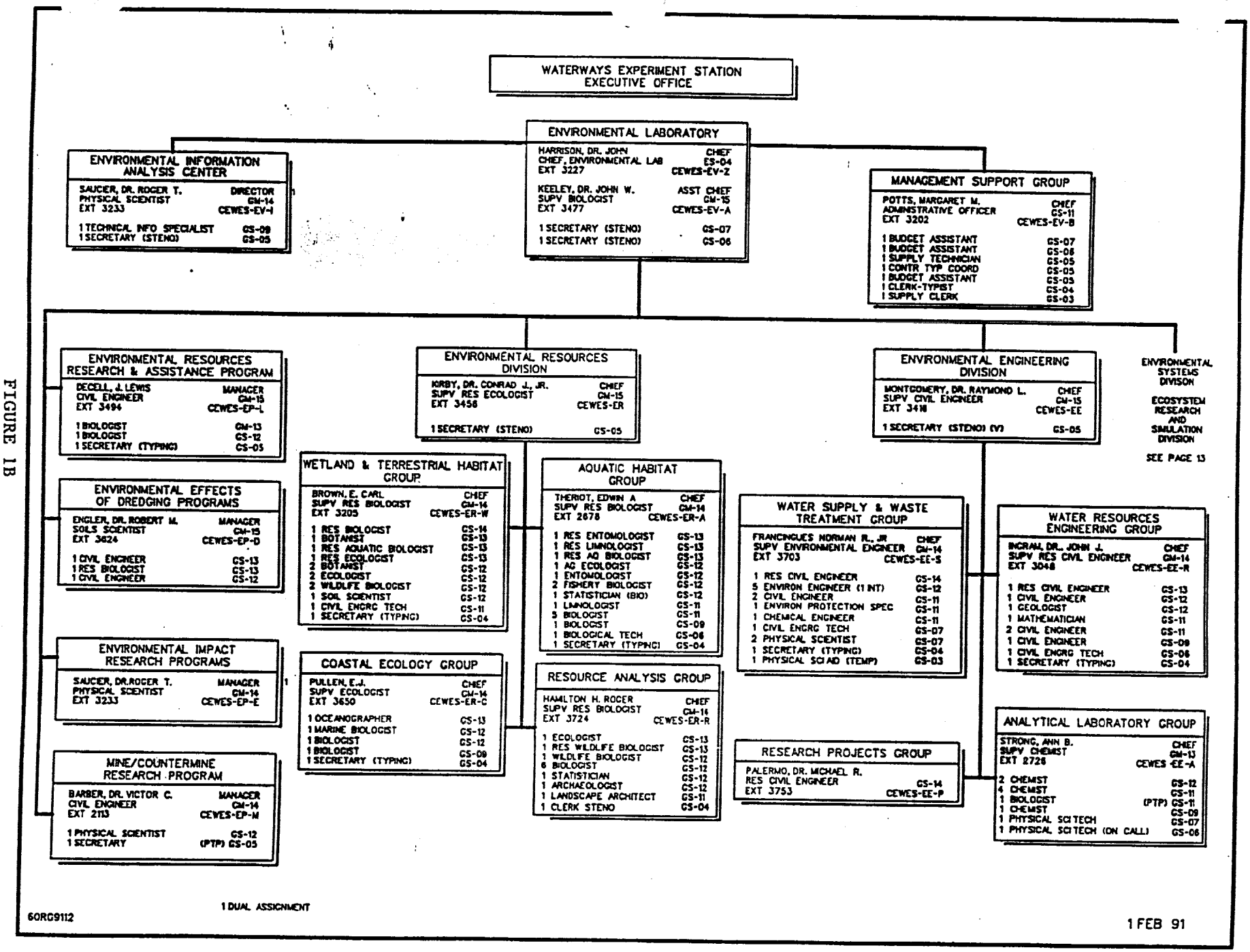

WATERWAYS EXPERIMENT STATION
EXECUTIVE OFFICE
ENVIRONMENTAL LABORATORY
HARRISON, DR. JOHN CHIEF
CHIEF, ENVIRONMENTAL LAB ES-04
EXT 3227 CEWES-EV-Z
KEELEY, DR. JOHN W. ASST CHIEF
SUPV BIOLOGIST GM-15
EXT 3477 CEWES-EV-A
1 SECRETARY (STENO) GS-07
1 SECRETARY (STENO) GS-06
ENVIRONMENTAL INFORMATION ANALYSIS CENTER
SAUCER, DR. ROGER T. DIRECTOR
PHYSICAL SCIENTIST GM-14
EXT 3233 CEWES-EV-I
1 TECHNICAL INFO SPECIALIST GS-09
1 SECRETARY (STENO) GS-05
MANAGEMENT SUPPORT GROUP
POTTS, MARGARET M. CHIEF
ADMINISTRATIVE OFFICER GS-11
EXT 3202 CEWES-EV-B
1 BUDGET ASSISTANT GS-07
1 BUDGET ASSISTANT GS-06
1 SUPPLY TECHNICIAN GS-05
1 CONTR TYP COORD GS-05
1 BUDGET ASSISTANT GS-03
1 CLERK-TYPIST GS-04
1 SUPPLY CLERK GS-03
ENVIRONMENTAL RESOURCES RESEARCH & ASSISTANCE PROGRAM
DECELL, J. LEWIS MANAGER
CIVIL ENGINEER GM-15
EXT 3494 CEWES-EP-L
1 BIOLOGIST GM-13
1 BIOLOGIST GS-12
1 SECRETARY (TYPING) GS-05
ENVIRONMENTAL RESOURCES DIVISION
KIRBY, DR. CONRAD J., JR. CHIEF
SUPV RES ECOLOGIST GM-15
EXT 3456 CEWES-ER
1 SECRETARY (STENO) GS-05
ENVIRONMENTAL ENGINEERING DIVISION
MONTGOMERY, DR. RAYMOND L. CHIEF
SUPV CIVIL ENGINEER GM-15
EXT 3418 CEWES-EE
1 SECRETARY (STENO) (V) GS-05
ENVIRONMENTAL SYSTEMS DIVISION
ECOSYSTEM RESEARCH AND SIMULATION DIVISION
SEE PAGE 13
ENVIRONMENTAL EFFECTS OF DREDGING PROGRAMS
ENGLER, DR. ROBERT M. MANAGER
SOILS SCIENTIST GM-15
EXT 3624 CEWES-EP-D
1 CIVIL ENGINEER GS-13
1 RES BIOLOGIST GS-13
1 CIVIL ENGINEER GS-12
WETLAND & TERRESTRIAL HABITAT GROUP
BROWN, E. CARL CHIEF
SUPV RES BIOLOGIST GM-14
EXT 3205 CEWES-ER-W
1 RES BIOLOGIST GS-14
1 BOTANIST GS-13
1 RES AQUATIC BIOLOGIST GS-13
1 RES ECOLOGIST GS-13
2 BOTANIST GS-12
2 ECOLOGIST GS-12
2 WILDLIFE BIOLOGIST GS-12
1 SOIL SCIENTIST GS-12
1 CIVIL ENGRG TECH GS-11
1 SECRETARY (TYPING) GS-04
AQUATIC HABITAT GROUP
THERIOT, EDWIN A CHIEF
SUPV RES BIOLOGIST GM-14
EXT 2678 CEWES-ER-A
1 RES ENTOMOLOGIST GS-13
1 RES LIMNOLOGIST GS-13
1 RES AQ BIOLOGIST GS-13
1 AQ ECOLOGIST GS-12
1 ENTOMOLOGIST GS-12
2 FISHERY BIOLOGIST GS-12
1 STATISTICIAN (BIO) GS-12
1 LIMNOLOGIST GS-11
5 BIOLOGIST GS-11
1 BIOLOGIST GS-09
1 BIOLOGICAL TECH GS-06
1 SECRETARY (TYPING) GS-04
WATER SUPPLY & WASTE TREATMENT GROUP
FRANCINGUES NORMAN R., JR CHIEF
SUPV ENVIRONMENTAL ENGINEER GM-14
EXT 3703 CEWES-EE-S
1 RES CIVIL ENGINEER GS-14
5 ENVIRON ENGINEER (1 INT) GS-12
2 CIVIL ENGINEER GS-11
1 ENVIRON PROTECTION SPEC GS-11
1 CHEMICAL ENGINEER GS-11
1 CIVIL ENGRG TECH GS-07
2 PHYSICAL SCIENTIST GS-07
1 SECRETARY (TYPING) GS-04
1 PHYSICAL SCI AID (TEMP) GS-03
WATER RESOURCES ENGINEERING GROUP
INGRAM, DR. JOHN J. CHIEF
SUPV RES CIVIL ENGINEER GM-14
EXT 3048 CEWES-EE-R
1 RES CIVIL ENGINEER GS-13
1 CIVIL ENGINEER GS-12
1 GEOLOGIST GS-12
1 MATHEMATICIAN GS-11
2 CIVIL ENGINEER GS-11
1 CIVIL ENGINEER GS-09
1 CIVIL ENGRG TECH GS-06
1 SECRETARY (TYPING) GS-04
ENVIRONMENTAL IMPACT RESEARCH PROGRAMS
SAUCER, DR. ROGER T. MANAGER
PHYSICAL SCIENTIST GM-14
EXT 3233 CEWES-EP-E
COASTAL ECOLOGY GROUP
PULLEN, E.J. CHIEF
SUPV ECOLOGIST GM-14
EXT 3650 CEWES-ER-C
1 OCEANOGRAPHER GS-13
1 MARINE BIOLOGIST GS-12
1 BIOLOGIST GS-12
1 BIOLOGIST GS-09
1 SECRETARY (TYPING) GS-04
RESOURCE ANALYSIS GROUP
HAMILTON H. ROGER CHIEF
SUPV RES BIOLOGIST GM-14
EXT 3724 CEWES-ER-R
1 ECOLOGIST GS-13
1 RES WILDLIFE BIOLOGIST GS-13
1 WILDLIFE BIOLOGIST GS-12
6 BIOLOGIST GS-12
1 STATISTICIAN GS-12
1 ARCHAEOLOGIST GS-12
1 LANDSCAPE ARCHITECT GS-11
1 CLERK STENO GS-04
RESEARCH PROJECTS GROUP
PALERMO, DR. MICHAEL R.
RES CIVIL ENGINEER GS-14
EXT 3753 CEWES-EE-P
ANALYTICAL LABORATORY GROUP
STRONG, ANN B. CHIEF
SUPV CHEMIST GM-13
EXT 2726 CEWES-EE-A
2 CHEMIST GS-12
4 CHEMIST GS-11
1 BIOLOGIST (PTP) GS-11
1 CHEMIST GS-09
1 PHYSICAL SCI TECH GS-07
1 PHYSICAL SCI TECH (ON CALL) GS-06
MINE/COUNTERMINE RESEARCH PROGRAM
BARBER, DR. VICTOR C. MANAGER
CIVIL ENGINEER GM-14
EXT 2113 CEWES-EP-M
1 PHYSICAL SCIENTIST GS-12
1 SECRETARY (PTP) GS-05
1 DUAL ASSIGNMENT
60RG9112
1 FEB 91

FIGURE 1B

CONTINUED FROM PAGE 12

WATERWAYS EXPERIMENT STATION EXECUTIVE OFFICE

ENVIRONMENTAL LABORATORY

ENVIRONMENTAL SYSTEMS DIVISION

LaGARDE, DR. VICTOR E.	CHIEF
SUPV RES CIVIL ENGINEER	GM-15
EXT 2683	CEWES-EN
THOMAS, WILLIE H.	R&D COORD
EXT 2826	MAJ
1 GENERAL ENGINEER	GS-13
1 COMPUTER SYS PROGRAMMER	GS-12
1 SECRETARY (STENO)	GS-05

ENVIRONMENTAL CONTRAINTS GROUP

KEOWN, MALCOLM P.	CHIEF
SUPV PHYSICIST	GM-14
EXT 3232	CEWES-EN-C
1 RES CIVIL ENGINEER	GS-13
1 RES PHYSICIST	GS-13
1 ENVIRONMENTAL ENGINEER	GS-13
3 CIVIL ENGINEER	GS-12
2 PHYSICIST	GS-12
1 MATHEMATICIAN	GS-12
1 HYDROLOGIST	GS-12
1 MECHANICAL ENGINEER	GS-12
1 MATHEMATICIAN	GS-11
1 ELECTRONICS ENGINEER	GS-11
1 WRITER EDITOR (INT)	GS-09
2 PHYSICAL SCIENTIST	GS-07
1 CIVIL ENGRG TECH	GS-06
1 SECRETARY (TYPING)	GS-04
1 CLERK-TYPIST	GS-04
1 CIVIL ENGRG TECH	GS-03

BATTLEFIELD ENVIRONMENT GROUP

CRESS, DR. DANIEL H.	CHIEF
SUPV RES PHYSICIST	GM-15
EXT 2732	CEWES-EN-B
2 RES CIVIL ENGINEER	GS-13
1 PHYSICIST	GS-12
1 ELECTRICAL ENGINEER	GS-12
1 COMP PROG ANALYST	GS-12
1 MECHANICAL ENGINEER	GS-12
1 CIVIL ENGINEER	GS-12
1 BOTANIST	GS-12
1 PHYSICAL SCENTIST	GS-12
1 ECOLOGIST	GS-11
1 PHYS SCENTIST	GS-11
1 PHYSICIST	GS-11
1 CIVIL ENGINEER	GS-11
1 MATHEMATICIAN	GS-11
1 COMP PROG ANALYST	GS-11
2 CIVIL ENGRG TECH	GS-09
1 ELECTRONICS ENGR	GS-09
1 CIVIL ENGRG TECH	GS-08
PHYSICIST	GS-07
SECRETARY (TYPING)	GS-04

ENVIRONMENTAL ANALYSIS GROUP

WEST, H. WADE	CHIEF
SUPV CIVIL ENGINEER	GM-14
EXT 2232	CEWES-EN-A
1 RES CIVIL ENGINEER	GS-13
1 OPER RES ANALYST	GS-13
1 RES CIVIL ENGINEER	GS-12
1 PHYSICAL SCIENTIST	GS-12
1 CHEMICAL ENGINEER	GS-11
1 CIVIL ENGINEER	GS-11
1 BIOLOGIST	GS-11
1 COMP PRGMR ANALYST	GS-11
1 MATHEMATICIAN	GS-11
1 BIOLOGIST	GS-09
1 MATHEMATICIAN	GS-09
1 ELECTRONICS ENGINEER	GS-09
1 CIVIL ENGRG TECH	GS-09
1 ELECTRICAL ENGR	GS-09
1 ENGRG TECH	GS-05
1 SECRETARY (STENO)	GS-04
1 ENGRG AID	GS-03

ECOSYSTEM RESEARCH AND SIMULATION DIVISION

ROBEY, DONALD L.	CHIEF
SUPV HYDROLOGIST	GM-15
EXT 2263	CEWES-ES
1 SECRETARY	GS-05

WATER QUALITY MODELING GROUP

DORTCH, MARK S.	CHIEF
SUPV HYDRAULIC ENGINEER	GM-14
EXT 3517	CEWES-ES-Q
1 RES ECOLOGIST	GS-14
1 HYDROLOGIST	GS-14
1 RES LIMNOLOGIST	GS-12
1 RES CIVIL ENGINEER	GS-12
1 HYDROLOGIST	GS-12
1 COMP SYS PROGRAMMER	GS-12
1 CIVIL ENGINEER	GS-12
1 ECOLOGIST (AG)	GS-12
1 CIVIL ENGINEER	GS-11
1 SECRETARY (TYPING)	GS-04

CONTAMINANT MOBILITY AND REGULATORY CRITERIA GROUP

SAUNDERS, DR. LLOYD H.	CHIEF
SUPV BIOLOGIST	GM-14
EXT 4297	CEWES-ES-R
1 SOIL SCIENTIST	GS-14
1 ECOLOGIST	GS-14
1 SOIL SCIENTIST	GS-13
3 RES BIOLOGIST	GS-13
2 ZOOLOGIST	GS-12
1 PHYS SCIENTIST	GS-12
1 STATISTICIAN (ON CALL)	GS-12
1 RES BIOLOGIST	GS-12
1 STATISTICIAN (BIO)	GS-12
1 AGRONOMIST	GS-11
1 BIOLOGIST	GS-11
1 CLERK (STENO) (V)	GS-04

AQUATIC PROCESSES AND EFFECTS GROUP

HART, DR. THOMAS L.	CHIEF
SUPV BIOLOGIST	GM-14
EXT 3449	CEWES-ES-A
1 RES BIOLOGIST	GS-15
1 RES LIMNOLOGIST	GS-14
1 RES CHEMIST	GS-14
1 RES MICROBIOLOGIST	GS-13
1 RES BIOLOGIST	GS-13
1 AQUATIC BIOLOGIST	GS-13
3 HYDROLOGIST	GS-12
3 RES BIOLOGIST	GS-12
1 PLANT PHYSIOLOGIST	GS-12
1 ECOLOGIST	GS-12
1 PHYS SCIENTIST	GS-11
1 BIOLOGIST	GS-11
1 BIOLOGIST	GS-09
1 PHYS SCIENTIST	GS-07
1 SECRETARY (TYPING)	GS-04

238-CS/GM
1-MIL

6ORG

1F

FIGURE 1C

policy is delineated in Station Regulations and is under the general supervision of the Safety and Occupational Health Office staffed by a safety officer, two registered nurses and a safety technician. A medical doctor is also on duty three days a week.

At the Analytical Laboratory Group level, safety meetings are held to update employees on any changes to policy. Training sessions such as those offered by J. T. Baker are held to educate personnel in good laboratory safety practices and the use of Material Safety Data Sheets. Sessions have also been held on the proper use of respirators in the laboratory. The 40 hour training course required by OSHA for workers at hazardous waste sites is offered to pertinent personnel. Some employees have also been trained in Department of Transportation requirements for shipping hazardous materials.

Laboratory safety inspections are held on a routine basis to assure that hoods, fire extinguishers, eye baths, showers, gas outlets, and electrical outlets are all in proper working order. Training sessions in the proper use of fire extinguishers are held annually by the WES fire department. Flammable solvents must be stored in proper storage cabinets and other reagents must be stored according to chemical reactivity classifications.

Laboratory wastes are disposed of according to hazard classification. All hazardous materials are collected in lab packs until they are turned over to the WES Safety Office for final disposal. WES is a RCRA permitted facility.

Laboratory personnel are trained in spill control measures and the proper use of spill control kits. Each laboratory area

has appropriate spill control kits available for procedures being conducted.

Personnel are encouraged to take advantage of free First Aid and CPR Courses.

