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Work Plan Amendment for:

Bioremediation/Metals Treatment of West Burn Pads Landfill Soils in Inert Landfill Trench 6 and Trench 7 Iowa Army Ammunition Plant, IA

Contract DACA45-97-0022-009
July 24, 2001

Prepared for:

USACE Omaha District
106 South 15th Street
Omaha, Nebraska 68102-1618

Prepared by:

Cape Environmental Management Inc
14113 West 72 Terrace
Shawnee, Kansas 66216
913/248-1278

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CAPE
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July 24, 2001
CAPE Proposal No. 00305.001.005

ATTN: Mr. Scott Marquess
U.S. EPA, Region VII
901 North 5th Street, FFSESUPR
Kansas City, KS 66101

SUBJECT: Work Plan Amendment for Bioremediation/Metals Treatment of West Burn Pads Landfill Soils in Inert Landfill Trenches 6 and 7 at Iowa Army Ammunition Plant, Iowa Contract Number DACW45-97-D-0022-0009

Dear Mr. Marquess:

Cape Environmental (CAPE) is pleased to provide the latest version of the subject Work Plan. This is an "Unofficial Submittal" and is for review purposes only.

The enclosed modification includes the following information:

- Work Approach and Figures
- Appendix A RFI Document Summary of Treatment Options
- Appendix B Cumulative Applied Formula
- Appendix C GRACE Treatability Study
- Appendix D Joliet AAP "Bake-off" Summary
- DARAMEND Toxicity Studies Excerpts
- Appendix E DARAMEND Treatment Studies
- Pantex Bench-Scale Treatability Study Data
- Yorktown Naval Weapons Station Full-Scale Treatment
- Appendix F DARAMEND Explosives Treatment
- Preliminary Procedures Manual
- Appendix G Metals Treatment Procedures and Treatability Study (To Be Provided Following Supplemental Treatability Testing).

Thank you for your consideration of our approach. If you have questions, please call Don Woody, Project Manager at (913) 558-2143 or Charlie Williams at (865) 671-0056.

Sincerely,
Cape Environmental

Darryl Bedoy
Proposal Coordinator

Enclosure

14113 West 72 Terrace Shawnee, KS 66216
(913) 248-1278/Fax (913) 248-1279

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1.0 INTRODUCTION

This *Work Plan Amendment*, prepared by Cape Environmental Management Inc. (CAPE), provides a detailed description of treatment activities that will be completed on a specific subset of explosives- and metals-impacted soils at the Inert Disposal Area (IDA) at the Iowa Army Ammunition Plant (IAAAP) in Middletown, Iowa. These soils are currently stockpiled in the Soil Repository (otherwise known as "Trench 6") and the Corrective Action Management Unit (otherwise known as the "CAMU" or as "Trench 7"). The site location is shown in Figure 1 and the location of Trenches 6 and 7 are shown in Figure 2.

1.1 Site Location and Description

The IAAAP, bordered by U.S. Highway 34 to the north, upland agricultural farms to the east and west, and the Skunk River valley to the south, encompasses approximately 19,000 acres. Approximately one-third of the property is occupied by active or formerly active production or storage facilities. The remaining land is divided between leased agricultural property and woodlands. IAAAP is a government-owned, contractor-operated facility. The current operating contractor is American Ordnance, formerly Mason & Hanger-Silas Mason Co., under the command of the U.S. Army Operations Support Command (OSC). OSC reports to the U.S. Army Armament, Munitions and Chemical Command (AMC).

1.2 Site History

Production of ammunition at the IAAAP began in 1941; current activities at the plant include load, assemble, and pack (LAP) production operations for various conventional ammunition items including projectiles, mortar rounds, warheads, and demolition charges. The LAP operations use explosive materials and lead-based initiating compounds. Past operations at the IAAAP have resulted in the contamination of soil and groundwater through the discharge of wastewater containing explosives and explosive byproducts and through open burning and land disposal of production wastes.