Annual physicals are provided to laboratory personnel to encourage a healthy work environment and to assure the absence of effects from laboratory chemicals.

New personnel are given on-the-job training in routine safety procedures. All training is documented in each employee's personnel file.

8. Glassware Cleaning, Sample Handling and Chain-of-Custody

a. Standard operating procedure for glassware cleaning.

Methods for cleaning glassware are selected according to the substances that are to be removed and the analysis required.

Metal Analysis

1. Rinse with tap water immediately after use

2. Place glassware in ultrasonic cleaner filled 3/4 full with reverse osmosis (R.O.) water and 15-20 ml commercial laboratory cleaning solution (i.e. Micro or Alconox). Cleaning solution should come into contact with all surfaces.

3. When tank is full, turn on ultrasonic cleaner and allow to run 2-3 hours. Turn off cleaner prior to removing glassware.

4. Rinse 3-5 times with R.O. water.

5. Rinse in 25% hydrochloric acid bath.

6. Rinse in 25% nitric acid bath.

7. Rinse 3 times with distilled water.

8. Invert and air dry on laboratory carts.

9. Store in closed cabinets until use.

Nutrient Glassware

1. Rinse with tap water immediately after use.
2. Place in ultrasonic cleaner as above.
3. Soak overnight in 10% sulfuric acid bath.
4. Rinse 3-5 times with R.O. water.
5. Rinse 3 times with distilled water.
6. Invert and air dry on laboratory carts.
7. Store in closed cabinets until use.

Ultrasonic cleaner tank should be drained every 2 weeks.

Organic Analysis

1. Rinse dirty glassware with last solvent used.
2. Rinse with tap water.
3. Place in soap bath and allow to soak at least 24 hours. (Change bath weekly--Use 1 bottle of strong basic soap such as Chem-solv to 1 full 20 gallon bath).
4. Remove from soap bath and rinse with warm tap water.
5. Rinse in 10% hydrochloric acid bath.
6. Rinse with R.O. water.
7. Rinse with methylene chloride.
8. Place in oven overnight at 275°.
9. Cool, remove from oven, and store in closed cabinet in an inverted position or covered with aluminum foil.
10. Prior to use, the glassware is again rinsed with the solvent to be used in the analysis.

b. Sample Bottle Preparation

WES normally purchases certified pre-cleaned (to EPA specifications) bottles and VOA vials for sample collection. In instances where large sample volumes are required (i.e. elutriate analysis requiring one-gallon or two and one-half gallon containers) cleaning procedures similar to those employed for laboratory glass are used. Certificates of contamination checks are filed and lot numbers of bottles shipped to sample collectors are maintained in a log book.

c. Sample Shipping Procedures

Personnel from the Analytical Laboratory Group (ALG) at WES do not normally go to the field to collect samples. However, the ALG frequently provides sample bottles as described above and interacts with the field crew to assure proper sample collection. The field crew is requested to initiate chain-of-custody procedures for projects requiring chain-of custody using WES form 2196 (Form 1). Field personnel are requested to label and identify samples to meet project specifications. They are given instructions as to the proper containers to use with the intended analyses, the proper preservation technique, and volumes needed. Table 1 identifies containers, preservation techniques and holding times.

For chain-of-custody samples, shipping containers are to be sealed, whether transported by field personnel or shipped by commercial carrier. Samples are to be shipped with sufficient ice to maintain a 4° C temperature and with sufficient packing to prevent breakage.

USAE WATERWAY ERIMENT STATION

CHAIN OF C ODY RECORD

FORM 1

PROJECT NAME

SAMPLERS: (Signature)

DATE	TIME	SAMPLE ID	NO. OF CONTAINERS								REMARKS

Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Relinquished by: (Signature)	Date /Time	Received by: (Signature)
Relinquished by: (Signature)	Date /Time	Received by: (Signature)	Date /Time	Remarks	

d. Sample Receipt and Log-In Procedures

Upon receipt at the laboratory, the sample management officer fills out a cooler receipt form (Form 2).

Receipt of chain-of-custody samples is recorded in a permanent receipt book. The sample collector or project manager is notified of any discrepancies noted on the cooler receipt form.

If samples are delivered by WES personnel, they are required to fill out WES Form 2079 (Form 3) with the information indicated by asterisks and to sign a sample receipt, WES Form 2118 (Form 4). The ALG sample management officer then verifies that the number of samples and the sample identification are as stated on Form 2097.

If samples are received by commercial carrier, Form 2097 is filled out by the sample management officer. The WES uses preprinted consecutively numbered duplicate gummed labels to identify samples. One label is placed on the sample bottle and the other label is placed on Form 2079 under the Lab I.D. No. next to the corresponding Project I.D. No. This information is also entered into a permanent log book, WES Form 2108 (Form 5). The estimated cost is calculated, entered onto the Sample Receipt Form 2118, and the original copy returned to the Project manager.

All samples except volatiles are stored in the locked walk-in cooler which is maintained at 4° and equipped with an alarm system that goes off when the temperature deviates by more than ± two degrees. A separate locked refrigerator is maintained for volatile analysis and temperatures are recorded in a refrigerator log. Two ALG employees have keys to the cooler and a permanent

Table 1

Required Containers, Preservation Techniques, and Holding Times

Name	Container[1]	Preservation	Maximum Holding Time
Bacterial Tests:			
Coliform, total	P,G	Cool, 4°C, 0.008%, $Na_2S_2O_3$	6 hours
Inorganic Tests:			
Chloride	P, G	None required	28 days
Cyanide, total and amenable to chlorination	P, G	Cool,4°C, NaOH to pH>12, 0.6g ascorbic acid	14 days
Hydrogen ion (pH)	P, G	None required	Analyze immediately
Nitrate	P, G	Cool, 4°C	48 days
Sulfate	P, G	Cool, 4°C	28 days
Sulfide	P, G	Cool, 4°C, and zinc acetate	7 days
Metals:			
Chromium VI	P, G	Cool,4°C	24 hours
Mercury	P, G	HNO_3 to pH<2	28 days
Metals, except chromium VI and mercury	P, G	HNO_3 to pH<2	6 months
Organic Tests:			
Oil and grease	G	Cool, 4°C, H_2SO_4 to pH$_2$	28 days
Organic carbon, total (TOC)	P, G	Cool, 4°C HC1 or H_2SO_4 to pH<2	28 days
Purgeable Halocarbons	G, Teflon-lined septum	Cool, 4°C, 0.008% $Na_2S_2O_3$	14 days
Purgeable aromatic hydrocarbons	G, Teflon-lined septum	Cool, 4°C, 0.0008% $Na_2S_2O_3$ HC1 to pH2	14 days
Acrolein and acrylonitrile	G, Teflon-lined septum	Cool, 4°C, 0.008% $Na_2S_2O_3$, Adjust pH to 4-5	14 days
Phenols	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$	7 days until extraction, 40 days after extraction
Benzidines	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$	7 days until extraction, 40 days after extraction
Phthalate esters	G, Teflon-lined cap	Cool, 4°C,	7 days until extraction, 40 days after extraction
Nitrosamines	G, Teflon-lined cap	Cool, 4°C, store in dark, 0.008% $Na_2S_2O_3$	7 days until extraction, 40 days after extraction
PCBs, acrylonitrile	G, Teflon-lined cap	Cool, 4°C	7 days until extraction, 40 days after extraction
Nitroaromatics and cyclic ketones	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$ store in dark	7 days until extraction, 40 days after extraction
Polynuclear aromatic hydrocarbons	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$, store in dark	7 days until extraction, 40 days after extraction
Haloethers	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$	7 days until extraction, 40 days after extraction
Chlorinated hydrocarbons	G, Teflon-lined cap	Cool, 4°C	7 days until extraction, 40 days after extraction
TCDD	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$	7 days until extraction, 40 days after extraction
Total organic halides (TOX)	G, Teflon-lined cap	Cool, 4°C, H_2SO_4 to pH<2	28 days
Pesticides	G, Teflon-lined cap	Cool, 4°C, pH 5-9	7 days until extraction, 40 days after extraction
Radiological Tests:			
Alpha, beta and radium	P, G	HNO_3 to pH<2	6 months

[1]Polyethylene (P) or Glass (G)

Source: SW-846

Cooler Receipt Form

PROJECT: _____

Cooler received on _____ and opened on _____ by

Signature _____

1.	Were custody seals on outside of cooler?	YES	NO
	If yes, how many and where? _____		
	Were signature and date correct?	YES	NO
2.	Were custody papers taped to lid inside cooler?	YES	NO
3.	Were custody papers properly filled out (ink, signed)	YES	NO
4.	Did you sign custody papers in the appropriate place?	YES	NO
5.	What kind of packing material was used? _____		
6.	Was sufficient ice used (if appropriate)?	YES	NO
7.	Were all bottles sealed in separate plastic bags?	YES	NO
8.	Did all bottles arrive in good condition (unbroken)?	YES	NO
9.	Were all bottle labels complete (#, date, signed, anal., preserv. etc.)?	YES	NO
10.	Did bottle labels and tags agree with custody papers?	YES	NO
11.	Were correct bottles used for tests indicated?	YES	NO
12.	Were VOA vials checked for absence of bubbles?	YES	NO
13.	Did each bottle contain sufficient sample?	YES	NO
14.	Were acid/base preserved samples checked with pH paper?	YES	NO

Explain any discrepancies

Form 2

ENVIRONMENTAL LABORATORY

DATA REPORTING SHEET

ANALYSIS REQUEST FORM

ANALYTICAL LABORATORY GROUP

SHEET ____ OF ____

PROJECT*		DATE RECEIVED*	SAMPLE LOCATION: FREEZER NO.
DATA CHECKED BY	JOB NO.*	DATE COMPLETED	SHELF NO.
CHEMICAL PRESERVATIVE *	PARAMETER *		

LAB I.D. NO	PROJECT I.D. NO *														

WES FORM 1 AUG 81 2079 Previous Editions May Be Used.

* INFORMATION SUPPLIED BY PERSON SUBMITTING SAMPLES

FORM 3

ALG SAMPLE RECEIPT	DIVISION	BRANCH	
PROJECT NAME	JOB NO.	DATE RECEIVED	NO. SAMPLES

SAMPLE NO.	PARAMETERS	ESTIMATED COST

PROJECT REP SIGNATURE	DATE	ALG SAMPLE RECIPIENT SIGNATURE	DATE

WES FORM MAR 77 2118 ORIGINAL

WES FORM MAR 77 2118 COPY 1

WES FORM MAR 77 2118 COPY 2

FORM 4

A. L. G. SAMPLE LOG

SAMPLE NO. _____ TO _____

LAB NO.	JOB NO.	SOURCE	NO. ANALYSES / NO. SAMPLES	DATE RECEIVED	INITIAL COST	SPECIAL COST	DATE DATA RETURNED	DATE BOTTLES RETURNED	ANALYSES REQUIRED

FORM 5

log is maintained to check chain-of-custody samples in and out of the cooler for analysis. The analyst is required to keep chain-of-custody samples behind locked doors if he is away from the area where analyses are in progress.

The sample management officer enters all pertinent information into the ALG computer data management system. Job files (Figure 2) are created for use by the analysts in recording their data.

In addition, a "special instruction form" (Form 6) has been developed to provide additional pertinent information to the analysts. This form is generated by the sample information officer and a copy is provided to each analyst having responsibility for analysis in a particular sample set.

e. Chain-of-Custody

For samples that may be used for regulatory or compliance purposes, a chain-of-study procedure is employed and begins in the field. This ensures that the samples are collected, transferred, stored, analyzed, and destroyed only by authorized personnel. The following chain-of-custody procedures are generally considered to be acceptable:

(1) A written procedure is provided to the field and laboratory personnel to assure that sample possession is traceable.

(2) Involve a minimum number of trained persons in sample collection and handling.

ANALYTICAL LABORATORY GROUP - D. REPORTING SHEET (PAGE 1 OF 6)

JOB DESCRIPTION: WILMINGTON ANAEROBIC TASK I - BRANNON
CHEM. PRESERVATIVE: HNO3

JOB NUMBER: AMELR081A1E9100
TYPE OF SAMPLE: Water

RECEIPT DATE: 13 AUG 91
EST. COMP. DATE: 20 SEP 91

	COLUMN.....	1	2	3	4	5	6	
	ANALYTE.....	24	25	27	30	31	34	
	PPM.....	AL	BA	CA	FE	MG	K	
SAMP #	DESCRIPTION							ROW
15018	WANS-C D1:1	CONC						1
		%REC						
		DUPL						
		DID						
15019	WANS-C D1:2	CONC						2
		%REC						
		DUPL						
		DID						
15020	WANS-C D2:1	CONC						3
		%REC						
		DUPL						
		DID						
15021	WANS-C D2:2	CONC						4
		%REC						
		DUPL						
		DID						
15022	WANS-C D3:1	CONC						5
		%REC						
		DUPL						
		DID						
15023	WANS-C D3:2	CONC						6
		%REC						
		DUPL						
		DID						

AL	Aluminum	BA	Barium
CA	Calcium	FE	Iron
MG	Magnesium	K	Potassium

FIGURE 2

SPECIAL INSTRUCTION FORM

SAMPLE SET:_____ RECEIPT DATE:_____

PROJECT/PI:_____(PHONE)_____

ANALYSES REQUESTED:_____

NO. OF SAMPLES:_____

SAMPLE MATRIX:_____

PRESERVATIVE: (Y/N)_____ NAME:_____

IF SAMPLES ARE NOT PRESERVED, WHY?_____

PRESERVATIVE SPOT CHECK: (Y/N_____ (see reverse)

SAMPLE SOURCE (Site location):_____

BACKGROUND INFORMATION ON SAMPLES:_____

_____

_____

_____

_____

_____

SPECIAL HANDLING:_____

_____

_____

_____

SPECIAL INSTRUCTIONS FOR ALG CHEMISTS:_____

_____

_____

_____

_____

_____

FORM 6

(3) Provide guidelines to be followed for sample collection, including number of samples, sampling method to be used, preservation, and handling.

(4) At the time the sample is collected a chain-of-custody tamperproof seal (Figure 3) is attached to the sample. Information on the tags must be written legibly with waterproof ink. A chain-of-custody record (Form 1) should accompany the samples.

(5) Bound field notebooks are used to record field measurements and information necessary to reconstruct the sample collection process.

f. Sample Disposal Procedures

Samples are normally maintained by the ALG for a period of 6 months. At that time they are returned to the project managers if feasible. If this is not practical, the ALG requests permission from the project manager to dispose of the samples or place them in a semi-permanent repository. Samples that have been determined to contain no hazardous materials are disposed of via the sewerage system or sent to a sanitary landfill. Samples classified as hazardous are submitted to the WES Safety Office for disposal.

9. Facilities

Analytical laboratory facilities occupy approximately 7500 sq ft of Building 6000 at the WES. Storage space is provided for stock chemicals, samples, glassware, equipment, and refrigeration. Laboratory space is divided according to analytical functions.

Hot and cold running water, high capacity sinks and drains capable of accepting acid waste, distilled/deionized water, and ultra-pure water for trace analyses are readily available. Reverse osmosis grade water is available at most benches. Provisions are made for adequate electrical outlets and vacuum systems.

The ten exhaust hoods are capable of venting organic solvents and acid fumes and include a special purpose hood for perchloric acid.

Contract janitors clean the laboratory on a daily basis to reduce possible contamination.

Safety features to comply with Federal Occupational Safety and Health Administration regulations include fire extinguishers, safety showers, eyewash stations, mandatory eye protection requirements, first aid equipment, protective garments, chemical dispensing devices, and safety education.

10. Instrumentation

Instrumentation is an integral part of the analytical laboratories and is constantly being improved and upgraded. "State of the art" equipment and practices are essential if laboratories are to obtain data that will meet the accuracy, precision, and sensitivity required by today's monitoring programs. A routine maintenance and calibration program is provided and documented. Major instruments maintained by the ALG are listed in Table 2.

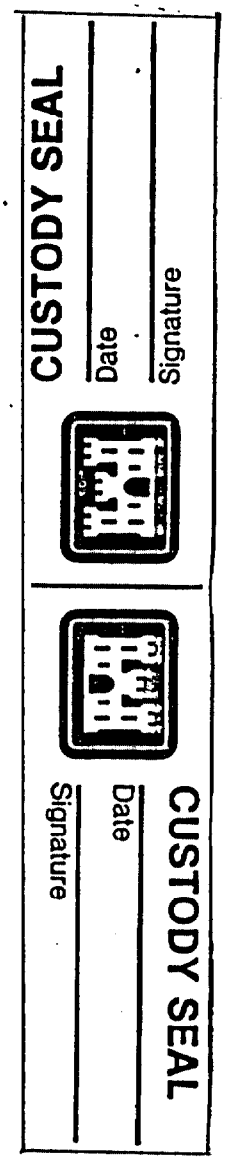


Figure 3. Example of tamper-proof seal

10a. Instrument Maintenance Procedures

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

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

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

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

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

Daily or routine maintenance of instruments is performed by the individual analysts and recorded in the instrument logs (i.e. Richard Karn is responsible for the GC/MS systems, Newberry Brown maintains the GCs, Don Rathburn or Mike Warren maintains the AAs, Don Brown maintains the ICP, DCP,
and autoanalyzers, Jeffretha Christian maintains the TOC analyzer and the mercury analyzer.)

Table 2

WES ALG Instrumentation

Instrument	Model	Year	Analyses
Autoanalyzers	Technicon GT-PC Models (3) 15 Channels	1986	Nutrients, cyanide, Alkalinity, Phenols Cloride, Fluoride
Argon Plasma Emission Spectrometer	Spectra Span VII	1990	Metals
ICAP Emission Spectrometer	Leeman Labs Plasma Spec III Seq/Simul With Auto-Sampler	1988	Metals
Atomic Absorption Spectrophotometers	Perkin-Elmer 5000 with Auto Samplers Model 500 Graphite furnaces (2)	1979 1981	Metals
	Perkin-Elmer 3030 Zeeman with auto-Sampler	1986	Metals
	Perkin-Elmer 5100 with Zeeman Bkg correction, auto-sampler and graphite furnace	1989	Metals
Gas Chromatographs	Hewlett-Packard 5840A with auto-sampler, EC & flame photometric detectors	1978	Pesticides, PCB's, herbicides
	Hewlett-Packard 5880A with auto-sampler, dual EC detectors, dual nitrogen-phosphorus & dual FID detectors	1984	PCB's Pesticides, herbicides, PAH's
	Perkin-Elmer Sigma-3 with thermal Conductivity detector	1978	Gases

(Continued)

Table 2 (Continued)

Instrument	Model	Year	Analyses
GC (cont)	Tracor 540 with auto-sampler, dual EC detectors & Nelson Analytical data reduction system	1987	PCBs, pesticides herbicides, PAHs
	Hewlett-Packard 5890 with auto-sampler and dual EC detectors	1990	PCBs, pesticides PAHs
Gas Chromatograph/ Mass Spectrometer/ Data Systems	Hewlett-Packard 5985 with auto sampler, EI, CI, both positive and negative capability	1980	Organics
	Upgraded	1988	
	Hewlett-Packard 5995 with EI, purge and trap	1982	Volatile organic compounds
	Upgraded	1988	
High Performance Liquid Chromatograph	Waters Diode Array with autosampler	1990	Organic compounds (Herbicides, PAHs and Explosives)
FT/IR	Perkin-Elmer Model 1600	1989	Total Recoverable Petroleum Hydro-carbons, Organic identities
Carbon Analyzer	Oceanographics International Model 700	1987	Total carbon, organic and inorganic
Spectrometer, Scanning UV/Vis	Hitachi Model 100-60	1977	Sulfates hydrocarbons Carbohydrates
Gold Foil Mercury Analyzer	Jerome Instrument	1987	Mercury
Mass Spectrometer/ Mass Spectrometer With GC and LC	EXTREL with Thermo-Beam interface to Waters HPLC and inter-face to Hewlett-Packard 5890 GC.	1990	Organics

(Continued)

Table 2 (Concluded)

Instrument	Model	Year	Analyses
Ion Chromatograph	Waters	1990	Anions, Cations and metallic species
Flow Injection Analyzer	Lachat	1990	Automated ion analysis
Low Background Alpha/Beta Counter	Gamma Products	1991	Gross alpha and Gross beta

11. Analytical Methods

Analytical methods are chosen based on data quality objectives. Analytical methods for routine environmental testing are selected using the following criteria:

a. The selected methods should measure desired constituents of samples in the presence of normal interferences with sufficient precision and accuracy to meet the required quality.

b. The selected procedures should use equipment and skills ordinarily available in the average environmental chemistry laboratory.

c. The selected methods should be sufficiently tested to have established their validity.

d. The selected methods should be sufficiently rapid to permit repetitive routine use in the examination of large numbers of environmental samples.

Complex matrices such as those encountered in sediment, soil and plant tissue may require extensive sample preparation and variance in procedures to compensate for analytical interferences. Procedural development is frequently necessary for samples of this type. Whenever possible a standard reference material in a similar matrix is analyzed with the sample to assure method reliability.

When Federal regulations must be met, such as for Section 304(h) of Public Law 92-500, for the Interim Primary Drinking Water Regulations, for the Resource Consumption and Recovery Act, or for Superfund, EPA approved methods will be used. The QA officer will coordinate any variances.

Methodologies are documented and readily available to each analyst. Laboratory inspections are made to assure adherence to the written procedure. Procedures currently in use by the ALG are listed in Appendix B.

12. Reagents

Reagents are available in a wide range of grades; the purity requirement varies with the type of analysis being conducted. For many analyses, American Chemical Society (ACS) reagent-grade quality is acceptable, and use of reagents lesser purity should be prohibited. Where special high-purity grades, such as spectro grade or reference grade, are required, the analytical procedure will specify the special grade or the required in-house purification, such as distillation or recrystallization.

Upon receipt, a reagent is labeled with the date of receipt and an expiration date if it is unstable. When reagent quality is critical and variation is expected in the quality by reagent lot or source, initial testing of the reagent may be necessary before placing it in laboratory stores.

An effective inventory control program is used to assure that reagent stocks are rotated, out-of-date reagents are discarded, and necessary stocks of reagents are maintained. Reagents are stored according to chemical class following manufacturer's directions to assure reagent integrity, such as storage of light-sensitive reagents in dark bottles, protection from excessive heat, and so on.

For most reagents, verification of reagent suitability is conducted by analyzing a reagent blank with the series of

analyses. Charting of the reagent blank determinations may be advisable.

Distilled or deionized water is used in all analyses and for final rinsing glassware. As a minimum, laboratory water must meet American Society for Testing and Materials (ASTM) specifications for either Type I or Type II reagent water (see Table 3). Type I reagent water is filtered deionized water and is the most common grade of water used in industrial hygiene laboratories. Type II reagent water is distilled water (usually double distilled) and is for most analytical methods requiring organic-free water.

Table 3

American Society for Testing and Materials

Specifications for Reagent Water[a]

	Type I	Type II	Type III	Type IV
Total matter, maximum mg/l	0.1	0.1	1.0	2.0
Electrical conductivity, maximum micromho/cm at 25°C	0.06	1.0	1.0	5.0
Electrical resistivity, minimum MΩ • cm at 25°C	16.66	1.0	1.0	0.20
pH at 25°C	[illegible]	[illegible]	6.2-7.5	5.0-8.0
Minimum color retention time (min)	60	60	10	10

[a] Source: American Society for Testing and Materials [67]

Laboratory water is periodically tested for specific conductance, and corrective actions are taken is needed. The analyst must be aware of possible sources of contamination from leaching, especially when water is stored for extended periods of time after deionization or distillation.

13. Calibration Procedures

Calibration of the GC/MS Systems. Once instrument tune is met the GC/MS system is calibrated before any samples or blanks are analyzed (See Appendix C for tuning procedure). Initial calibration is accomplished through the analysis of a minimum of five concentrations of standards. Five concentrations are used to confirm the linearity of response of the compounds examined. System calibration is verified at the start of every 12 hour analytical period. Relative response factors (RRF) are calculated for each compound based on the concentrations and areas of the characteristic ions for the compound to be measured and its assigned internal standard. Percent Relative standard deviations (RSD) are then calculated for each compound based on the mean of the initial relative response factors of the five standard concentrations. The percent RSD of the calibration check compounds listed in tables 4 and 5 are used to check calibration. The maximum acceptable percent RSD for these compounds is 30.0.

Table 4

Volatile Calibration Check Compounds

Vinyl Chloride
1,1-Dichloroethene
Chloroform
1,2-Dichloropropane
Toluene
Ethylbenzene

Table 5

Semivolatile Calibration Check Compounds

Acenaphthene	4-Chloro-3-Methylphenol
1-4-Dichlorobenzene	2,4-Dichlorophenol
Hexachlorobutadiene	2-Nitrophenol
N-Nitroso-di-n-phenylamine	Pentachlorophenol
Di-n-octylphthalate	2,4,6-Trichlorophenol
Fluoranthene	Phenol
Benzo(a)pyrene	

In addition, system performance check compounds (SPCC) are injected to ensure that minimum RRFs are achieved. The compounds used are listed in tables 6 and 7 along with their minimum acceptable RRFs. Once the percent RSD for the CCCs and the minimum RRF for the SPCCs are met, the calibration is valid and sample analysis can begin.

Gas chromatograph calibration. A calibration curve is determined for each of the compounds to be analyzed. Determination of the calibration curve involves preparing standards (usually three to five) from EPA or EPA certified standards. The samples are analyzed under normal conditions and the area under the peak is determined through integration. To determine the calibration factor, the area under the curve is divided by a standard amount (sample weight):

$$\textit{Calibration factor} = \frac{\textit{Area under the curve}}{\textit{sample weight}}$$

To determine the variation between the Calibration Factors, a Percent Relative Deviation is calculated. The percent RSD is calculated by dividing the

Table 6

Volatile System Performance Check Compounds

Compound	Minimum Acceptable RRF
Chloromethane	0.300
1,1-Dichloroethane	0.30
1,1,2,2-Tetrachloroethane	0.30
Bromoform	0.25
Chlorobenzene	0.30

Table 7

Semivolatile System Performance Check Compounds

Compound	Minimum Acceptable RRF
N-Nitroso-Di-n-propylamine	0.050
Hexachlorocyclopentadiene	0.050
2,4-Dinitrophenol	0.050
4-Nitrophenol	0.050

standard deviation of the Calibration factor by the mean of the calibration factors:

$$\%RSD = \frac{Standard\ Deviation}{Mean}$$

If the variation is less than 10 percent, the calibration is considered linear for all the samples analyzed for that particular compound.

Metals Analysis Calibrations. Standard curves derived from data consisting of one reagent blank and three or four concentrations are prepared for each analyte. The response for each prepared standard is based upon the average of three replicate readings of each standard. The standard curve is used with each subsequent analysis provided that the standard curve is verified by using at least one reagent blank and one standard at a level normally encountered or expected in such samples. If the results of the verification are not within ± 10% of the original curve, a reference standard is employed to determine if discrepancy is with the standard or the instrument. New standards are prepared quarterly at a minimum.

Balances. Balances are checked daily using weights traceable to class S weights. Once each month the balances are checked with the Class S weights. Acceptance for balances which are direct reading to 0.01 gram shall be ±0.01 g for 0 to 100 g and ±0.1 percent of the applied weight over 100 g. A certified balance technician checks the balances annually.

14. Detection Limits

Procedures described in the CLP documents (references 2.p and 2.q.) are used to determine ability to meet contract required detection limits (i.e. for metals, standards are run at 3 to 5 times instrument detection limits taking seven consecutive measurements on three non-consecutive days; the standard

deviation is determined each day and three times the average standard deviation is used as the actual instrument detection limit.) For organic analyses, the method detection limits for the method are used, keeping in mind that the analyses are highly matrix dependent and higher detection limits are reported when interferences prohibit the reporting of the specified limits. See Appendix D for ALG detection limits.

15. Reference Standards

The WES uses a number of sources for reference standards, including NIST (NBS) and EPA. Other commercial sources are specified as being traceable to NIST if at all possible.

Reference Standards-Metals

NIST	SPECTROMETRIC Solutions
3104	Barium
3105	Beryllium
3107	Boron
3108	Cadmium
3112	Chromium
3113	Cobalt
3114	Copper
3128	Lead
3131	Magnesium
3132	Manganese
3133	Mercury
3134	Molybdenum
3136	Nickel
3141	Potassium

3149 Selenium

3150 Silicon

3151 Silver

3152 Sodium

3153 Strontium

3158 Thallium

3161 Tin

3165 Vanadium

3168 Zinc

3171 Multielement Solution Mix A (Al, Be, Cd, Cr, Fe, Mg, Mn, Ni, K, Na)

3172 Multielement Solution Mix B (As, Ba, Ca, Co, Cu, Pb, Se, Ag, Sr. Zn)

2124-1,-2,-3,-4 Spectrometric Standard Solutions (Co, Cu, Fe, Ni)

2126-1,-2,-3,-4 Spectrometric Standard Solutions (Sb, As, Se, Sr.)

2127-1,-2,-3,-4 Spectrometric Standard Solutions (Al, Be, P, Si)

SPECPURE STANDARDS

14485A Aluminum

14487A Calcium

14375A Iron

ENVIRONMENTAL PROTECTION AGENCY

ICAP-7 (Ag, Si, B, Al, Ba, K, Na)

ICAP-19 (Sb, As, Be, Cd, Ca, Cr, Cu, Co, Fe, Pb, Mg, Mo, Ni, Se, V, Zn, Ti, Mn)

LEEMAN LABS

621-4100 Solution A (Al, Ca, Mg, Fe Traceable to EPA ICAP 7 and ICAP 19)

621-4100 Solution AB (Ca, Mg, Fe, Ag, Cd, Ni, Pb, Zn, V, Ba, Be, Co, Cr, Cu, Mn Traceable to ICAP 7 and ICAP 19)

621-4100 Interference Check Sample (Mg Traceable to NBS SRM 3131)

621-4100 Interference Check Sample (Fe Traceable to NBS SRM 3126)

621-4100 Interference Check Sample (Ca Traceable to NBS SRM 3109)

621-4100 Interference Check Sample (Al Traceable to NBS SRM 3101)

OTHER INORGANIC REFERENCE STANDARDS

NIST

3181 Anion Standard Solution Sulfate

3182 Anion Standard Solution Chloride

3183 Anion Standard Solution Fluoride

ORGANIC REFERENCE STANDARDS

PURCHASED ORGANICS

SUPELCO

4-8902 Supelpreme-HC Internal Standards Mix

4-8878 Acids Spiking Solution

4-8869 Base-Neutrals Spiking Solution

4-8876 Purgeable Surrogate Standard Mix-CLP

4-8875 Acids Surrogate Standard Mix-CLP

4-8925 Base Neutral Surrogate Standard Mix-CLP

4-8990 Dibutylchlorendate

4-8835 Purgeables Internal Standard Mix-CLP

4-8908 Supelpreme-HC Hazardous Substances Mix 2

4-8902 Supelpreme-HC Internal Standards Mix

4-8907 Supelpreme-HC Hazardous Substances Mix 1

4-8851 Purgeables A

4-8852 Purgeables B

4-8853 Purgeables C

Chlorinated Biphenyl Standards were purchased from the National Research Council of Canada for congener analysis.

STANDARD REFERENCE MATERIALS AND CHECK SAMPLES FOR QUALITY CONTROL

The following SRMS from NIST are in the laboratory:

1642b Mercury in water

1643b Trace elements in water

1645 Trace elements in river sediment

1646 Trace elements in estuarine sediment

1566 Oyster tissue

1567 Bovine Liver

1573 Tomato leaves

Quality control samples from Environmental Resource Associates are received on a bi-monthly basis for waste water, potable water, priority pollutants, and pesticides.

Additional quality control samples from EPA and NRC of Canada and private vendors are ordered as needed to supplement samples listed above.

16. Analysis of QC Samplers and Documentation

Frequency and type of QC samples are determined by project requirements. For routine analyses in the ALG, the first sample in a sample batch and every eighth sample thereafter has a duplicate and spike analysis. Method blanks are run with every sample batch. Standard reference materials (where matrix is available) are run with every batch of inorganic samples and at least bimonthly for organic samples. The ALG routinely uses the surrogates and internal standards specified in SW-846 for organic analyses. If CLP or SW-846 protocols are requested, QC samples are run to conform to their specifications. Data for QC samples are included in reports to customers.

Data for spiked samples and standard reference materials are used to determine laboratory accuracy. Data for duplicate sample analyses are used to determine precision. These data are also used to generate control charts.

The ALG has its own reporting format that was primarily designed to satisfy our research customers; however forms such as those contained in the CLP protocol may be supplied upon request

17. Data Evaluation

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

1. Completeness
2. Duplicate values for precision
3. Recovery of Spikes for accuracy
4. Method blanks for contamination

5. Surrogate recoveries for organic analysis

6. Data for QA check samples (EPA, ERA or NBS SRMS)

7. Reasonableness and trends

If data falls outside acceptable limits as described in the procedures, samples are rerun if sample is available. If data falls outside acceptable limits on the reruns and QA check sample data is good, then data may be reported with qualifying explanations. Acceptable data is usually defined by the procedures (i.e. SW-846, CLP, 600 methods, 500 methods).

18. Control Charts

All inorganic parameters routinely analyzed are charted. A minimum of 20 points is required for limit calculations. Precision control charts are prepared from the duplicate analysis data and accuracy charts are prepared from matrix spikes. Charts are also prepared utilizing blank spike data and using SRMs and external QA samples. Control charts for organics are limited to the CLP spiked compounds and surrogates. PCB-1248 is usually the spiking compound for PCB analysis. Procedures for preparing control charts are described in reference 2e.

19. Corrective Actions

During the performance of work under any laboratory task, out of control conditions may occur which call for corrective action. Typically QC parameters given in the various methods are employed to determine the need for action. The type of action required is documented, although documentation may only require appropriate instrument and/or laboratory logbook entries, as

opposed to a formal corrective action memo. A corrective action form (form 7) is also used to document actions that are taken.

Corrective actions may also include procedural matters related to internal custody of samples, sample log-in, sample data processing and so forth. These are usually provided via inhouse memo from the Chief, ALG or the Quality Control officer.

As necessary, modifications to inhouse procedures, equipment, standards, policy and so forth may be needed to rectify recurring or otherwise significant laboratory problems. These are usually resolved via group meetings where a course of action is decided upon and a time for correction is defined.

When significant changes are made the QA manual will be updated to reflect the changes.

20. Data Reduction

Data reduction is shown in the following flow chart (Figure 4). It is the responsibility of the analyst to conduct initial data reduction. The readings from the instruments or analytical system are calculated into appropriate concentration units for the results. Rounding occurs only after calculations are complete. The calculations are normally performed on the raw data sheets. The results are then transcribed on to the computer generated data files.

ALG QUALITY ASSURANCE CORRECTIVE ACTION FORM

ANALYSIS: _____ DATE: _____

ANALYST: _____ INSTRUMENT: _____

PROBLEM: _____

_____

_____

_____

SAMPLE NUMBER(S) AFFECTED: _____

_____

_____

_____

RECOMMENDED CORRECTIVE ACTION: _____

_____

_____

_____

CORRECTIVE ACTION TAKEN BY ANALYST: _____

_____

_____

_____

COMMENTS: _____

_____

_____

_____

_____

DATE CORRECTIVE ACTION TAKEN: _____

REVIEWED BY: _____

FORM 7

Form 7

DATA REDUCTION ANALYSIS FLOW CHART

LABORATORY DATA MANAGEMENT SYSTEM
(Bench Sheets)

↓

ANALYSIS OF SAMPLES

↓

ANALYST'S NOTEBOOK

↓

RAW DATA TO BENCH SHEETS

↓

TEAM LEADER

↓

LABORATORY DATA MANAGEMENT SYSTEM ⇄ QC CHECK

↓

CHIEF, ANALYTICAL LABORATORY GROUP

↓

LABORATORY DATA MANAGEMENT SYSTEM

↓

FINAL REPORT
(Initialed by C/ALG)

Figure 4

The next step in data reduction is data review by the team leader. Data is checked for validity and completeness. Questionable data is brought to the attention of the analyst and corrective action is taken if necessary.

Data is then forwarded to the sample management officer for entry into the Laboratory Data Management system. Data entry is checked by the team leader, corrections are made, and the report is then sent to the quality assurance officer and the Chief, Analytical Lab Group for review. Any corrections are made and final report is generated that has been initialed by the Chief, ALG. All raw data is filed.

21. Data Outliers

Sample data that falls outside acceptable limits are reanalyzed if possible. If sample is not available to rerun the sample, data are reported with qualifying statements and with external QA data to support the results, assuring that the analytical system was in control. Method blanks are analyzed with each set of samples and reported with the sample data. Organic method blanks are spiked with surrogates.