1.3 Description of Previous Remedial Activities

In July 2000, CAPE was tasked by the U.S. Army Corps of Engineers (USACE) to perform treatment/stabilization activities on contaminated soils from specific Focused Feasibility Study (FFS) sites as identified in the IAAAP Interim Soils Operable Unit (OU) Record of Decision (ROD), dated March 1998. These sites, generally referred to as the West Burn Pads Landfill (WBPLF) sites, include four distinct sites that are located within one contiguous 8-acre area. These four WBPLF sites are the West Burn Pads, the West Burn Pads Landfill, the Burn Cages, and the Burn Cages Ash Disposal Landfill. Primary contaminants of concern in materials from the WBPLF sites are explosives (e.g.,

RDX, HMX, and TNT) and heavy metals (e.g., barium and lead). CAPE was tasked to stabilize metals-contaminated soils (with special emphasis on barium, as the dominant metal contaminant) originating from the WBPLF sites.

Between July 2000 and October 2000, Environmental Chemical Corporation (ECC) excavated metals- and explosives-contaminated soils from the WBPLF sites and transported them to the IDA, where the soil was segregated and stockpiled in three separate depository areas. ECC segregated the soils based on level and type of contamination. This segregation was primarily driven by varying levels of two major soil contaminants, RDX and barium. Refer to Section 1.5 of this work plan amendment for additional information regarding soil segregation and placement criteria. The three IDA soil depositories consisted of the "Random Fill" landfill cell (located along the southeast edge of the IDA and designed primarily for permanent containment of soil with relatively low levels of explosives contamination), the Trench 6 Soil Repository (designed primarily for permanent containment of soil with relatively moderate levels of explosives contamination), and the Trench 7 CAMU landfill cell (designed primarily for temporary storage of soil with relatively high levels of explosives contamination). Within each of these three IDA soil depository areas, the WBPLF soil was segregated into stockpiles of soil requiring metals treatment and stockpiles not requiring metals treatment. Details of the work performed by ECC are documented in the *Draft Remedial Action Report, Focused Feasibility Study Soils Removal Action – West Burn Pads* (ECC, June 2001).

Following ECC's placement of the WBPLF soils at the IDA, CAPE initiated work activities in accordance with the approved *Work Plan Amendment, Barium-Contaminated Soils Stabilization* (CAPE, October 2000). Fieldwork consisted of metals-stabilization activities using a combination of portland cement and synthetic gypsum. WBPLF soils requiring metals treatment were thoroughly mixed and irrigated in 22-inch lifts using a Caterpillar SM350 soil stabilizer machine. The mixed soils were cured for a minimum of 4 hours, and then sampled. Samples were submitted to an on-site laboratory for Toxicity Characteristic Leaching Procedure (TCLP) extraction using SW-846 Method 1311; the extract was then analyzed for metals using Graphite Furnace / Cold Vapor Method-7000-series procedures. Some quality assurance (QA) / quality control (QC) samples were also sent to an off-site laboratory for TCLP extraction and analysis using U.S. Environmental Protection Agency (EPA) Method 6010B or Method 7470 procedures, as applicable. Each composite sample represented approximately 250 cubic yards of treated soils. Soils that satisfied the cleanup objectives were segregated with material requiring no additional treatment. Soils not satisfying the cleanup objectives were designated for re-treatment and were reintegrated with soil requiring treatment. Between early October 2000 and early November 2000, CAPE successfully treated all WBPLF soils that required metals treatment from the stockpiles within the Random Fill landfill cell and within Trench 6. However, CAPE was not successful in efforts to treat the more-heavily-contaminated WBPLF soils in Trench 7 for metals. Based on the unsuccessful attempts to treat Trench 7 material and due to the approaching end of the construction season, the project team agreed that treatment methods for WBPLF soil containing very high levels of metals contamination should be re-evaluated before any further attempts to treat the WBPLF soil in Trench 7. CAPE then prepared the site for winter shutdown and demobilized by mid-November 2000. Details of the work performed by CAPE are documented in the Draft *Closure Report, Focused Feasibility Study Soils Removal, Barium Stabilization* (CAPE, May 2001).

After demobilizing from the IAAAP site for the winter shutdown, verification samples were collected from the Random Fill landfill cell and from Trench 6 to confirm that the WBPLF soils had been segregated appropriately and to confirm that the metals treatment had successfully reached treatment goals. These verification samples indicated that some of the WBPLF soil placed in Trench 6 was contaminated with higher-than-expected levels of explosives. In fact, the explosives content of some of the WBPLF soil in Trench 6 was found to be high enough that the soil was determined to have been incorrectly placed in Trench 6 instead of in Trench 7. Per the terms of the IAAAP Final Soils OU ROD, dated September 1998, this "incorrectly-placed" WBPLF soil stockpiled in Trench 6, and all of the WBPLF soil stockpiled in Trench 7, requires treatment for explosives. Refer to Section 1.5 of this work plan amendment for additional information regarding soil placement and treatment criteria.

As a result of these events, CAPE was tasked by the USACE to research and evaluate options for treatment of the WBPLF soil (currently staged in Trenches 6 and 7) requiring additional treatment. CAPE researched available information to determine technically viable and cost-effective alternatives for treating the soils. Initial research indicated that it might be advantageous to treat the WBPLF soil in Trench 7 for explosives before metals treatment, especially if the explosives treatment process utilizes biological degradation and if the metals treatment process results in a pH change which could negatively impact indigenous microbes within the soil. Additionally, it was determined that it was necessary to treat the "incorrectly-placed" WBPLF soil in Trench 6 (for explosives) before the future placement of additional soil in the Soil Repository. Furthermore, it was determined to be desirable to treat the WBPLF soil in Trench 7 for both explosives and metals so that the metals-impacted WBPLF materials could be removed from Trench 7 at the completion of this project effort (thereby leaving only explosives-contaminated soil remaining in Trench 7).

The soil treatment methods initially researched by CAPE included thermal processing, composting, bioslurry, and an application of various proprietary reagents to treat soils for explosives and metals. General information used to evaluate these soil treatment methods is summarized in a Request for Information (RFI) from CAPE to USACE; this information is presented in Appendix A of this work plan amendment. Based on CAPE's research, the recommended methods for explosives and metals treatment involve application of proprietary reagents; these soil treatment methods are discussed in detail in Section 2 of this work plan amendment.

1.4 Project Objectives

The objectives of this project are to complete the treatment of the explosives- and metals-contaminated WBPLF soils (that are currently staged in Trenches 6 and 7) to the cleanup goals defined in Section 1.5 of this work plan amendment.

Based upon the quantity of ECC truckloads delivered and an assumption of 8 cubic yards of soil per truckload, Trench 6 presently contains an estimated 5,112 cubic yards of WBPLF soil; approximately half of this material, or approximately 2,556 cubic yards, requires treatment for explosives. Trench 7 contains an estimated 4,032 cubic yards of WBPLF soils; all of this WBPLF material in Trench 7 requires treatment for both

explosives and metals. The present configuration of WBPLF soil in Trenches 6 and 7 is shown in Figure 3.

Treatment activities described in this work plan amendment will be performed as a continuation of fieldwork initiated by CAPE during the 2000 construction season; therefore, this work plan amendment is intended to be used in conjunction with the previously approved *Work Plan Amendment* (CAPE, October 2000).

1.5 Soil Remediation Goals / Treatment Criteria

The Final Soils OU ROD for the IAAAP site, dated September 1998, defines soil remediation goals based on the Resource Conservation and Recovery Act (RCRA) Land Disposal Restrictions (LDRs) and a 10^{-6} cumulative risk level for ingestion and dermal contact. Table 13 contained within the Final Soils OU ROD lists risk-based soil remediation goals for several potential chemicals of concern. Appendix B of this work plan amendment contains the applicable cumulative risk formula, a cumulative risk formula calculation spreadsheet, and laboratory data for soil verification samples recently collected from WBPLF soils staged within Trench 6. Figure 4 also provides a summary of this recent Trench 6 WBPLF soil sampling information.

If the cumulative risk is less than 10^{-6} (i.e., the Cumulative Risk Index is less than 1.0) AND the soil does not fail any LDRs, the soil is considered "lightly-contaminated" "random fill" material and is designated for permanent placement (typically without treatment) in an on-site RCRA-Subtitle-D-equivalent landfill cell.

If the cumulative risk, ***excluding metals contribution***, is less than 10^{-6} (i.e., the Cumulative Risk Index is less than 1.0) BUT the soil fails LDRs due to hazardous levels of leachable metals, the soil is still considered "lightly-contaminated" "random fill" material designated for permanent placement, ***after treatment for metals***, in an on-site RCRA-Subtitle-D-equivalent landfill cell.