22. Agency Approvals and Internal Audits

As the primary research and development facility for Corps environmental research, the ALG has not solicited formal approval from other agencies or states, although the ALG has conducted numerous research projects for the Environmental Protection Agency, the Navy, the Coast Guard, the Air Force, and other Army branches. The ALG is a validated Quality Assurance Laboratory

for the Corps Superfund and DERP projects as well as for NEESA 20.2 projects.

Internal Audits

Several methods of internal audits are used including worksheet review, on-site analyst review, intra- and interlaboratory sample examination. Presently the ALG participates in the Corps of Engineers Interlaboratory Testing Program and subscribes bi-monthly to the Environmental Research Associates Quality Control Sample program. In addition the QA officer submits EPA, NRC or NIST quality assurance samples to the laboratory for internal review of the measurement process. System audits are conducted semi-annually to evaluate sample handling, sample analysis, record control, proficiency testing, personal practices, training, workload, and manpower needs.

23. Document Control

The sample management officer is also in charge of document control. She maintains the master logbook, the computer logbook, the computer-generated bench sheets, the completed computer generated bench sheets and the final computer generated reports. Each analyst maintains the raw data files from his/her instruments. The document flow is outlined in the Data Reduction Analysis Flow Chart. Final Data reports are approved by the team leader, the quality assurance officer and the Chief, ALG.

24. QA Reports

QA reports are tailored to customer request. QA reports for DERP projects where WES ALG serves as the QA lab utilize the following outline.

A. Cover letter

B. Report Narrative

1. Summary

2. QC data discussion

3. QA/QC data comparison

4. Other Problems

5. Corrective Actions

C. Data comparison tables

25. Supervisory Control

Behind every good analytical laboratory is a good supervisor who maintains a continuing interest in the quality of data produced. A QA program provides the management mechanism to document precision, accuracy, completeness, and comparability of data. In this regard, the Quality Assurance Office will check on a weekly basis to review analytical laboratory operations and QC with analysts. Management is provided with a status report on a regular basis.

26. Contractor Laboratories

Quality Assurance for contractor laboratories begins with and is most directly controlled in the procurement process. If the contracting officer and project officer fail to procure high quality sampling and analytical services, the project is subject

to inferior data from the beginning. For this reason, all contracts, grants, and interagency agreements (IAG's) developed by EL primarily for the purpose of measuring chemical components in water and wastewater shall be subject to the following QA requirements:

a. All requests for proposals (RFP's) grant and IAG application shall include a separate clause dealing with QA requirements.

b. As part of the selection process, technical evaluation criteria shall be applied to the proposed contractor QA program and the percentage of effort to be devoted to QA activities shall be specifically stated.

The QA section of the Technical proposal shall address the following items:

(1) Goal of the QA program.

(2) Organization and responsibility of the QA program.

(3) Sample collection procedures including site selection, site information requirements, frequency, sample handling and preservation, chain of custody, and field analyses.

(4) Facilities, personnel, and equipment.

(5) Calibration procedures--standards and verification.

(6) Analytical procedures.

(7) Internal and external QC practices.

(8) Data handling and reporting.

(9) Documentation of QA practices.

(10) Percentage effort devoted to QA (cost and time).

c. Before selection and award of a contract, and at the option of WES, bidders may be required to show:

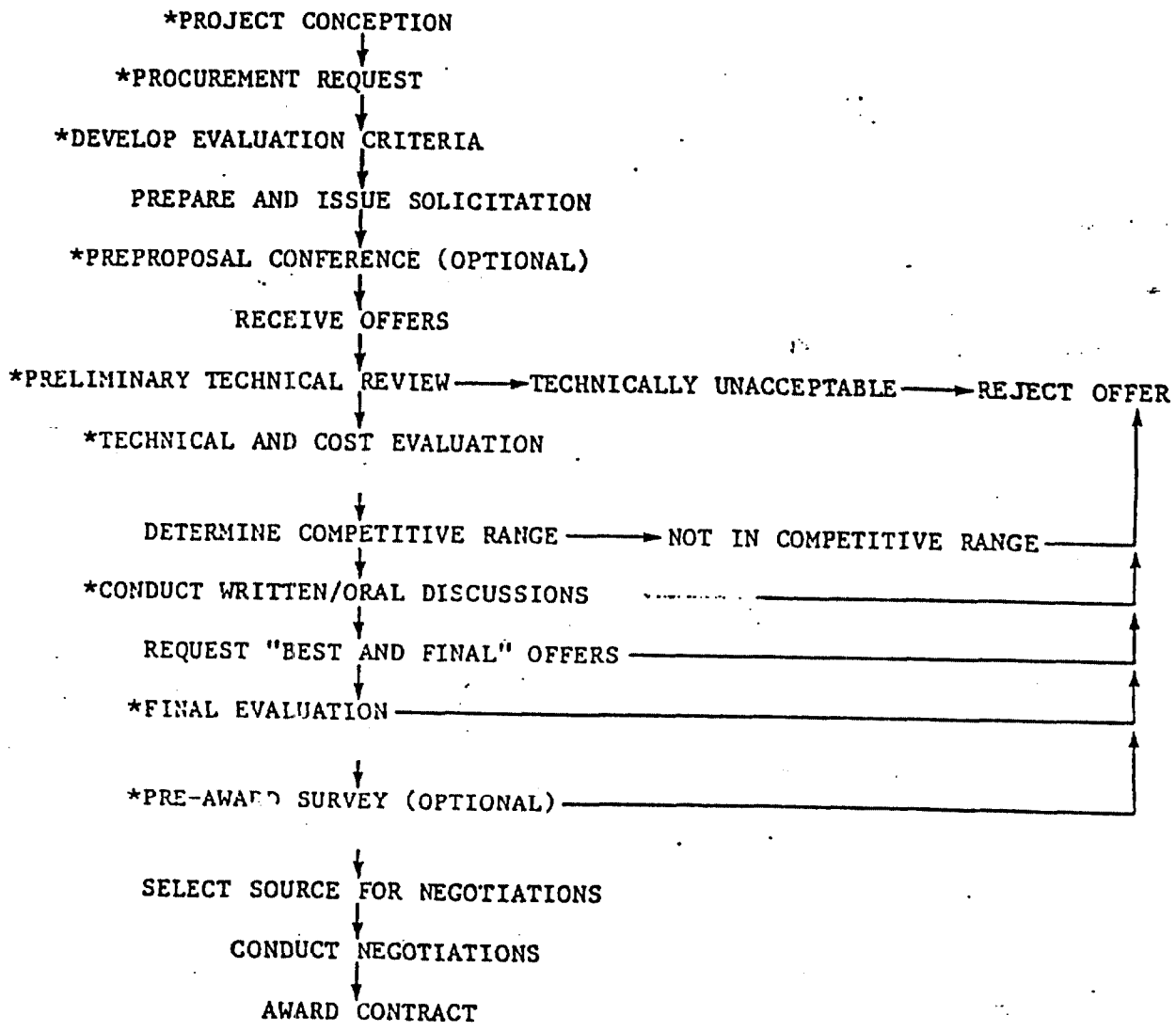
   (1) Acceptable performance on audit samples.

   (2) By on-site evaluation (laboratory inspection by WES) that manpower, equipment, and supplies necessary for completion of the project are available.

d. EL may also require that a specified number of number samples be analyzed by both the Contractor and EL.

Figure 5 shows the sequence of events in awarding a contract and the areas where quality assurance should be injected. It is the responsibility of the WES project officer to see that QA requirements which are a part of the contract, grant, or IAG are met during the course of the monitoring project. Prior to contract awards the EL QA officer should be available to provide technical advice to the project officer and should work with him in the initial development of the contract, grant, or IAG. The QA program developed by the contract, grant, or IAG must be coordinated with the EL QA officer before award.

If the contractor laboratory performs water quality analyses for projects generated by the Districts, an inspection is required prior to initiation of testing and at least every two years thereafter (Reference 2b). If the contractor laboratory is performing analyses for DERP or Superfund projects, the requirements in reference 2c must be met.

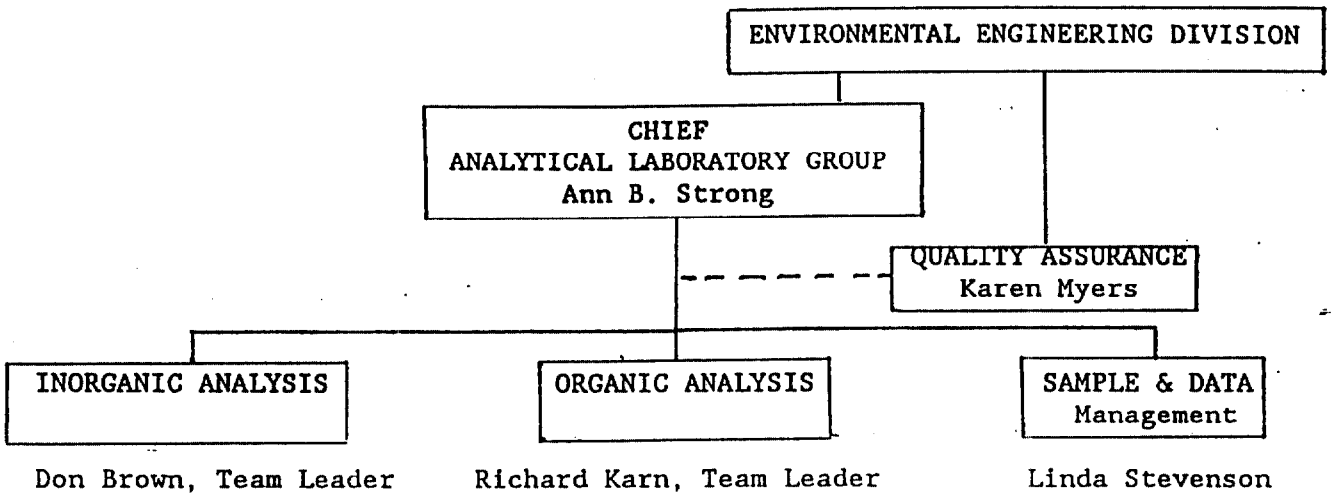


*QA considerations are important at these points in the process.

Figure 5. Processing sequence for contract source evaluation and selection

Appendix A

Resumés of ALG Personnel



DUTIES

Ann B. Strong, GM 13, Supervisory Chemist supervises overall activities of the ALG, including final check of all data prior to submission to customer.

Richard Karn, GS-12, Chemist has oversight for all organic analysis and is GC/MS expert.

Don Brown, GS-11, Chemist schedules all inorganic analysis and is an experienced analyst using the autoanalyzer, the DCP, the ICAP and the GFAA.

Donald Rathburn, GS-12, Research Chemist, Experienced in all phases of Analytical Chemistry including Mass Spectroscopy and AA.

Linda Stevenson, GS-7, Physical Science Technician is responsible for sample and data management keeping track of all samples received, computer entry and tracking of all samples, fiscal reports, data reports.

Newberry Brown, GS-11, Chemist is primary gas chromatograph operator.

Glennard Warren, GS-11, Chemist is GFAA operator and also performs autoanalyzer analyses using Technicons and Lachat.

Karen Myers, GS-11, Biologist is experienced in operation of DCP, GC, and HPLC and serves as QA officer.

Agnes Morrow, GS-11, Chemist is experienced in organic extractions and GC operation; also performs IR analyses.

Robert Jones, Jr., GS-09, Chemist is experienced in organic extractions, FT-IR operation, and ion chromatography.

Jeffretha Christian, GS-06, Physical Science Technician performs mercury and TOC analyses under Don Brown's oversight.

Willar Tyler, IPA Chemist for 9 years, performs digestions, auto-analyzer analyses, and other wet chemistry analyses.

Allyson Lynch, Contract Analyst, is experienced in performing organic extractions.

Ann Halpenny/Weathersby, Contract Chemist, is currently receiving on-the-job training in organic extraction.

Charles White, GS-12, Chemist, is experienced in running metals and other inorganic analysis.

PROFESSIONAL RESUME'

STRONG, ANN B., SUPERVISORY RESEARCH CHEMIST

EDUCATION

B.S. - Chemistry, Mississippi College
University of Florida Graduate School

PROFESSIONAL EXPERIENCE

1981 - Present	Chief, Analytical Laboratory Group, GM-13 USAE Waterways Experiment Station
1980 - 1981	Supervisory Chemist, GS-12 USAE Waterways Experiment Station
1979 - 1980	Physical Scientist, GS-12 USAE Waterways Experiment Station
1976 - 1979	Chief, Monitoring and Analytical Services, GS-13, USEPA - Eastern Environmental Radiation Facility
1971 - 1976	Chief, Analytical Services, GS-12 USEPA - Eastern Environmental Radiation Facility
1970 - 1971	Supervisor, Environmental Analysis Unit, GS-11. USEPA - Eastern Environmental Research Facility
1966 - 1970	Supervisor, Milk Section, GS-09 USPHA - Southeastern Radiological Health Lab
1962 - 1966	Chemist, GS-07 USPHS - Southern Radiological Health Lab

Major Projects

Project Officer for EPA's Environmental Radiation Ambient Monitoring System (EPA's nationwide monitoring program for radiation.

Supervised the EPA-ORP Analytical Laboratory, including radiochemical laboratory functions and radiation counting facilities.

Consultant for radioanalytical procedures adopted for compliance with the Safe Drinking Water Act and the Resource Conservation and Recovery Act.

Provided analytical data to be used in setting radiation standards for the Clean Air Act.

Developed procedures for determining stable elements in environmental samples by flame atomization techniques.

Project Officer for determining radionuclides in human bone.

Supervised the development work for improving radiochemical procedures for plutonium, uranium, and thorium resulting in increased productivity and accuracy.

Developed procedures for determining stable strontium in milt, food and total diet.

Prepared quality assurance program for water and wastewater analysis for Environmental Laboratory, USAE/WES.

Prepared basic quality assurance program for Lower Mississippi Valley Division-Corps of Engineers.

Served as Acting Chief, Analytical Laboratory Group, December 1980 through June 1981.

Chief, Analytical Laboratory Group, 1981 - present. Supervised the chemical analysis of all samples for the Environmental Laboratory. Manages the CE audit sample program for Superfund and DERP programs. Manages the CE interlaboratory testing program.

MEMBERSHIPS

Association of Official Analytical Chemists, Chairman of Committee on Environmental Quality and Member of Official Methods Board.
ASTM, D-19 Committee
Water Pollution Control Federation
International Radiation Protection Association
Health Physics Society
Alabama Chapter of Health Physics (secretary--two terms)
National Subcommittee on Detection of Changes in Environmental Levels
Phi Theta Kappa Honor Society
National Committee to review and revise National Interim Primary Drinking Water Regulations

AWARDS

Who's Who in the South and Southwest - 1979
Who's Who in the South and Southwest - 1980
Who's Who in Technology Today - 1980
Who's Who in Technology Today - 1984
Significant Accomplishments Award - 1982
Significant Accomplishments Award - 1983
Significant Accomplishments Award - 1984
Exceptional Performance Award - 1987

PUBLICATIONS

Strong, Ann B., Porter, Charles R., Carter, Melvin W., and Wilson, Edward F. "Localization of Fallout in United States from May 1966 Chinese Nuclear Test," Public Health Reports, Vol 82, No. 6, June 1967.

Strong, Ann B., Rehnberg, Georgia L., and Moss, Ursula R. "Determination of Strontium in Environmental Media," Talanta, Vol 15, No. 1, 1968.

Rehnberg, Georgia L., Strong, Ann B., Porter, Charles R., and Carter, Melvin W. "Levels of Stable Strontium in Milk and Total Diet", Environmental Science and Technology, Vol 3, No. 2, February, 1969.

Butler, F. E., Lieberman, R., Strong, A. B., Moss, U. R. "Sampling and Analysis of Soils for Plutonium," Proceedings of the Environmental Plutonium Symposium, Los Alamos, NM, August 4-5, 1971.

Strong, Ann B., Porter, Charles R., Kahn, B. "Stable Strontium: Calcium Ratios in U.S. Bone and Total Diet Samples, "Second International Conference on Strontium Metabolism, USAEC Series CONF 720818, Glasgow Strontian, Great Britain, August 16-19, 1972.

Strong, Ann B. and Brooks, Imogene B. "Tritium in Surface Waters Affected Nuclear Facilities," Proceedings of the International Conference on Radiation Effects and Tritium Technology for Fusion Reactors, 3 Volumes, October 1-5, 1975, Gatlinburg, TN.

Strong, Ann B., Smith, J. Michael, and Johnson, Raymond H., Jr. "EPA Assessment of Fallout in the United States from Atmospheric Nuclear Testing on September 26 and November 17, 1976, by the People's Republic of China," EPA 520/5-77-002, August, 1977.

Smith, J. Michael, Broadway, Jon A., and Strong, Ann B. "United States Population Dose Estimates of Iodine-131 in the Thyroid After the Chinese Atmospheric Nuclear Weapons Tests," Science, Vol 200, April 7, 1978.

Blanchard, R. L. Strong, A. B., Lieberman, R., and Porter, C. R. "The Eastern Environmental Radiation Facility's Participation in Interlaboratory Comparisons of Environmental Sample Analyses," ORP/EERF-79-2, March, 1979.

Broadway, J. A. and Strong, A. B. "Population Dose and Health Impact Estimates Calculated from Radionuclides in Human Bone," Submitted to Science for publication.

Broadway, J. A. and Strong, A. B. "Radionuclides in Human Bone (1972-1975) with Estimates of Population Dose and Health Impact. Health Physics, Vol 45, September, 1983.

Strong, Ann B. "Radiological Procedures for Environmental Samples," USEPA Technical Report (to be published).

Eicholz, G. G., Desrosiers, A. E., Kahn, B., Strong, A., Wakamo, C. L., Winkie, W. H., and Williams, E. F. "Detection of Changes in Environmental Levels Due to Nuclear Power Plants," Upgrading Environmental Radiation Data, EPA 520/1-80-012, August 1980.

Strong, Ann B. "Laboratory Analyses." Proceedings of a seminar on Attaining Water Quality Goals Through Water Management Procedures. 17-18 February, 1982.

Lutton, R. J., Butler, D. K.; Meade, R. J.; Patrick, D. M.; Strong, A. B.; and Taylor, H. M.; "Tests for Evaluating Sites for Disposal of Low -Level Radioactive Waste", NUREG/CR 3038 Prepared Laboratory, US Army Engineer Waterways Experiment Station, Vicksburg, MS 39180 December 1982.

Lutton, R. J., Strohm, W. E.,; and Strong, A. B.; "Subsurface Monitoring Programs at Sites for Disposal of Low-Level Radioactive Waste" NUREG/CR-3164, Prepared for US Nuclear Regulatory Commission by Geotechnical Laboratory, US Army Engineer Waterways Experiment Station, Vicksburg, MS 39180 April 1983.