If the cumulative risk is between 10^{-6} and 10^{-5} (i.e., the Cumulative Risk Index is between 1.0 and 10.0) AND the soil does not fail any LDRs, the soil is considered "moderately-contaminated" and it is designated for permanent placement (typically without treatment) in the on-site RCRA-Subtitle-C-equivalent Trench 6 Soil Repository landfill cell.

If the cumulative risk, ***excluding metals contribution***, is between 10^{-6} and 10^{-5} (i.e., the Cumulative Risk Index is between 1.0 and 10.0) BUT the soil fails LDRs due to hazardous levels of leachable metals, the soil is still considered "moderately-contaminated" material designated for permanent placement, ***after treatment for metals***, in the on-site RCRA-Subtitle-C-equivalent Trench 6 Soil Repository landfill cell.

If the cumulative risk is 10^{-5} or greater (i.e., the Cumulative Risk Index is 10.0 or greater), the soil is considered "heavily-contaminated" and it is designated for temporary storage (awaiting treatment) in the on-site Trench 7 CAMU landfill cell.

Remediation criteria for explosives treatment are based upon a reduction of explosives contamination within the treated soil (from pre-treatment cumulative risk levels greater than 10^{-5}) to cumulative risk levels of 10^{-6} or less. Since RDX is typically the dominant non-metals contributor to the cumulative risk formula for the WBPLF soils, RDX levels

can be used as a measurement indicator for explosives treatment progress. Therefore, since 53 mg/kg of RDX represents a 10^{-6} risk level, 53 mg/kg of RDX in the WBPLF soil can be considered an approximate cleanup goal for the explosives treatment process. However, the cumulative risk formula (using all applicable explosives concentrations in the WBPLF soil) will be used to measure the final success of the explosives treatment process, which must reduce the cumulative risk of the soil to less than 10^{-6}.

Remediation criteria for metals treatment are based on compliance with RCRA LDRs. Phase IV LDR treatment standards for soil require a 90 percent reduction in concentrations of hazardous constituents, with treatment for any given constituent capped at ten times the Universal Treatment Standard (UTS). Therefore, this "90 percent reduction, capped at 10xUTS" is an absolute minimum requirement for the treatment of WBPLF soil relocated to the IDA and contaminated with hazardous levels of leachable metals. This "90 percent reduction, capped at 10xUTS" could potentially allow for the landfill placement of treated soil exceeding TCLP limits, but only if that soil is placed in a RCRA hazardous waste landfill cell (i.e., the Trench 6 Soil Repository). However, to provide a "safety factor" in the design of the metals treatment process and to simplify the treatment criteria by selection of a single metals treatment standard applicable to all three soil depository areas at the IDA, CAPE has been directed by USACE to set WBPLF soil treatment goals that meet (or "pass") TCLP limits for all applicable metals. One variation to this guidance is that silver-contaminated soil, if any WBPLF soil unexpectedly requires treatment for silver, may need to be treated to less than the applicable 5.0 mg/L TCLP limit to meet the "90 percent reduction, capped at 10xUTS" minimum requirement.

For reference purposes, Table 1 presents a summary of relevant TCLP limits, Universal Treatment Standards, and "10xUTS" limits for the typical suite of eight RCRA metals. Note that these metals are NOT all expected to be drivers for treatment of metals-contaminated WBPLF soil staged in Trenches 6 and 7. Although the metals treatment process must be capable of achieving all mandatory LDR criteria, a review of the numerous WBPLF soil samples previously collected (for site characterization, excavation, segregation, placement, and treatment purposes) reveals only relatively modest contamination by all of these metals except barium and, to a much lesser degree, lead (as measured by total metals analyses). This review of previous WBPLF soil samples also found that only a few samples are known to have exceeded TCLP limits (by relatively small margins) for lead, cadmium, and chromium.

TABLE 1
Metals Treatment Criteria

Metal	TCLP Limits (mg/L)	Universal Treatment Standards (UTS, mg/L TCLP)	10 x UTS (mg/L TCLP)
Arsenic	5.0	5.0	50.0
Barium	100.0	21.0	210.0
Cadmium	1.0	0.11	1.1
Chromium	5.0	0.60	6.0
Lead	5.0	0.75	7.5
Mercury	0.2	0.025	0.25
Selenium	1.0	5.7	57.0
Silver	5.0	0.14	1.4

For the WBPLF soils currently requiring treatment (and currently staged in Trench 6 and Trench 7), the Army will manage the treatment residuals via burial and permanent containment in the Trench 6 Soil Repository after completion of treatment of explosives to a cumulative risk level of less than 10^{-6} and treatment of metals to achieve compliance with LDRs.

2.0 PROJECT ACTIVITIES

Following approval of this work plan amendment, CAPE will mobilize to the site and begin site preparation activities. Once site preparation is completed, CAPE will begin treatment of the explosives-contaminated WBPLF soils, followed by metals treatment. After achieving the soil remediation goals, the treated soil will be placed in Trench 6 for final/permanent disposition, the site will be restored, and CAPE will demobilize equipment and personnel. These project activities are discussed in additional detail in the following subsections.

2.1 Mobilization and Site Preparation

Mobilization involves the travel of site personnel and transport of equipment to the site. A site office/lunch trailer will be set up and electrical service will be provided to the trailer. Portable sanitary facilities will also be provided during mobilization and will remain for the duration of site activities. Initial site preparation activities include obtaining site access and clearances/permits; conducting pre-construction briefings; establishing support areas, site controls, and work zones; and locating utilities and underground landfill system components, as appropriate.

2.2 Protection of Landfill Liner Systems

With due consideration for the importance of maintaining the integrity of the critical (and expensive) landfill liner systems underlying Trench 6 and Trench 7, protective measures will be implemented to ensure that the liner systems are not damaged by the soil remediation activities of this project effort. During site preparation, land surveying will be performed at both Trench 6 and Trench 7 to delineate the location of critical buried liner components. This is required as a first step to ensure that CAPE's field crew is aware of the location of the liners and to create adequate horizontal and vertical protective "buffer" zones that must be maintained throughout the duration of fieldwork. In addition, CAPE will not be allowed to begin intrusive fieldwork within or near the Trench 6 and Trench 7 landfill areas until USACE concurs with the delineation of work zones and buffer zones within/around these two landfill cells. Furthermore, only low-ground-pressure (LGP) equipment will be allowed to operate within Trench 6 and Trench 7 unless adequate vertical soil cover (pre-approved by USACE) is provided to protect the liner systems from excessive loads. Finally, as directed and pre-approved by USACE, CAPE will provide on-site supervision of critical field activities by a qualified independent landfill liner expert. However, if these measures do not successfully prevent accidental damage to the liner systems, any/all damage will be expeditiously and properly repaired under the supervision of the above-mentioned (qualified independent) landfill liner expert.

2.3 Soil Treatment

As previously mentioned in this work plan amendment, analytical results from recent verification sampling in Trench 6 indicate that high-concentration explosives (i.e., greater than 10^{-5} cumulative risk, based upon explosives contamination) are present in some of the WBPLF soils currently staged in Trench 6. Before this verification sampling, Trench 6 was subdivided into quadrants, identified as Blocks A, B, C, and D. Each quadrant/block was further subdivided into three equal grid areas. Five-point composite soil samples were prepared from grab samples collected from each grid area within each block. Each composite sample was collected in a manner intended to ensure that it was representative of the WBPLF soil within its respective grid area. Analytical results for the five-point composite WBPLF soil samples collected from each of the 12 grid areas within Trench 6 are provided in Appendix B and the results are summarized in Figure 4. As shown in Figure 4, the soil in Blocks A and D contain average RDX concentrations of 257 mg/kg and 157 mg/kg, respectively. These WBPLF soils meet Trench 6 criteria for explosives (i.e., they have cumulative risk levels between 10^{-6} and 10^{-5}); therefore, WBPLF soil in Blocks A and D does not require treatment for explosives. However, the WBPLF soil in Blocks B and C contain average RDX concentrations of 567 mg/kg and 840 mg/kg, respectively. Therefore, these WBPLF soils are considered Trench 7 material (due to cumulative risk levels exceeding 10^{-5}) and, in accordance with the Final Soils OU ROD, this WBPLF soil in Blocks B and C must be treated for explosives. These Block B and C soils are those WBPLF soils previously mentioned as "incorrectly-placed" in Trench 6 instead of Trench 7.