Strong, Ann B. "Laboratory Inspections for Quality Assurance/Quality Control." Proceedings of a seminar on Water Quality, R&D: Successful Bridging Between Theory and Applications. 25-27 February, 1986.

Strong, Ann B.; Myers, Karen; and Warren, Glennard; "Proceedings of the Fifth Corps Chemists Meeting 15-16 May 1988" MP El 89-2, Environmental Laboratory, US Army Engineer Waterways Experiment Station, Vicksburg, MS 39180.

Karn, Richard A. and Strong, Ann B.; "Quality Assurance Guidelines for Organic Analysis", TR EL 89-18, December 1989.

Strong, Ann B. and Morrow, Agnes; "Proceedings of Sixth Corps Chemists Meeting 16-17 May 1989" MP EL-90-14. September 1990.

Strong, Ann B. and Anderson, Rita; "Mercury Analysis to Meet Water Quality Criteria", WOTS Bulletin, October 1990.

Strong, Ann B. "Proceedings of Seventh Corps Chemists Meeting 22-24 May 1990, TR W-91-1 July 1991

PRESENTATIONS

"Evaluation of Rapid Field Method for the Collection of Radionuclides from Milk," presented at the Annual Meeting of the Health Physics Society, Chicago, IL, June 28-July 2, 1970.

"Radiological Surveillance Around a Nuclear Power Barge in a Fresh Water Lake," presented at the annual meeting of the Health Physics Society, Las Vegas, NV, June 12-16, 1972.

"Environmental Radiation Ambient Monitoring System," presented at EPA Symposium, Las Vegas, Nevada, February, 1973.

"Off-Site Plutonium Surveillance in the Cape Kennedy Environs," presented at the annual meeting of the Health Physics Society, June 12-16, 1972.

"Tritium in Surface Waters Affected by Nuclear Facilities," presented at the International Conference on Radiation Effects and Tritium Technology for Fusion Reactors, October 1-5, 1975, Gatlinburg, TN.

"The Distribution of Fallout in the United States from the Chinese Nuclear Tests of September 26 and November 17, 1976, as observed by the ERAMS," presented at the annual meeting of the Health Physics Society, July 3-8, 1977, Atlanta, GA.

"Environmental Laws and Regulations," Corps Chemists Meeting, Portland, Oregon, May 1990.

"Quality Assurance for Sediment Analyses," Water Quality Seminar, Las Vegas, NV. February 1990

TRAINING AND CONFERENCES

Water Quality Seminars, Dallas, TX - 1982
Superfund IPR, Washington, DC - 1982
QA for Superfund Conference, Washington, DC - 1982
Division Lab Conference, Atlanta, GA - 1983
Quality Assurance for the Analytical Laboratory NBS - 1984
Interagency Workshop and QA for Marine Pollution Measurements, NBS
- 1984
Corps Chemists Seminar, NED - 1985
Pittsburgh Conference, New Orleans - 1985
Superfund - DERP Conference, Omaha - 1985
CLP Conference, EPA-Las Vegas, NV - 1985

Chemical and Biological Characterization of Sludge and Sediment EPA,
Cincinnati - 1986
Water Quality Seminar, New Orleans - 1986
Chemical Quality Management Seminar for Superfund & DERA, Battelle
- 1986
Division Laboratory Conference, San Francisco - 1987
Water Quality Seminar, Charleston, S.C. - 1988
Corps Chemists Meeting, WES - 1988
Annual Meeting of the Association of Official Analytical Chemists, Palm Beach, FL - 1988
Interagency Workgroup on Marine and Estuarine Sampling and Analytical Protocols, Washington, D. C. - 1988
Hazardous Waste Worker Training Program April 1989
Corps Chemists Meeting, WES - 1989
Quality Assurance in Environmental Measurements Symposium Las Vegas, NV May 1989
Nuclear Radiation Safety (LSU) WES - June 1989
Water Quality Seminar, Las Vegas, NV - February 1990
Authorities, Responsibilities, and Procedures for Testing Sediments, WES, March 1990
Corps Chemists Meeting, Portland, OR May 1990
Annual Meeting of the AOAC, New Orleans, LA September 1990
Fourth Annual Interagency Meeting on Quality Assurance for Environmental Measurements, Jackson, WY, September 1990.
Annual Meeting of the AOAC, Phoenix, AZ, August 1990
Fifth Annual Interagency Meeting on Quality Assurance for Environmental Measurements, Richmond, VA, September 1991

PROFESSIONAL RESUME'

Karn, Richard A., Research Chemist

Education

B.S. Chemistry, New Mexico Institute of Mining and Technology, 1968.

M.S. Organic Chemistry, University of Colorado, 1973.

Professional Experience

1979 - Present	Research Chemist, Analytical Laboratory Group, WES. Specialty: GC/MS, Environmental samples, organic Team Leader
1975 - 1979	Chemist, Rocky Mountain Arsenal, Specialty: GC/MS, Development of procedures for organo-phosphorus compounds
1974 - 1975	Dugway Proving Ground Analytical testing for nerve gases
1973 - 1974	Dow Corning Corp. Process development; identification and removal of trace impurities in silicon chemical production

Major Projects

GC/MS Analyses for contaminated harbor studies - Black Rock, Indiana, and New Bedford

Investigation of TCLP procedures for volatile organics

Investigation of Organic Compounds from Rocky Mountain Arsenal

GC/MS analyses for solidification stabilization projects

Acquisition of MS/MS system with Thermobeam interface to LC and interface to GC.

Training

Basic Gas Chromatography, Hewlett Packard, 1976.

Gas Chromatography trouble-shooting, Hewlett Packard, 1976.

Basic Skills in Statistics, Denver Regional Training Center, 1978.

HP 5980 Series GC/MS Operations and Maintenance, 1978.

Class Capillary and Priority Pollutants in Water, Hewlett Packard, 1979.

HP 5985 Mass Spec Operators Course, Hewlett Packard, 1980.

Modern Mass Spectrometry, Hewlett Packard, 1982.

Analysis of Priority Pollutants by GC/MS/DS, Hewlett Packard, 1980.

Advances in Analytical Methods for Monitoring Organic Chemicals in the Environment, EPA, 1984.

Wetland and Upland Plant and Animal Bioassay, 1985.

Hazardous Waste Worker Training Program, May, 1989.

Aquarius, Hewlett-Packard, Atlanta, GA June 1989.

Awards

Sustained Superior Performance, 1982.
Special Service, 1982.
Sustained Superior Performance, 1984.
Special Service, 1985.
Sustained Superior Performance, 1987.
Sustained Superior Performance, 1988.
Sustained Superior Performance, 1990.
Outstanding Performance, 1991.

Publication

"An Improved Cyclization Procedure for Chloropropylchlorosilance: Efficient Synthesis of Silacyclobutanes"

"Unexpected Low Reactivity for Spirosilanes; 4-Silaspiro (3,3) heptane"

"Electrophilic and Nucleophilic Reactivity of 4-Silaspiro (3,3) Heptane and r-Silaspiro (3,5) Nonane"

"Toxic Metal Removal Using Silyated Silica Gel"

"Effects of Cleanup Procedures on Measured PCB Concentrations In Chicago River Sediment", 1988

"Quality Assurance Guidelines for Organic Chemical Analysis" 1989

Presentations

Corps Chemists Meeting, Boston, MA 1986
Corps Chemists Meeting, Cincinnati, OH 1987
Corps Chemists Meeting, WES, 1988

Corps Chemists Meeting, Portland, OR 1990

PROFESSIONAL RESUME'

STEVENSON, Linda K.

Education

Course work at Hinds Jr. College, Vicksburg Branch to be applied to an Associate of Arts Degree in Applied Science. Physical Geology, Elementary Algebra, Intermediate Algebra, Introduction to Computer Programming, Physical Science Survey I, Introduction to Microcomputers and BASIC, Advanced BASIC Programming, Data Base Management, and Computer Programming-PASCAL 1.

Experience

May, 1976 - March, 1983	Secretary, Environmental Laboratory, WES
April, 1983 - Present	Physical Science Aid/Technician, Analytical Laboratory Group, WES

Major Duties

Responsible for data management in the ALG, logs samples into laboratory, prepares computer data work sheets, keeps sample backlog current, maintains fiscal records, prepares final data reports, performs moisture, solids, and volatiles analyses and performs extractions for Organic analysis.

Awards

Outstanding Performance 1986
Outstanding Performance 1988
Outstanding Performance 1990
Vogel Award for Outstanding Technician 1990

PROFESSIONAL RESUME'

MYERS, Karen L., Biologist

Education

B. S. Microbiology, University of Southern Mississippi, 1973.

One semester Graduate School, University Southern Mississippi.

Professional Experience

1982 - Present	Biologist, Analytical Laboratory Group, WES. Specialty: DC argon Plasma Emission Spectroscopy, Gas chromatography High Performance Liquid Chromatography

Major Projects

Black Rock Field Verification Study
Naval Weapons Station Study
New Bedford Harbor
Yazoo Basin
Crane Naval Station

Training

Micro-computer Methods, Mississippi State University, WES Center, 1983.

Introduction to Data Processing, Hinds Jr. College, Vicksburg Branch, 1983.

FORTRAN Programming and Applications, Hinds Jr. College, Vicksburg Branch, 1983.

Calculus II, Hinds Jr. College, Vicksburg Branch, 1984.

Calculus III, Hinds Jr. College, Vicksburg Branch, 1984.

Calculus IV, Hinds Jr. College, Vicksburg Branch, 1984.

BASIC Programming, Hinds Jr. College, Vicksburg Branch, 1984.

Differential Equations, Hinds Jr. College, Vicksburg Branch, 1985.

Advanced Momentum, Heat, and Mass Transfer, Mississippi State University Grad Center, Vicksburg, 1985.

Introduction to Partial Differential Equations, Jackson Engineers Grad Program 1985.

Engineering Mechanics, Hinds Community College, 1986.

Organizing and Writing Professional and Technical Communications, M. D. Morris, P.E., WES, 1987.

Awards

Outstanding Performance, 1987
Member of Phi Kappa Phi
Outstanding Performance, 1990
Exceptional Performance, Quality Step Increase 1991

PROFESSIONAL RESUME'

BROWN, B. Newberry, Chemist

Education

B.S. Delta State College, 1951
M.S. ED (Chemistry) Mississippi State University, 1965

Professional Experience

January, 1984 to Present	Chemist, Analytical Laboratory Group, WES. Specialty: Gas Chromatography
January, 1980 to December, 1984	Instructor, Wood Jr. College. Taught Freshman College Chemistry, Physics and Physical Science
December, 1976 to January, 1980	Chemist, Analytical Laboratory Group. WES. Specialty: Metals Analysis
August, 1963 to December, 1976	Instructor, Wood Jr. College. Taught Freshman College Chemistry, Physics, and Algebra
August, 1962 to August, 1963	High School Science teacher.
September, 1953 to	Instrument mechanic for Mississippi
August, 1962	Power & Light Co.
October, 1950 to October, 1953	Science teacher.

Major Projects

PCB analyses by Gas Chromatograph for such projects as Black Rock Harbor, Indiana Harbor, and New Bedford Harbor. Developed procedures for congener analysis.

Pesticide and herbicide analyses for various water quality projects.

PAH analysis by GAS Chromatograph.

Recent Training

Statistical Methods, Northeast Louisiana University, Tallulah Branch, 1985.

Application Oriented Basic Programming for HP 5880/3388, Hewlett Packard, 1985.

Advanced BASIC Programming, Hinds Jr. College, Vicksburg Branch, 1987.

Laboratory Applications of LOTUS 1, 2, 3 and other software, American Chemical Society, Denver, Co., 1987.

Computer Programming, PASCAL 1, Hinds Community College Vicksburg Branch, 1988.

Awards

Sustained Superior Performance, 1985.

PROFESSIONAL RESUME'

BROWN, Donald R., Chemist

Education

B.S. Chemistry, University of Kentucky, 1973.

Professional Experience

1973 to Present	Chemist, Analytical Laboratory Group, WES. Specialty: Inorganic Analysis including Nutrients, Metals, TOC, Phenols, Cyanides, etc. Skilled in operation of Auto-analyzer, Atomic Absorption Spectrometer, DC Plasma, Inductively Coupled Argon Plasma, UV-VIS and computer applications

Training

Micro-processing Fundamentals, New Orleans, LA, 1978.

Maintenance of Zeeman AA, Berkeley, CA, 1978.

Electronics for Chemists, Philadelphia, PA, 1978.

Hazardous Chemical Safety School, 1978.

Chemical Systems Information Network, NTIS Workshop, 1983.

Statistical Methods, Northeast Louisiana University, Tallulah Branch, 1985.

Environmental Analysis - Priority Pollutants ACS Short Course, Pittsburgh Conference, 1986.

Elementary Statistics and Probability, Mississippi College, 1986.

Statistical Data Analysis, Mississippi College, 1987.

Transportation of Hazardous Materials, U.S. Dept. of Transportation, WES, 1988.

Computer Programming, PASCAL 1. Hinds Community College, 1988.

Nuclear Radiation Safety (LSU) WES, June 1989.

Introduction to File Structures, Miss. State University, 1990.

Memberships

American Chemical Society

Awards

Sustained Superior Performance, 1986.

Outstanding Performance, 1988.

Outstanding Performance, 1989.

Outstanding Performance, 1990.

PROFESSIONAL RESUME'

JONES, Robert P., Jr.

Education

B.S. Chemistry, Milsaps College, GPA 3.9/4.0, 1986

University of Mississippi Medical School, Completed 2 years

Career-related Experience

December 1989 to present Chemist, Analytical Laboratory Group, WES. Performs distillations, extractions, etc. for organic prep analysis. Performs TRPH analysis by FT-IR and performs ion-chromatography analyses.

Forensic Toxicologist, MS. Crime Lab, Dec. 1986-July 1987, May 1988-Aug 1988, May 1989-Aug 1989. Experience in gas chromatography, fluorescence polarization immunoassay and thin-layer chromatography.

Activities

Phi Theta Kappa Honorary Fraternity

PROFESSIONAL RESUME'

MORROW, Agnes B.

Education

B.S. Chemistry, Alcorn State University, 1985

Experience

July, 1986 - Present	Chemist, Analytical Laboratory Group, WES. Performs distillations, extractions, etc. for organic prep for GC and GC/MS analyses. Performs oil and grease analyses. Runs GC for pesticide and herbicide analysis.

Committee

Alcorn State University Committee

Training

"Fundamentals of Gas Chromatography", Hewlett-Packard, New Orleans, LA - 1988

"Logical Troubleshooting for Gas Chromatography", Hewlett-Packard New Orleans, LA - 1988

"Computer Programming, Pascal", Hinds Community College, Vicksburg, MS - 1988

"Capillary Gas Chromatography", Hewlett Packard, New Orleans, LA - 1989

"Basic Computer Programming", Hinds Community College, Vicksburg, MS - 1989

Performance and Honors

Performance Award - 1990
Performance Award - 1991

PROFESSIONAL RESUME'

RATHBURN, Donald R., Research Chemist

Education

B.A., Natural Science, Park College, 1958
M.S., Chemistry, Kansas State University, 1962
Ph.D., Chemistry, Kansas State University, 1969

Experience

1990 - Present	Research Chemist, Analytical Laboratory Group, WES. Specialty, Mass Spectroscopy and Zeeman Furnace AA.
1983 - 1990	Chemist, U.S. Air Force, Wiesbaden, Germany
1978 - 1983	Research Chemist, Organic team leader, Analytical Laboratory Group, WES
1977 - 1978	Acting Chief, Analytical Laboratory Group, WES
1973 - 1974	Vicksburg Chemical Co., Analytical Chemist and head of Quality Control; Vice-pres. of Prairie Metals (a subsidiary of Vicksburg Chemical)
1972 - 1973	NIH Special Research Fellow, Kansas State Univ. 1965 - 1972 Assistant Professor, Midwestern University.

Professional Organizations

American Chemical Society
American Association for the Advancement of Science
Texas Academy of College Teachers
American Association of University Professors
Alpha Chi Sigma Chemical Fraternity
Beta Beta Beta Biological Honor Fraternity

Other Activities

Abstractor for Chemical Abstracts
Personalities of the South, 1971
American Men of Science, 1972
Contributor to Sadtler Indices
Soccer Coach
Sponsor, ACS Affiliates
Sponsor, Chess Club
Soccer Referee
Scouting
Little Theater

Publications

Ph.D. Dissertation: "Pressure and Radiant Energy Effects in the Bombardment of Solid Propane with Hydrogen Atoms," Kansas State University, 1969. Research Director: Dr. Herb C. Moser.

M.S. Thesis: "An Investigation of the Pile Neutron Irradiation of Tetramethylammonium Chloride," Kansas State University, 1962. Research Director: Dr. Robert W. Kiser.

D. Netzel, C. Stanley, and D. Rathburn: "A Neutron Activation Method for Soil Removal Measurements: A Comparison of the Reflectance Method and the Neutron Activation Method," The Journal of the American Oil Chemists' Society, 41, 678(1964).

D. W. Rathburn: "Carbon-14 Containing Compounds Produced by the Pile Neutron Irradiation of Tetramethylammonium Chloride," The Texas Journal of Science, 23, 201(1971).

Edwin Weigand and D. W. Rathburn: "Polyphosphoric Acid Cyclization of Acetamidoketones to 2,5-Dimethyl-1,3-oxazoles," Synthesis, 1, 648-9(1970).

S. E. Fredrickson, Jr., and D. W. Rathburn: "Ion-molecule Reactions is Geiger-Mueller Discharges," Appl. Sci. Res., 24, 209(1971).

D. W. Rathburn, Kenneth Knarr, and H. C. Moser: "Pressure Effects in Hydrogen Reactions with Frozen Propene," Trans. Faraday Soc., 67, 2333(1971).

James R. Goetz and D. W. Rathburn: "Hydrolysis of 2-Methylbenzoxazole to 2-Hydroxyacetanilide," The Texas Journal of Science, 24, 261(1972).

Dennis Deavenport, C. H. Harrison, and D. W. Rathburn: "NMR Spectroscopy of Substituted Oxazoles and 4-Oxazolidinones," Accepted for publication by Organic Magnetic Resonance.

Edwin E. Weigand and Donald W. Rathburn: "Synthesis of Some Propionamidoketones and 2,5-Diethyl-1,3-oxazolos," Accepted for publication by Journal of Chemical and Engineering Data.

Papers in Preparation

D. W. Rathburn and H. C. Moser: "Hydrogen Atom Recombination in the Hydrogen Atom Bombardment of Propane Films at 77°K."

Jimmy W. Hosch, Beverly Mechock, Dennis Deavenport and D. W. Rathburn: "The Structure of Oxazole-Mercury Compounds."