The equipment that CAPE plans to use for mixing the proprietary treatment reagents into the soil can effectively mix soil in lifts placed at an optimum thickness of 24 inches (with a maximum tilling depth of 26 inches); therefore, the contaminated WBPLF soils requiring treatment will be spread out to a maximum depth of 24 inches. To spread the estimated 6,588 cubic yards of WBPLF soil requiring treatment (i.e., 2,556 cubic yards from Trench 6 plus 4,032 cubic yards from Trench 7) to a uniform 24-inch depth, a footprint of approximately 89,000 square feet will be needed for treatment. However, Trench 7 has relatively limited usable space available to spread the soils out to the required depth of 24 inches. The total usable area in Trench 6 (i.e., not including the water collection sump at the south end and not including 10-foot-wide protective buffer zones for the liner system) is approximately 71,560 square feet; therefore, Trench 6 will be used as the primary treatment area. The remaining 17,440 square feet of required treatment area will be set up in Trench 7. As a result, of the estimated 6,588 cubic yards of WBPLF soil to be treated within this project effort, Trench 6 will be used to treat approximately 5,300 cubic yards. Trench 7 will be used to treat the remainder (or approximately 1,288 cubic yards). Actual volumes of WBPLF soil treated in Trench 6 and Trench 7 during this project effort will depend upon the accuracy of the assumption that ECC delivered 8 cubic-yards of soil per truckload to the IDA; adjustments will be made in the field, as required and as appropriate, to maximize the amount of soil treated in Trench 6 and to minimize the amount of soil treated in Trench 7.

2.3.1 Preparation of Treatment Areas

To prepare the Trench 6 treatment area, CAPE will first transfer WBPLF soils from Blocks B and C (see Figure 4) with a track-mounted loader to a temporary stockpile

within Trench 6; this will allow the WBPLF soil from Blocks A and D to be graded across the bottom of the cell in a uniform layer to create a working base (i.e., Layer 1) for the treatment area. These WBPLF soils in Layer 1 do not require treatment during this project effort. The temporarily stockpiled Block B and C materials will then be graded with a bulldozer in a uniform lift thickness above the Layer 1 base material to form Layer 2; this lift of Layer 2 soil shall be no greater than 24 inches thick to allow for its treatment using the previously mentioned soil mixing/tilling equipment.

WBPLF soil will then be excavated from Trench 7 using an LGP bulldozer to push the soil near a loading ramp that will be constructed near the northeast corner of Trench 7. A track-mounted loader will be used to load the Trench 7 WBPLF soils into tandem dump trucks, which will be used to transfer the soil into Trench 6; see Figure 5 for the transport route between Trench 7 and Trench 6. These trucks will be filled to no greater than two-thirds capacity to ensure no spillage during transport. To minimize decontamination requirements and the possibility of contaminant releases, the operations to transfer soil between Trench 7 and Trench 6 will be set up such that the transport trucks will never be in contaminated areas. At both trenches, the transport trucks will be positioned at clean ramp areas for loading and unloading across clearly defined lines that separate clean and contaminated work zones. Equipment operators will work diligently to prevent spillage of contaminated materials into clean ramp areas while loading and unloading the trucks. However, if any contaminated materials are accidentally spilled into clean areas, CAPE will immediately clean up the spilled materials and decontaminate any trucks or other equipment, as required.

After the WBPLF soil from Trench 7 is dumped into Trench 6, a bulldozer will be used to spread the materials on top of Layer 2. These Trench 7 materials will form Layer 3. The combined thickness of Layers 2 and 3 shall be no greater than 24 inches to allow for proper tilling/treatment. When the combined thickness of Layers 2 and 3 reaches a depth of 24 inches, no more WBPLF soil will be transferred from Trench 7 for treatment in Trench 6. The remaining WBPLF soil in Trench 7 will be graded into a 24-inch (maximum) lift (in an area located near the north end of the CAMU cell) for treatment within Trench 7. Materials in Trenches 6 and 7 will be graded to promote drainage.