Papers

D. W. Rathburn: "The Neutron Irradiation of Tetramethylammonium Chloride." Presented at the Kansas Academy of Science Meeting, Spring, 1961.

D. Netzel, C. Stanley and D. Rathburn: "A Neutron Activation Method for Soil Removal Measurement." Presented at the American Oil Chemists' Society Meeting, Fall, 1963.

Daniel A. Netzel, Charles W. Stanley and Donald W. Rathburn: Absolute Soil Removal Determination by Neutron Activation Analysis." Presented at Midwest Regional ACS Meeting, Fall, 1963.

D. W. Rathburn and R. W. Kiser: "The Ammonia Counter." Presented at the Kansas Academy of Science Meeting, Spring, 1965.

C. H. Harrison and D. W. Rathburn: "Synthesis and Properties of Oxazoles." Presented at the Texas Academy of Science, Spring, 1967.

Dennis Deavenport and D. W. Rathburn: "NMR Spectroscopy of Substituted Oxazoles and 4-Oxazolidinones." Presented at the Texas Academy of Science, March 15, 1968.

Dennis Deavenport and D. W. Rathburn: "Nuclear Magnetic Resonance Spectra Substituted Oxazoles and 4-Oxazolidinones." Presented at the ACS Meeting in Miniature, April 20, 1968.

Jimmy W. Hosch and D. W. Rathburn: "The Determination of Activity Co-efficients Volatile Solutes in Volatile Solvents by Gas Chromatography." Presented at the ACS Meeting in Miniature, April 20, 1968.

Dennis Deavenport and Donald W. Rathburn: "NMR Spectroscopy of Oxazoles and Olazolidinones." Presented at the Annual Undergraduate Research Conference, December 2, 1967.

Jimmy Hosch and Donald W. Rathburn: "Activity Co-efficients by Gas Chromatography Using Volatile Solvents." Presented at the Annual Undergraduate Conference, December 2, 1968.

Dale Perry and D. W. Rathburn: "Gas Chromatographic Separation of Oxazoles." Presented at the Third Annual Southwest Undergraduate Research Conference, November 23, 1968.

Sherman Fredrickson an D. W. Rathburn: "Characteristic Parameters of Gases in Geiger-Mueller Counters." Presented at the Third Annual Southwest Undergraduate Research Conference November 23, 1968.

D. D. Deavenport, Beverly Mechock, J. W. Hosch and D. W. Rathburn: "The Structure of Oxazole-Mercury Compounds." Presented at the Texas Academy of Science, March 14, 1969.

Jean Eustice and D. W. Rathburn: "Oxazole-Produced Fluctuations in the Cardio-Respiratory Functions of Rabbits." Presented at the Texas Academy of Science, March 14, 1969.

Sherman Fredrickson and D. W. Rathburn: "Organic Quenched Geiger Counters Containing Methyl Acetate." Presented at the Texas Academy of Science, March 6, 1970.

Ed Wiegand and D. W. Rathburn: "Alkyl Substituted Oxazole Syntheses with Amino Acids." Presented at the Texas Academy of Science, March 6, 1970.

Dennis Deavenport and D. W. Rathburn: "NMR Spectra of Substituted Oxazoles and 4-Oxazolidinones." Presented at the Southwest Regional ACS Meeting, December 4, 1968.

D. W. Rathburn and H. C. Moser: "Effects of Radiant Heat in Gas-Solid Reactions of Hydrogen Atoms with Alkenes at 77°K." Presented at the Midwest Regional ACS Meeting, October 31, 1968.

D. W. Rathburn: "Radiant Heat Effects in Gas-Solid Reactions of Hydrogen Atoms with Alkenes at 77°K." Presented at the Oklahoma ACS Tetrasectional Meeting, March 21, 1970.

Jimmy Huffines and D. W. Rathburn: "The Preparation of 3-Oxetanones and their Use in the Synthesis of Oxazoles." Presented at the ACS Meeting in Miniature, April 17, 1970.

Sherman Fredrickson and D. W. Rathburn: "The Use of Methyl Acetate in Geiger-Mueller Counters." Presented at the ACS Meeting in Miniature, April 17, 1970.

Robert R. Zinn and D. W. Rathburn: "Fourier Transform Spectroscopy--A Literature Study." Presented at the ACS Meeting in Miniature, April 18, 1970.

PROFESSIONAL RESUME'

WARREN, Glennard M.

Education

B.S. Chemistry, Alcorn State University, 1979

Professional Experience

August, 1979 - Present	Chemist, Analytical Laboratory Group, WES. Specialty: Graphite Furnace AA and Auto-analysis for nutrients.

Training

Environmental Biology, Alcorn State University, Vicksburg Branch, 1980.

Environmental Microbiology, Mississippi State University, WES Center, 1981.

Basic Hydraulics, Hinds Jr. College, Vicksburg Branch, 1984.

Computer Literacy, Alcorn State University, WES Center, 1984.

Water Resources I, Mississippi State University, WES Center, 1985.

Principals of Management, Hinds Jr. College, Vicksburg Branch, 1986.

Interpersonal Relations, OPM Vicksburg, 1986.

Statistics, Alcorn State University, 1986.

Advanced Geochemistry, Jackson Engineering Graduate Program, 1987.

Analytical Atomic Spectrometry, Absorption, Emission, and Mass, ACS Education Division, New Orleans, 1987.

Principles of Oral Communication, Hinds Community College, 1987.

Effective Speaking and Human Relations, Dale Carnegie, 1988.

Nuclear Radiation Safety, WES, June 1989.

PROFESSIONAL RESUME'

CHRISTIAN, Jeffretha M.

Education

Three years college, Alcorn State University

Experience

Teaching assistant, Elementary School

Physical Science Aid/Technician	1980 - Present, on-the-job training in total solids, suspended solids, volatile solids, Mercury by Cold vapor, total organic carbon, Elutriate Preparation and acid digestion

Training

College Algebra, Hinds Jr. College, Vicksburg Branch, 1985.

Interpersonal Communications Leadership Seminars, 1986.

Introduction to Micro-computers and BASIC, Hinds Jr. College, Vicksburg Branch, 1986.

Environmental Biology, Alcorn State University, Sept-Dec 1988.

Awards

Performance Award, 1990.

Appendix B

ALG Procedures - FY 91

References:

1. U. S. Environmental Protection Agency, Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-020, March 1979 and EPA 600/4-82-055 Dec 1982. Environmental Monitoring and Support Laboratory, Cincinnati, OH 45268.

2. U. S. Environmental Protection Agency, Test Methods for Evaluating Solid Waste, SW-846 Third Edition, November 1986 with December 1988 revisions. Office of Solid Waste and Emergency Response, Washington, DC 20460.

3. U. S. Environmental Protection Agency, Manual of Analytical Methods for the Analysis of Pesticides in Humans and Environmental Samples, EPA-600/8-80-038, June 1980. Health Effects Research Laboratory, Research Triangle Park, NC 27711.

4. Federal Register, "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act", Vol 49, No. 209, Friday, October 26, 1984.

5. Plumb, Russell H., Jr. Procedures for Handling and Chemical Analysis of Sediment and Water Analysis, EPA/CE-81-1 May 1981. Environmental Laboratory, U. S. Army Engineer Waterways Experiment Station, Vicksburg, MS 39180.

6. American Public Health Association, Standard Methods for the Examination of Water and Wastewater 16th Edition, 1985. 1015 Fifteenth Street NW, Washington, DC 20005.

7. ASTM, 1990 Annual Book of ASTM Standards, Water and Environmental Technology Vol 11.01 and 11.02. 1987. 1916 Race Street, Philadelphia, PA 19103.

8. U. S. Environmental Protection Agency, Chemistry Laboratory Manual for Bottom Sediments and Elutriate Testing March 1979. Region V Central Regional Laboratory, 536 Clark Street, Chicago, IL 60605.

9. Palermo, Michael R. "Development of a Modified Elutriate Test for Estimating the Quality of Effluent from Confined Dredged Material Disposal Areas" Technical Report D-86-4. August 1986. Department of the Army Waterways Experiment Station, Corps of Engineers, P. O. Box 631, Vicksburg, MS 39180.

Table 1

List of Nonmetal Inorganic Test Procedures

			Reference (Method No. or page)			
	Parameter	Media	Ref 1 EPA 1979	Ref 2 SW-846	Ref 6 Std Meth	Other
1.	Acidity	Water	305.1			
2.	Alkalinity	Water	310.2			
3.	Ammonia-N	Water	350.1			
4.	BOD	Water			507	
5.	Cation Exchange Capacity	Soil				Ref 5, p 3-20
6.	COD	Water	410.4			
7.	COD,	Sediment				Ref 8, p 54
8.	Chloride	Water	325.2			
9.	Cyanide	Water	335.3			
10.	CN amenable to Cl	Water	335.1 & 335.3			
11.	Hardness	Water	130.1			
12.	Kjeldahl N	Water	351.2			
13.	Nitrate-Nitrite-N	Water	353.2			
14.	Nitrite-N	Water	353.2			Ref 5, p 3-163
15.	Oil & Grease	Water	413.1			
16.	TOC	Water & Sed			505C	
17.	Phenols, tot	Water	420.2			
18.	Phosphorus, total	Water	365.4			
19.	Othophosphate	Water	365.1			

(Continued)

Table 1 (Concluded)

	Parameter	Media	Reference (Method No. or page) Ref 1 EPA 1979	Ref 2 SW-846	Ref 6 Std Meth	Other
20.	Total solids Dried 103-105°C	Water	160.3		209A	
		Soil, Sed			209F	
21.	Total Dissolved Solids Dried 180°C	Water	160.1		209B	
22.	Total Suspended Dried 103-105°C	Water	160.2		209C	
23.	Settleable solids	Water	160.5		209E	
24.	Total Volatile Solids	Water	160.4		209D	
25.	Sulfate	Water	375.2			
26.	Sulfide	Water	376.2			
27.	Elutriate test sediments, std					Ref 5 p 2-28
28.	Elutriate test sed, modified					Ref 9
29.	EP Toxicity Liquid & Solid			1310		
30.	TCLP			1311		

Table 2

Analytical Procedures for Metals

	Parameter	Media	Ref 1 EPA-1979	Ref 2 SW-846	Other	Routine Meth Det. limits
1.	Digest for tot rec met	Water		3005		
2.	Digest for tot metals	Water		3010		
3.	Digest for Metals-GFAA	Water		3020		
4.	Digest for Metals	Sed., Soil & Sludge		3050		
5.	Simultaneous anal by DCP				Ref 7, D4190-82	
5a.	Simultaneous anal by ICP		200.7	6010		
6.	Aluminum, DCP ICP		 200.7	 6010	Ibid	10ug/l 100ug/l
7.	Antimony, DCP ICP		 200.7	 6010	Ibid	
8.	Antimony, GFAA		204.2	7041		5ug/l
9.	Arsenic, GFAA		206.2	7060		5ug/l
10.	Arsenic, hydride		206.3	7061		5ug/l
11.	Barium, AA		208.1	7080		100ug/l
12.	Barium, GFAA		208.2			2ug/l
13.	Barium, DCP ICP		 200.7	 6010	Ref 7, D4190-82	30ug/l 30ug/l
14.	Beryllium, DCP ICP	 200.7	 6010		Ibid	1ug/L 1ug/L
15.	Boron, DCP ICP	 200.7	 6010		Ibid	30ug/l 1ug/L

(Continued)

Table 2 (Continued)

Parameter	Media	Ref 1 EPA-1979	Ref 2 SW-846	Other	Routine Meth Det. limits
16. Cadmium, DCP				Ibid	20ug/L
ICP		200.7	6010		20ug/l
17. Cadmium, GFAA		213.2	7131		0.1ug/l
18. Calcium, DCP				Ibid	30ug/l
ICP		200.7	6010		
19. Calcium, AA		215.1	7140		
20. Chromium, DCP				Ibid	20ug/l
ICP		200.7	6010		20ug/l
21. Chromium, GFAA		218.2	7191		1ug/l
22. Chromium VI		218.4	7197		10ug/l
23. Cobalt, DCP				Ibid	50ug/l
ICP		200.7	6010		50ug/l
24. Cobalt, GFAA		219.2	7201		1ug/l
25. Copper, DCP				Idid	
ICP		200.7	6010		30ug/l
26. Copper, GFAA		220.2			1ug/l
27. Iron, DCP				Ibid	30ug/l
ICP		200.7	6010		30ug/l
28. Iron, AA		236.1	7380		30ug/l
29. Iron, GFAA		236.2	7381		1ug/l
30. Lead, DCP				Ibid	1mg/l
ICP		200.7	6010		100ug/l
31. Lead, GFAA		239.2	7421		1ug/l
32. Magnesium, DCP				Ibid	30ug/l
ICP		200.7	6010		30ug/l
33. Magnesium, AA		242.1	7450		
34. Manganese, DCP				Ibid	30ug/l
ICP		200.7	6010		30ug/l

(Continued)

Table 2 (Continued)

	Parameter	Media	Ref 1 EPA-1979	Ref 2 SW-846	Other	Routine Meth Det. limits
35.	Manganese, AA		243.1	7460		
36.	Manganese, GFAA		243.2			1ug/l
37.	Mercury, Cold Vapor	Water	245.1	7470		0.2ug/l
		Sed.	245.5	7471		0.2ug/l
38.	Molydenum, DCP				Ibid	30ug/l
	ICP		200.7	6010		30ug/l
39.	Molydenum, GFAA		246.2	7481		1ug/l
40.	Nickel, DCP				Ibid	30ug/l
	ICP		200.7	6010		30ug/l
41.	Nickel, GFAA		249.2			1ug/l
42.	Potassium, DCP				Ibid	50ug/l
	ICP		200.7	6010		
43.	Potassium, AA		258.1	7610		10ug/l
44.	Selenium, GFAA		270.2	7740		5ug/l
45.	Selenium, Hydride		270.3	7741		5ug/l
46.	Silver, DCP				Ibid	30ug/l
	ICP		200.7	6010		30ug/l
47.	Silver, GFAA		272.1	7761		1ug/l
48.	Sodium, DCP				Ibid	50ug/l
	ICP		200.7	6010		50ug/l
49.	Sodium, AA		273.1	7770		5ug/l
50.	Thallium, DCP				Ibid	50ug/l
	ICP		200.7	6010		50ug/l
51.	Thallium, GFAA		279.2	7841		1ug/l
52.	Tin, DCP				Ibid	50ug/l
53.	Tin, GFAA		282.2			5ug/l

(Continued)

Table 2 (Concluded)

Parameter	Media	Ref 1 EPA-1979	Ref 2 SW-846	Other	Routine Meth Det. limits
54. Titanium, GFAA	283.2				10ug/l
55. Vanadium, DCP				Ibid	100ug/l
ICP	200.7	6010			50ug/l
56. Vanadium, GFAA	286.2	7911			5ug/l
57. Zinc, DCP				Ibid	30ug/l
ICP	200.7	6010			10ug/l
58. Zinc, GFAA	289.2				5ug/l

Table 3

Organic Procedures

	Parameter	Media	Reference		
			Ref 4 Fed Reg 1984	Ref 2 SW-846	Ref 6 Std Meth
1.	Soxhlet Extraction	Soil & Sed.		3540	
2.	Sep funnel Liq-Liq extr	Water Soluble		3510	
3.	Purge & trap Prep-GC			5030	
4.	Sonication Extraction	Soil, Tissue & Sed.		3550	
5.	Florisil Cleanup	Pest, PCB, & ClHC		3620	
6.	Silica Gel Cleanup	PAH		3630	
7.	Sulfur Cleanup	Sed.		3660	
8.	Volatile Organics	Water	624		
		Water & Solid Ext.		8260	
9.	Semivol. Organics (BNA)	Water	625		
		Water & Solid Ext.		8270	
10.	Cl-Pest & PCBs	Water	608		
		Water & Solid Ext.		8080	
11.	Polynuclear Aromatic HC	Water	610		
		Water & Solid Ext.		9100	
12.	Organophos Pesticides	Water & Solid Ext.		8140	509A
13.	Chlorinated Herbicides	Water & Solid Ext.		8150	509B

(Continued)

Table 3 (Continued)

Parameter	Media	Reference		
		Ref 4 Fed Reg 1984	Ref 2 SW-846	Ref 6 Std Meth
14. Explosives	Water			*
15. Explosives	Soil			**

16. Other Methods as Requested Such as Hydrazine, Nitrosoamines, TNT, and DIMP.

Detection limits for organic analysis are typically those given for the methods. They are, however, subject to matrix interferences and may be higher depending on the nature of the interference.

* Jenkins, T. F., et al., USA Cold Regions Research and Engineering Laboratory, CRREL Report 84-29.

** Jenkins, T. F. and Walsh, Marianne E., USA Cold Regions Research and Engineering Laboratory, CRRL Report 87-7.

Appendix C

DFTPP TUNING

REFERENCES:

E-16	
D-98	regulations detailed
E-11	spectrum
D-102	1.6.1.2 - Demonstrates consistent spectra from MS to MS. Spells out requirements for qualitative verification that must be met.

NOTES:

A) DFTPP must be verified once per shift or every 12 hrs.

B) Note that all MS give different looking DFTPP spectra, which implies a wide range of PFTBA spectra.

```
69 = 100 --
219 = 55       -- fairly normal
502 = 1.2 --

69 = 100 --
219 =  20      -- perfectly ok, often
502 = 0.2 --      seen on benchtops
```

C) There are many different ways to tune DFTPP. The methods given below (some specific, some general) are ways that many users have found successful. In addition, there are many "markers" that different users look for during the tune that seem to indicate that the tune will be successful. Some of the more popular of these goals are:

1) Tune until 219 and 131 are approximately equal and range between 20 and 60% of 69.

2) After tuning, check spectrum scan and see if m/e 50 and m/e 502 are equal. The closer to equal, the better the chance that the tune will be successful.

Look for guidelines such as these on your MS to help guide you during tuning.

D) DO NOT TUNE UNLESS IT IS NECESSARY! It will cost you only 5 - 10 min to attempt to verify your last tune. Experience has shown that the more often you tune, the more often you have to recalibrate your ID file. This is because you are adjusting your mass response ratios when you tune.

PROCEDURE A: 5987/5988

MANUAL TUNE - PFTBA OPEN

1) REPEAT PROFILE - set plunger to max 219
2) Set GC temp to 225-275 (ie. elution temp of DFTPP) so GC flow = flow at DFTPP elution.
3) Run AUTOTUNE - set source to 250
4) MANUAL TUNE (source @ 250, GC - 250)
5) set A/D = 1 (0.5 sec/scan or faster)
6) run REPEAT PROFILE about 1 min to warm up and stabilize the source and EM.
7) PARAMETER RAMP (make sure plunger is adjusted)
   Begin to max 219, starting with REP
   A) REP
   B) IF
   C) DO
   D) ENT LENS
   leave the X-RAY alone at this point.
8) in REPEAT PROFILE use the X-RAY to set 69:219:502 ratio. 502/219 should be >3% and <5%. (do not be confused and set 502/69 ratio).
9) use DO to achieve final ratios, if needed.
10) do PEAK WIDTH and MASS AXIS CALIBRATION
11) check spectrum to make sure calibrations did not shift peak ratios.
12) store tune as MTDFTP

NOTES:

A) If 502 has a precursor, you will probably lose m/e 441 in DFTPP spectra. This is more of a problem on bench-tops than big systems. Cleaning the ENT LENS will often eliminate this precursor.

PROCEDURE B: 5995

A) Set oven to 250 with XFR, OVN1, 250 (ie. elution temp of DFTPP, so GC flow = flow at DFTPP elution)
B) Set source to 250 with XFR, SORS, 250
C) Run AUTOTUNE
D) MANUAL TUNE - PFTBA OPEN
Note: If you have previously created a manual tune file, use NEW TUNE FILE to load it.
1) Edit temp zones
Source 250
Analyser 180
Transfer 280
2) Edit scan parameters to set A/D = 1 (0.5 sec/scan or faster)
3) run REPEAT PROFILE about 1 min to warm up and stabilize source and EM.
4) PARAMETER RAMP - begin to max 219
A) REP leave alone
B) IF most useful lens
C) ENT LENS can be useful
leave the X-RAY alone at this point.
NOTE: on benchtops, if we set IF = 100, this is often all that is necessary. As a first attempt just adjust the IF and leave other lenses alone.
5) in REPEAT PROFILE, use X-RAY to set 69:219:502 ratio. 502/219 ratio should be >3% and <5% (do not be confused and set 502/69 ratio). Adjust ratio using X-RAY, being careful not to adjust too far and deteriorate peak shape.
6) do PEAK WIDTH and MASS AXIS CALIBRATION
7) SPECTRUM SCAN - check spectrum to make sure calibrations did not shift peak ratios. Remember, 502/219 should be >3% and <5%. Also, look at 131/219 ratio. They should be approximately equal.
8) Store tune as MTDTP

NOTES:
A) If 502 has a precursor, you will probably lose m/e 441 in DFTPP spectra. This is more of a problem on benchtops than big systems. Cleaning the ENT LENS will often eliminate this precursor.

Appendix D

Detection Limits

in DPTPP

Table 1

Method 608

Chromatographic Conditions and Method

Detection Limits

Parameter	Retention time (min) Col. 1	Col. 2	Method detection limit (μg/L)
α-BHC	1.35	1.82	0.003
γ-BHC	1.70	2.13	0.00
β-BHC	1.90	1.97	0.00
Heptachlor	2.00	3.35	0.003
δ-BHC	2.15	2.20	0.009
Aldrin	2.40	4.10	0.004
Heptachlor epoxide	3.50	5.00	0.083
Endosulfan I	4.50	6.20	0.014
4,4'-DDE	5.13	7.15	0.004
Dieldrin	5.45	7.23	0.002
Endrin	6.55	8.10	0.006
4,4'-DDD	7.83	9.08	0.011
Endosulfan II	8.00	8.28	0.004
4,4'DDT	9.40	11.75	0.012
Endrin aldehyde	11.82	9.30	0.023
Endosulfan sulfate	14.22	10.70	0.066
Chlordane	mr	mr	0.014
Toxaphene	mr	mr	0.24
PCB-1016	mr	mr	nd
PCB-1221	mr	mr	nd
PCB-1232	mt	mr	nd
PCB-1242	mr	mr	0.065
PCB-1248	mr	mr	nd
PCB-1254	mr	mr	nd
PCB-1260	mr	mr	nd

Column 1 conditions: Suplecoport (100/120 mesh) coated with 1.5% SP-2250/1.95% SP-2401 packed in a 1.8 m long × 4 mm ID glass column with 5% methane/95% argon carrier gas at 60 mL/min flow rate. Column temperature held isothermal at 200°C, except for PCB-1016 through PCB-1248, should be measured at 160°C.

Columne 2 conditions: Supelcoport (100/120 mesh) coated with 3% OV-1 packed in a 1.8 m long × 4 mm ID glass column with 5% methane/95% argon carrier gas at 60 mL/min flow rate. Column temperature held isothermal at 200°C for the pesticides; at 140°C for PCB-1221 and 1232; and at 170°C for PCB-1016 and 1242 to 1268.

mr = Multiple peak response. Se Figures 2 thru 10.

nd = Not determined.

Table 1

Method 624

Chromatographic Conditions and Method

Detection Limits

Parameter	Retention time (min)	Method detection limit (µg/L)
Chloromethane	2.3	nd
Bromomethane	3.1	nd
Vinyl chloride	3.8	nd
Chloroethane	4.6	nd
Methylene chloride	6.4	2.8
Trichlorofluoromethane	8.3	nd
1,1-Dichloroethene	9.0	2.8
1,1-Dichloroethane	10.1	4.7
trans-1,2-Dichloroethene	10.8	1.6
Chloroform	11.4	1.6
1,2-Dichloroethane	12.1	2.8
1,1,1-Trichloroethane	13.4	3.8
Carbon tetrachloride	13.7	2.8
Bromodichloromethane	14.3	2.2
1,2-Dichloroproane	15.7	6.0
cis-1,3-Dichloropronene	15.9	5.0
Trichloroethene	16.5	1.9
Benzene	17.0	4.4
Dibromochloromethane	17.1	3.1
1,1,2-Trichloroethane	17.2	5.0
trans-1,3-Dichloropropene	17.2	nd
2-Chloroethylvinlyl ether	18.6	nd
Bromoform	19.8	4.7
1,1,2,2-Tetrachloroethane	22.1	6.9
Tetrachloroethene	22.2	4.1
Toluene	23.5	6.0
Chlorobenzene	24.6	6.0
Ethyl benzene	26.4	7.2
1,3-Dichlorobenzene	33.9	nd
1,2-Dichlorobenzene	35.0	nd
1,4-Dichlorobenzene	35.4	nd

Column conditions: Carbopak B (60/80 mesh) coated with 1% SP-1000 packed in a 6 ft by 0.1 in. ID glass column with helium carrier gas at 30 mL/min flow rate. Column temperature held at 45°C for 3 min, then programmed at 8°C/min to 220°C and held for 15 min.

nd = not determined.

Method 625

Chromatographic Conditions and Method Detection Limits

for Base/Neutral Extractables

Parameter	Retention time (min)	Method detection limit (μg/L)
1,3-Dichlorobenzene	7.4	1.9
1,4-Dichlorobenzene	7.8	4.4
Hexachloroethane	8.4	1.6
Bis(2-Chlorethyl) ether	8.4	5.7
1,2-Dichlorobenzene	8.4	1.9
Bis(2-chloroisopropyl) ether	9.3	5.7
N-Nitrosodi-n-propylamine		
Nitrobenzene	11.1	1.9
Hexachlorobutadiene	11.4	0.9
1,2,4-Trichlorobenzene	11.6	1.9
Isophorone	11.9	2.2
Naphthalene	12.1	1.6
Bis(2-chloroethoxy) methane	12.2	5.3
Hexachlorocyclopentadiene[a]	13.9	
2-Chloronaphthalene	15.9	1.9
Acenaphthylene	17.4	3.5
Acenaphthene	17.8	1.9
Dimethyl phthalate	18.3	1.6
2,6-Dinitrotoluene	18.7	1.9
Fluorene	19.5	1.9
4-Chlorophenyl phenyl ether	19.5	4.2
2,4-Dinitrotoluene	19.8	5.7
Diethylphthalate	20.1	1.9
N-Nitrosodiphenylamine[a]	20.5	1.9
Hexachlorobenzene	21.0	1.9
β-BHC[a]	21.1	
4-Bromophenyl phenyl ether	21.2	1.9
δ-BHC[a]	22.4	
Phenanthrene	22.8	5.4
Anthracene	22.8	1.9
β-BHC	23.4	4.2
Heptachlor	23.4	1.9
δ-BHC	23.7	3.1
Aldrin	24.0	1.9
Dibutyl phthalate	24.7	2.5
Heptachlor expoxide	25.6	2.2
Endosulfan I[a]	26.4	
Fluoranthene	26.5	2.2
Dieldrin	27.2	2.5
4,4'-DDE	27.2	5.6

(Continued)

[a] See Section 1.2.

Chromatographic Conditions and Method Detection Limits for Base/Neutral Extractables (Concluded)

Parameter	Retention time (min)	Method detection limit (μg/L)
Pyrene	27.3	1.9
Endrin[a]	27.9	
Endosulfan II[a]	28.6	
4,4'-DDD	28.6	
Benzidine[a]	28.8	44
4,4'-DDT	29.3	4.7
Endosulfan sulfate	29.8	5.6
Endrin aldehyde		
Butyl benzyl phthalate	29.9	2.5
Bis(2-ethylhexyl) phthalate	30.6	2.5
Chrysene	31.5	2.5
Benzo(a)anthracene	31.5	7.8
3,3'-Dichlorobenzidine	32.2	16.5
Di-n-octyl phthalate	32.5	2.5
Benzo(b)fluoranthene	34.9	4.8
Benzo(k)fluoranthene	34.9	2.5
Benzo(a)pyrene	36.4	2.5
Indeno(1,2,3-c,d)pyrene	42.7	3.7
Dibenzo(a,h)anthracene	43.2	2.5
Benzo(ghi)perylene	45.1	4.1
N-Nitrosodimethylamine[a]		
Chlordane[b]	19-30	
Toxaphene[b]	25-34	
PCB 1016[b]	18-30	
PCB 1221[b]	15-30	30
PCB 1232[b]	15-32	
PCB 1242[b]	15-32	
PCB 1248[b]	12-34	
PCB 1254[b]	22-34	36
PCB 1260[b]	23-32	

[b] These compounds are mixtures of various isomers. (See figures 2 thru 12.) Column conditions: Supecoport (100/120 mesh) coated with 3% SP-2250 packed in a 1.8 m long × 2mm ID glass column with helium carier gas at 30 mL/min flow rate. Column temperature held isothermal at 50°C for 4 min, then programmed at 8°C/min to 270°C and held for 30 min.

Chromatographic Conditions, Method Detection Limits, and Characteristic Masses for Acid Extractables

Parameter	Retention time (min)	Method detection limit (µg/L)
2-Chlorophenol	5.9	3.3
2-Nitrophenol	6.5	3.6
Phenol	8.0	1.5
2,4-Dimethylphenol	9.4	2.7
2,4-Dichlorophenol	9.8	2.7
2,4,6-Trichlorophenol	11.8	2.7
4-Chloro-3-methylphenol	13.2	3.0
2,4-Dinitrophenol	15.9	42
2-Methyl-4,6-dinitrophenol	16.2	24
Pentachlorophenol	17.5	3.6
4-Nitrophenol	20.3	2.4

Column conditions: Supelcoport (100/120 mesh) coated with 1% SP-1240DA packed in a 1.8 m × 2mm ID glass column with helium carrier gas at 30 mL/min flow rate. Column temperature held isothermal at 70°C for 2 min then programmed at 8°C/min to 200°C.

CLP Required Limits

Volatiles

Target Compound List (TCL) and Contract

Required Quantitation Limits (CRQL)*

	Volatiles	CAS Number	Quantitation Limits** Water ug/L	Low Soil/Sediment[a] ug/kg
1.	Chloromethane	74-87-3	10	10
2.	Bromomethane	74-83-9	10	10
3.	Vinyl Chloride	75-01-4	10	10
4.	Chloroethane	75-00-3	10	10
5.	Methylene Chloride	75-09-2	5	5
6.	Acetone	67-64-1	10	10
7.	Carbon Disulfide	75-15-0	5	5
8.	1,1-Dichloroethene	75-35-4	5	5
9.	1,1-Dichloroethane	75-34-3	5	5
10.	1,2-Dichloroethene (total)	540-59-0	5	5
11.	Chloroform	67-66-3	5	5
12.	1,2-Dichloroethane	107-06-2	5	5
13.	2-Dutanone	78-93-3	10	10
14.	1,1,1-Trichloroethane	71-55-6	5	5
15.	Carbon Tetrachloride	56-23-5	5	5
16.	Vinyl Acetate	108-05-4	10	10
17.	Bromodichloromethane	75-27-4	5	5
18.	1,2-Dichloropropane	78-87-5	5	5
19.	cis-1,3-Dichloropropene	10061-01-5	5	5
20.	Trichloroethene	79-01-6	5	5
21.	Dibromochloromethane	124-48-1	5	5
22.	1,1,2-Trichloroethane	79-00-5	5	5
23.	Benzene	71-43-2	5	5
24.	trans-1,3-Dichloropropene	10061-02-6	5	5
25.	Bromoform	75-25-2	5	5

(Continued)

[a] Medium Soil/Sediment Contract Required Quatitation Limits (CRQL) for Volatile TCL Compunds are 125 times the individual Low Soil/Sediment CRQL.

* Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

** Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

Volatiles

Target Compound List (TCL) and Contract Required

Quantitation Limits (CRQL)* (Concluded)

Volatiles	CAS Number	Quantitation Limits** Water ug/L	Low Soil/Sediment[a] ug/kg
26. 4-Methyl-2-pentanone	108-10-1	10	10
27. 2-Hexanone	591-78-6	10	10
28. Tetrachloroethene	127-18-4	5	5
29. Toluene	108-88-3	5	5
30. 1,1,2,2-Tetrachloroethane	79-34-5	5	5
31. Chlorobenzene	108-90-7	5	5
32. Ethyl Benzene	100-41-4	5	5
33. Styrene	100-42-5	5	5
34. Xylenes (Total)	1330-20-7	5	5

CLP Required Limits

Semivolatiles Target Compound List (TCL) and Contract

Required Quantitation Limits (CRQL)*

Semivolatiles	CAS Number	Quantitation Limits** Water ug/L	Low Soil/Sediment[b] ug/kg
35. Phenol	108-95-2	10	330
36. bis(20Chloroethyl) ether	111-44-4	10	330
37. 2-Chlorophenol	95-57-8	10	330
38. 1,3-dichlorobenzene	541-73-1	10	330
39. 1,4-Dichlorobenzene	106-46-7	10	330
40. Benzyl aclcohol	100-51-6	10	330
41. 1,2-Dichlorobenzene	95-50-1	10	330
42. 2-Methylphenol	95-48-7	10	330
43. bis(2-Chloroisopropyl) ether	108-60-1	10	330
44. 4-Methylphenol	106-44-5	10	330
45. N-Nitroso-di-n-dipropylamine	621-64-7	10	330
46. Hexachloroethane	67-72-1	10	330
47. Nitrobenzene	98-95-3	10	330
48. Isophorone	78-59-1	10	330
49. 2-Nitrophenol	88-75-5	10	330
50. 2,4-Dimethylphenol	105-67-9	10	330
51. Benzoic acid	65-85-0	50	1600
52. bis(2-Chloroethoxy) methane	111-91-1	10	330
53. 2,4-Dichlorophenol	120-83-2	10	330
54. 1,2,4-Trichlorobenzene	120-82-1	10	330

(Continued)

[b] Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for SemiVolatile TCL Compounds are 60 times the individual Low Soil/Sediment CRQL.

* Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

** Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

Semivolatiles Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL)* (Continued)

Semivolatiles	CAS Number	Quantitation Limits** Water ug/L	Low Soil/Sediment[b] ug/kg
55. Naphthalene	91-20-3	10	330
56. 4-Chloroaniline	106-47-8	10	330
57. Hexachlorobutadiene	87-68-3	10	330
58. 4-Chloro-3-methylphenol (para-chloro-meta-cresol)	59-50-7	10	330
59. 2-Methylnaphthalene	91-57-6	10	330
60. Hexachlorocyclopentadiene	77-47-4	10	330
61. 2,4,6-Trichlorophenol	88-06-2	10	330
62. 2,4,5-Trichlorophenol	95-95-4	50	1600
63. 2-Chloronaphthalene	91-58-7	10	330
64. 2-Nitroaniline	88-74-4	50	1600
65. Dimethylphthalate	131-11-3	10	330
66. Acenaphthylene	208-96-8	10	330
67. 2,6-Dinitrotoluene	606-20-2	10	330
68. 3-Nitroaniline	99-09-2	50	1600
69. Acenaphthene	83-32-9	10	330
70. 2,4-Dinitrophenol	51-28-5	50	1600
71. 4-Nitrophenol	100-02-7	50	1600
72. Dibenzofuran	132-64-9	10	330
73. 2,4-Dinitrotoluene	121-14-2	10	330
74. Diethylphthalate	84-66-2	10	330
75. 4-Chlorophenyl-phenyl ether	7005-72-3	10	330
76. Fluorene	86-73-7	10	330
77. 4-Nitroaniline	100-01-6	50	1600
78. 4,6-Dinitro-2-methylphenol	534-52-1	50	1600
79. N-nitrosodiphenylamine	86-30-6	10	330
80. 4-Bromophenyl-phenylether	101-55-3	10	330
81. Hexachlorobenzene	118-74-1	10	330
82. Pentachlorophenol	87-86-5	50	1600
83. Phenanthrene	85-01-8	10	330
84. Anthracene	120-12-7	10	330
85. Di-n-butylphthalate	84-74-2	10	330
86. Fluoranthene	206-44-0	10	330
87. Pyrene	129-00-0	10	330
88. Butylbenzylphthalate	85-68-7	10	330
89. 3,3'-Dichlorobenzidine	91-94-1	20	660

(Continued)

Semivolatiles Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL)* (Concluded)

Semivolatiles	CAS Number	Quantitation Limits** Water ug/L	Low Soil/Sediment[b] ug/kg
90. Benzo(a)anthracene	56-55-3	10	330
91. Chrysene	218-01-9	10	330
92. bis(2-Ethylhexyl)phthalate	117-81-7	10	330
93. Di-n-octylphthalate	117-84-0	10	330
94. Benzo(b)fluoranthene	205-99-2	10	330
95. Benzo(k)fluoranthene	207-08-9	10	330
96. Benzo(a)pyrene	50-32-8	10	330
97. Indeno(1,2,3-cd)pyrene	193-39-5	10	330
98. Dibenz(a,h)anthracene	53-70-3	10	330
99. Benzo(g,h,i)perylene	191-24-2	10	330

CLP Required Limits

Pesticides and PCBs Target Compound List (TCL) and

Contract Required Quantitation Limits (CRQL)*

	Pesticides/PCBs	CAS Number	Quantitation Limits** Water ug/L	Low Soil/Sediment[c] ug/kg
100.	alpha-BHC	319-84-6	0.05	8.0
101.	beta-BHC	319-85-7	0.05	8.0
102.	delta-BHC	319-86-8	0.05	8.0
103.	gamma-BHC (Lindane)	58-89-9	0.05	8.0
104.	Heptachlor	76-44-8	0.05	8.0
105.	Aldrin	309-00-2	0.05	8.0
106.	Heptachlor epoxide	1024-57-3	0.05	8.0
107.	Endosulfan I	959-98-8	0.05	8.0
108.	Dieldrin	60-57-1	0.10	16.0
109.	4,4'-DDE	72-55-9	0.10	16.0
110.	Endrin	72-20-8	0.10	16.0
111.	Endosulfan II	33213-65-9	0.10	16.0
112.	4,4'-DDD	72-54-8	0.10	16.0
113.	Endosulfan sulfate	1031-07-8	0.10	16.0
114.	4,4'-DDT	50-29-3	0.10	16.0
115.	Methoxychlor	72-43-5	0.5	80.0
116.	Endrin ketone	53494-70-5	0.10	16.0
117.	alpha-Chlordane	5103-74-2	0.5	80.0
118.	gamma-Chlordane	5103-74-2	0.5	80.0
119.	Toxaphene	8001-35-2	1.0	160.0
120.	Aroclor-1016	12674-11-2	0.5	80.0
121.	Aroclor-1221	11104-28-2	0.5	80.0
122.	Aroclor-1232	11141-16-5	0.5	80.0
123.	Aroclor-1242	53469-21-9	0.5	80.0
124.	Aroclor-1248	12672-29-6	0.5	80.0
125.	Aroclor-1254	11097-69-1	1.0	160.0
126.	Aroclor-1260	11096-82-5	1.0	160.0

[c] Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for SemiVolatile TCL Compounds are 60 times the individual Low Soil/Sediment CRQL.

* Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

** Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

Table 1

GAS Chromatography of Pesticides and PCBs[a]

Method 8080

Parameter	Retention time (min) Col. 1	Col. 2	Method detection limit (μg/L)
Aldrin	2.40	4.10	0.004
α-BHC	1.35	1.82	0.003
β-BHC	1.90	1.97	0.006
δ-BHC	2.15	2.20	0.009
γ-BHC	1.70	2.13	0.004
Chlordane (technical)	e	e	0.014
4,4'-DDD	7.83	9.08	0.011
4,4'-DDE	5.13	7.15	0.004
4,4'-DDT	9.40	11.75	0.012
Dieldrin	5.45	7.23	0.002
Endosulfan I	4.50	6.20	0.014
Endosulfan II	8.00	8.28	0.004
Endosulfan sulfate	14.22	10.70	0.066
Endrin	6.55	8.10	0.006
Endrin aldehyde	11.82	9.30	0.023
Heptachlor	2.00	3.35	0.003
Heptachlor epoxide	3.50	5.00	0.083
Methoxychlor	18.20	26.60	0.176
Toxaphene	e	4	0.24
PCB-1016	e	e	nd
PCB-1221	e	e	nd
PCB-1232	e	e	nd
PCB-1242	e	e	0.065
PCB-1248	e	e	nd
PCB-1254	e	e	nd
PCB-1260	e	e	nd

[a] U.S. EPA Method 1-617. Organochloride Pesticides and PCBs. Environmental Monitoring and Support Laboratory, Cincinnati, Ohio 45268.

e Multiple response.

nd Not determined.

Method 8240 Practical Quantitation Limits (PQL)

for Volatile Organics[a]

Volatiles	Practical Quantitation Limits[b] Ground Water ug/L	Low Soil/Sediment ug/kg
Acetone	100	100
Acetonitrile	100	100
Allyl chloride	5	5
Benzene	5	5
Benzyl chloride	100	100
Bromodichloromethane	5	5
Bromoform	5	5
Bromomethane	10	10
2-Butanone	100	100
Carbon disulfide	100	100
Carbon tetrachloride	5	5
Chlorobenzene	5	5
Chlorodibromomethane	5	5
Chlorethane	10	10
2-Chloroethyl vinyl ether	10	10
Chloroform	5	5
Chloromethane	10	10
Chloroprene	5	5
1,2-Dibromo-3-chloropropane	100	100
1,2-Dibromoethane	5	5
Dibromomethane	5	5
1,4-Dichloro-2-butene	100	100
Dichlorodifluoromethane	5	5
1,1-Dichloroethane	5	5
1,2-Dichloroethane	5	5
1,1 Dichloroethene	5	5
trans-1,2-Dichlorethane	5	5
1,2-Dichloropropane	5	5
cis-1,3-Dichloroprepene	5	5
trans-1,3-Dichloropropene	5	5
Ethylbenzene	5	5
Ethyl methacrylate	5	5
2-Hexanone	50	50
Isobutyl alcohol	100	100

[a] Sample PQLs are highly matrix-dependent. The PQLs listed herein are provided for guidance and may not always be achievable. See the following information for further guidance on matrix-dependent PQLs.

[b] PQLs listed for soil/sediment are based on wet weight. Normally data is reported on a dry weight basis; therefore, PQLs will be higher, based on the percent moisture in each sample.

Method 8240 Practical Quantitation Limits (PQL)

for Volatile Organics[a] (Continued)

Volatiles	Practical Quantitation Limits[b] Ground Water ug/L	Low Soil/Sediment ug/kg
Methacrylonitrile	100	100
Methylene chloride	5	5
Methyl iodide	5	5
Methyl methacrylate	5	5
4-Methyl-2-pentanone	50	50
Pentachloroethane	10	10
Propionitrile	100	100
Styrene	5	5
1,1,1,2-Tetrachloroethane	5	5
1,1,2,2-Tetrachloroethane	5	5
Tetrachloroethene	5	5
Toluene	5	5
1,1,1-Trichloroethane	5	5
1,1,2-Trichloroethane	5	5
Trichloroethene	5	5
1,2,3-Trichloropropane	5	5
Vinyl acetate	50	50
Vinyl chloride	10	10
Xylene (Total)	5	5

Other Matrices:	Factor[1]
Water miscible liquid waste	50
High-level soil & sludges	125
Non-water miscible waste	500

[1]PQL = [PQL for ground water (Table 2)] X [Factor]. For non-aqueous samples, the factor is on a wet-weight basis.

Method 8260 Chromatographic Retention Times and Method Detection Limits (MDL) for Volatile Organic Compounds on Wide Bore Capillary Columns

Analyte	Retention Time (minutes) Column 1[a]	Column2[b]	Column 3[c]	MDL[d] (ug/L)
Dichlorodifluoromethane	1.55	0.70	--	0.10
Chloromethane	1.63	0.73	2.07	0.13
Vinyl Chloride	1.71	0.79	2.12	0.17
Bromomethane	2.01	0.96	2.26	0.11
Chloroethane	2.09	1.02	2.31	0.10
Trichlorofluoromethane	2.27	1.19	2.42	0.08
1,1-Dichloroethane	2.89	1.57	3.08	0.12
Methylene chloride	3.60	2.06	3.32	0.03
trans-1,2-Dichloroethene	3.98	2.36	3.48	0.06
1,1-Dichloroethane	4.85	2.93	4.10	0.04
2,2-Dichloropropane	6.01	3.80	4.43	0.35
cis-1,2-Dichloroethene	6.19	3.90	4.42	0.12
Chloroform	6.40	4.80	4.58	0.03
Bromochloromethane	6.74	4.38	4.54	0.04
1,1,1-Trichloroethane	7.27	4.84	5.09	0.08
Carbon tetrachloride	7.61	5.26	5.18	0.21
1,1-Dichloropropene	7.68	5.29	5.18	0.10
Benzene	8.23	5.67	5.29	0.04
1,2-Dichloroethane	8.40	5.83	5.29	0.04
Trichloroethene	9.59	7.27	6.07	0.19
1,2-Dichloropropane	10.09	7.66	6.20	0.06
Bromodichloromethane	10.59	8.49	6.39	0.08
Dibromomethane	10.65	7.93	6.27	0.24
Toluene	12.43	10.00	7.36	0.11
1,1,2-Trichloroethane	13.41	11.05	8.07	0.10
Tetrachloroethene	13.74	11.15	8.21	0.14
1,3-Dichloropropane	14.04	11.31	8.20	0.04
Dibromochloromethane	14.39	11.85	8.39	0.05
1,2-Dibromoethane	14.73	11.83	--	0.06
1-Chlorohexane	15.46	13.29	--	0.05
Chlorobenzene	15.76	13.01	9.33	0.04

(Continued)

[a] Column 1 - 60 meter x 0.75 mm i.d. VOCOL capillary. Hold at 10°C for 5 minutes, then program to 160°C at 6°/min.

[b] Column 2 - 30 meter x 0.53 mm i.d. DB-624 wide-bore capillary using cryogenic oven. Hold at 10°C for 5 minutes, then program to 160°C at 6°/min.

[c] Column 3 - 30 meter x 0.53 i.d. DB-624 wide-bore capillary, cooling GC oven to ambient temperatures. Hold at 45°C for 2 minutes, then program to 200°C at 8°/min and hold for 6 minutes.

[d] MDL based on a sample volume.

Method 8270 Practical Quantitation Limits (PQL)

For Semivolatile Organics[A]

Semivolatiles	Practical Quantitation Limits[b] Ground Water ug/L	Low Soil/Sediment[1] ug/Kg
Acenapthene	10	660
Acenaphthylene	10	
Acetophenone	10	
2-Acetylaminoflurene		
1-Acetyl-2-thiourea		
2-Aminoanthraquinone		
Aminoazobenzene		
4-Aminobiphenyl		
Anilazine		
o-Anisidine		
Anthracene		
Aramite		
Azinphos-methyl		
Barban		
Benz(a)anthrace		
Benzo(b)fluoranthene		
Benzo(k)fluoranthene		
Benzoic acid		
Benzo(g,h,i)perylene		
Benzo(a)pyrene		
p-Benzoquinone		
Benzyl alcohol		
Bis(2-chloroethoxy) methane		
Bis(2-chloroethyl) ether		
Bis(2-chloroisopropyl) ether		
4-bromophenyul phenyl ether		
Bromoxynil		
Butyl benzyl phthalate		
Captafol		
Captan		
Carbaryl		
Carbofuran		
Carbophenothion		
Chlorfenvinphos		

How is this different from DQ ???

Are these MDL or vs. CRQL's of DQ?

(Cont

[a] PQLs listed for soil/sediment are b[illegible] normally data is reported on a dry weight basis, there [illegible] will be higher based on the % moisture in each sample. This is based on a 30-g sample and gel permeation chromatography cleanup.

[b] Sample PQLs are highly matrix-dependent. The PQLs listed herein are provided for guidance and may not always be achievable.

ND Not detemined.

Method 8270 Practical Quantitation Limits (PQL)

For Semivolatile Organics[A] (Continued)

Semivolatiles	Practical Quantitation Limits[b] Ground Water ug/L	Low Soil/Sediment[1] ug/Kg
4-Chloroaniline	20	1300
Chlorobenzilate	10	ND
5-Chloro-2-methylaniline	10	ND
4-Chloro-3-methylphenol	20	1300
3-(Chloromethyl) pyridine hydrochloride	100	ND
2-Chloroanaphthalene	10	660
2-Chlorophenol	10	660
4-Chlorophenyl phenyl ether	10	660
Chrysene	10	660
Coumaphos	40	ND
p-Cresidine	10	ND
Crotoxyphos	20	ND
2-Cyclohexyl-4,6-dinitrophenol	100	ND
Demeton-o	10	ND
Demeton-s	10	ND
Diallate (cis or trans)	10	ND
Diallate (trans or cis)	10	ND
2,4-Diaminotoluene	20	ND
Dibenz(a,j)acridine	10	ND
Dibenz(a,h)anthracene	10	660
Dibenzofuran	10	660
Dibenzo(a,e)pyrene	10	ND
Di-n-butylphthalate	10	ND
Dichlone	NA	ND
1,2-Dichlorobenzene	10	660
1,3-Dichlorobenzene	10	660
1,4-Dichlorobenzidine	10	660
3,3'-Dichlorobenzidine	20	1300
2,4-Dichlorophenol	10	660
2,6-Dichlorophenol	10	ND
Dichlorovos	10	ND
Dicrotophos	10	ND
Diethylphthalate	10	660
Diethylstilbesterol	20	ND
Diethyl sulfate	100	ND
Dimethoate	20	ND
3,3'-Dimethoxybenzidine	100	ND
Dimethylaminoazobenzene	10	ND
7,12-Dimethylbenz(a)anthracene	10	ND
3,3'-Dimethylbenzidine	10	ND

(Continued)

NA Not applicable.

Method 8270 Practical Quantitation Limits (PQL)

For Semivolatile Organics[A] (Continued)

Semivolatiles	Practical Quantitation Limits[b] Ground Water ug/L	Low Soil/Sediment[1] ug/Kg
a,a-Dimethylphenethylamine	ND	ND
2,4-Dimethylphenol	10	660
Dimethyl phthalate	10	660
1,2-Dinitorbenzene	40	ND
1,3-Dinitrobenzene	20	ND
1,4-Dinitrobenzene	40	ND
4,6-Dinitro-2-methylphenol	50	3300
2,4-Dinitrophenol	50	3300
2,4-Dinitrotoluene	10	660
2,6-Dinitrotoluene	10	660
Dinocap	100	ND
Dinoseb	20	ND
5,5-Diphenylhydantoin	20	ND
Di-n-octyl phthalate	10	660
Disulfoton	10	ND
EPN	10	ND
Ethion	10	ND
Ethyl carbamate	50	ND
Bis(2-ethylhexyl)phthalate	10	660
Ethyl methanesulfonate	20	ND
Famphur	20	ND
Fensulfothion	40	ND
Fenthion	10	ND
Fluchloralin	20	ND
Fluoranthene	10	660
Fluorene	10	660
Hexachlorobenzene	10	660
Hexachlorobutadiene	10	660
Hexachlorocyclopentadiene	10	660
Hexachloroethane	10	660
Hexachlorophene	50	ND
Hexachloropropene	10	ND
Hexamethyl phosphoramide	20	ND
Hydroquinone	ND	ND
Indeno(1,2,3-cd)pyrene	10	660
Isodrin	20	ND
Isophorone	10	660
Isosafrole	10	ND
Kepone	20	ND
Leptophos	10	ND
Malathion	50	ND
Maleic anhydride	NA	ND
Mestranol	20	ND
Methapyrilene	100	ND

(Continued)

Method 8270 Practical Quantitation Limits (PQL)

For Semivolatile Organics[A] (Continued)

Semivolatiles	Practical Quantitation Limits[b] Ground Water ug/L	Low Soil/Sediment[1] ug/Kg
Methoxychlor	10	ND
3-Methylcholanthrene	10	ND
4,4'-Methylenebis(2-chloroaniline)	NA	ND
Methylmethanesulfonate	10	ND
2-Methylnaphthalene	10	660
Methyl parathion	10	ND
2-Methylphenol	10	660
3-Methylphenol	10	ND
4-Methylphenol	10	660
Mevinphos	10	ND
Mexacarbate	20	ND
Mirex	10	ND
Monocrotophos	40	ND
Naled	20	ND
Naphthalene	10	660
1,4-Naphthoquinone	10	ND
1-Naphthylamine	10	ND
2-Naphthylamine	10	ND
Nicotine	20	ND
5-Nitroacenaphthene	10	ND
2-Nitroaniline	50	3300
3-Nitroaniline	50	3300
4-Nitroaniline	20	ND
5-Nitro-o-anisidine	10	ND
Nitrobenzene	10	660
4-Nitrobiphenyl	10	ND
Nitrofen	20	ND
2-Nitrophenol	10	660
4-Nitrophenol	50	3300
5-Nitro-o-toluidine	10	ND
4-Nitroquinoline-1-oxide	40	ND
N-Nitrosodibutylamine	10	ND
N-Nitrosodiethylamine	20	ND
N-Nitrosodiphenylamine	10	660
N-Nitroso-di-n-propylamine	10	660
N-Nitrosopiperidine	20	ND
N-Nitrosopyrrolidine	40	ND
Octamethyl pyrophosphoramide	200	ND
4,4'-Oxydianiline	20	ND
Parathion	10	ND
Pentachlorobenzene	10	ND
Pentachloronitrobenzene	20	ND
Pentachlorophenol	50	3300
Phenacetin	20	ND

(Continued)

Method 8270 Practical Quantitation Limits (PQL)

For Semivolatile Organics[A] (Concluded)

Semivolatiles	Practical Quantitation Limits[b] Ground Water ug/L	Low Soil/Sediment[1] ug/Kg
Phenanthrene	10	660
Phenobarbital	10	ND
Phenol	10	660
1,4-Phenylenediamine	10	ND
Phorate	10	ND
Phosalone	100	ND
Phosmet	40	ND
Phosphamidon	100	ND
Phthalic anhydride	100	ND
2-Picoline	ND	ND
Piperonyl sulfoxide	100	ND
Pronamide	10	ND
Propylthiouracil	100	ND
Pyrene	10	660
Pyridine	ND	ND
Resorcinol	100	ND
Safrole	10	ND
Syrychnine	40	ND
Sulfallate	10	ND
Terbufos	20	ND
1,2,4,5-Tetrachlorobenzene	10	ND
2,3,4,6-Tetrachlorophenol	10	ND
Tetrachlorvinphos	20	ND
Tetraethyl pyrophosphate	40	ND
Thionazine	20	ND
Thiophenol (Benzenethiol)	20	ND
Toluene diisocyanate	100	ND
o-Toluidine	10	ND
1,2,4-Trichlorobenzene	10	660
2,4,5-Trichlorophenol	10	660
2,4,6-Trichlorophenol	10	660
Trifluralin	10	ND
2,4,5-Trimethylaniline	10	ND
Trimethyl phosphate	10	ND
1,3,5-Trinitrobenzene	10	ND
Tris(2,3-dibromopropyl) phosphate	200	ND
Tri-p-tolyl phosphate(h)	10	ND
0,0,0-Triethylphosphorothioate	NT	ND

NT Not tested.

Other Matrices	Factor[1]
Medium-level soil and sludges by sonicator	7.5
Non-water miscible waste	75

[1]PQL = [PQL for Low Soil/Sediment (Table 2)] X [Factor].