During the construction of these WBPLF soil treatment lifts, a 10-foot horizontal buffer zone and 3-foot vertical ground cover will be maintained at all times between heavy equipment and the Trench 6 and Trench 7 landfill liners. These precautions will be implemented to ensure that the integrity of the liners is maintained. The proposed buffer zones within Trenches 6 and 7 are illustrated in Figure 6. A cross-section of the constructed layers of WBPLF soil to be treated within Trench 6 is shown in Figure 7. Following preparation of Trench 6 and Trench 7 for explosives treatment, CAPE will mobilize a technical representative from the explosives-treatment subcontractor to oversee activities related to application of their proprietary treatment process.

2.4 Explosives Treatment

CAPE evaluated a number of treatment options for explosives-contaminated soil and determined that the GRACE Bioremediation Technologies (GRACE) DARAMEND process was technically viable, cost-effective, and best suited for the needs of this current project effort. As a result, GRACE was authorized to execute a site-specific bench-scale treatability study with WBPLF soil from Trench 7, using both untreated materials and

materials partially treated for metals. The results of the GRACE DARAMEND treatability study indicate that the WBPLF soils can be treated to below 10^{-6} cumulative risk levels for explosives in approximately five or six treatment cycles. Complete results from this site-specific IAAAP-WBPLF treatability study are included in GRACE's *Draft Final Report, Bench-Scale DARAMEND Treatability Investigation: Nitroaromatic Explosive-Impacted Soil* (GRACE, June 2001a), which is included within Appendix C of this work plan amendment.

The IAAAP Final Soils OU ROD requires that thermal or biological treatment methods be used to remediate WBPLF soils that are highly contaminated with explosives (i.e., pre-treatment levels exceed a 10^{-5} cumulative risk). The use of DARAMEND is consistent with those alternative provisions of the ROD since the DARAMEND treatment process is organic in nature and incorporates indigenous bacteria to aid in remediation. The EPA's Superfund Innovative Technology Evaluation (SITE) program also recognizes DARAMEND as an effective bioremediation technology.

In addition to the site-specific IAAAP-WBPLF soil treatability study conducted by GRACE, other bench-scale and pilot-scale studies and full-scale demonstrations have also demonstrated the effectiveness of DARAMEND treatments on a variety of soils containing explosives, including TNT, RDX, and HMX. Information regarding some of these studies and demonstration projects using DARAMEND for treatment of explosives-contaminated soil is presented in the following section to provide supporting evidence that DARAMEND is a technically viable treatment process with a proven track record.

It is noteworthy to point out that GRACE has enough confidence in the ability of DARAMEND to successfully treat the WBPLF soils to the required explosives remediation criteria, that GRACE will provide a warranty of performance for the DARAMEND treatment. This performance warranty was a factor in the selection of DARAMEND for the explosives-contaminated soil treatment process required within this project effort.

2.4.1 Supporting Studies and Demonstration Projects using DARAMEND for Treatment of Explosives-Contaminated Soil

DARAMEND has been successfully applied during pilot-scale treatability studies on organic explosive-impacted soils at two U.S. Army sites. At the first site, the Joliet Army Ammunition Plant (JAAP), two pilot studies (10 tons each) were conducted by an independent, third party evaluator (Plexus Scientific), and these studies successfully demonstrated the effectiveness of DARAMEND treatment on JAAP soils impacted with Tetryl and TNT. Another pilot-scale study was conducted at the same site with a larger volume (i.e., approximately 200 tons) using an aerated windrow approach. In this study, DARAMEND bioremediation was also effective in treating explosives-contaminated soils in a timely and cost-effective manner. Toxicity studies performed on the DARAMEND soil treatment process at the JAAP "Bakeoff" indicate there will be no toxic effects resulting from the explosives treatment process at the proposed application rates. Relevant excerpts from the referenced JAAP studies are provided within Appendix D of this work plan amendment. At the second U.S. Army site, the Raritan Arsenal in Edison, New Jersey, a pilot-scale demonstration was completed in February 1998. In this study, DARAMEND bioremediation was successful in reducing the TNT concentrations from 451 mg/kg to less than 10 mg/kg in 42 days.

In early July 1998, GRACE conducted bench-scale treatability studies to evaluate the effectiveness of DARAMEND bioremediation on organic explosive-impacted soil from the Pantex Plant in Amarillo, Texas. Two treatability investigations were initiated to determine the contaminant removal efficiencies for Pantex soil under a variety of DARAMEND treatment protocols. The first study included treatments that cycled between anoxic and oxic conditions. The second study included treatments maintained under anoxic conditions at all times. Analytical results from samples collected following 194 days of treatment indicated significant reductions in the concentrations of organic explosive compounds. In the most effective DARAMEND treatment of the cycled study, concentrations of RDX and total explosives were reduced from 21,325 mg/kg and 28,408 mg/kg to 55 mg/kg and 88 mg/kg, respectively. This corresponds to a 99.7 percent reduction in total explosives. In the most effective DARAMEND treatment of the purely anoxic study, concentrations of RDX and total explosives were reduced from 21,325 mg/kg and 28,408 mg/kg to 3.3 mg/kg and 13.3 mg/kg, respectively. This corresponds to greater than a 99.9 percent reduction in total explosives. Further details are provided in Appendix E.

More recently, DARAMEND bioremediation has been successfully applied in a full-scale demonstration (1,200 tons) on TNT-, RDX-, and HMX-impacted soil at the U.S Naval Weapons Station (WPNSTN) Yorktown, in Yorktown, Virginia. Initial mean TNT concentrations in excess of 10,000 mg/kg were successfully reduced to 6.2 mg/kg (i.e., to below the remedial goal of 15 mg/kg) after 14 treatment cycles. Initial mean RDX concentrations of 210 mg/kg were successfully reduced to 3 mg/kg (i.e., to below the remedial goal of 5 mg/kg) during the same treatment period. HMX and amino-DNT concentrations were also reduced substantially. A second batch of soil (i.e., another 1,200 tons) is currently being treated at WPNSTN Yorktown. Treatment results for the current batch are expected to be available during July 2001. Additional information regarding this full-scale treatment demonstration at WPNSTN is included within Appendix E of this work plan amendment.

2.4.2 Explosives (DARAMEND) Treatment Process

After the WBPLF soils are prepared in Trench 6 and Trench 7 in accordance with specifications, a round of soil sampling will take place to determine the initial (pre-treatment baseline) concentrations of explosives in the soils. Explosives sampling (for initial pre-treatment baseline determination, mid-treatment progress-checks, and final post-treatment verification) will consist of the collection and preparation of one five-point composite soil sample from each treatment grid area or "cell", not to exceed 300 cubic yards of soil in any treatment grid area or "cell". Therefore, based on a 24-inch treatment lift, one five-point composite soil sample will be prepared and analyzed per 4,050 (maximum) square feet of treatment area. The five soil samples collected for each composite soil sample will be collected from the full soil treatment depth (0 to 24 inches) at each discrete sample location and then composited in a stainless steel bowl. Composited soil samples will be systematically quartered and re-quartered until the correct volume is achieved for each analytical sample. Each composite soil sample will

be collected and prepared in a manner designed to ensure that it is representative of the soil within its respective treatment area or "cell".

Initial pre-treatment soil samples and final post-treatment verification soil samples will be sent to an off-site USACE-certified laboratory for explosives analyses using EPA Method 8330 procedures. In accordance with standard project QC procedures, approximately 10 percent of all soil samples sent to the primary laboratory will be split and analyzed in duplicate. In addition, at the direction of the USACE project chemist, QA split samples for approximately 10 percent of the "off-site-analysis" explosives soil samples will be sent to another USACE-approved laboratory for an independent check of the primary laboratory's analytical results.

Soil samples collected during treatment, for the purpose of checking treatment progress (i.e., after intermediate treatment cycles), will typically be analyzed on-site for explosives (RDX/TNT) using USACE-approved spectroscopic field test kits. However, to verify that the field test kits are producing results that are suitable for the intended purpose, (at the direction of the USACE project chemist) approximately 5 to 10 percent of these intermediate soil samples will be split and sent to an off-site USACE-certified laboratory for explosives analysis using EPA Method 8330 procedures.

For illustration purposes, Figure 8 shows a possible layout for the treatment area grids and soil sample locations within Trench 6 and Trench 7. The actual treatment area grids and soil sampling locations will be adjusted in the field based on actual soil volumes and treatment areas and dimensions; however, no grid area (or treatment "cell") will exceed 300 cubic yards of soil. The treatment area grids will be laid out in the field with a tape measure. Pin flags (or equivalent) will be used to delineate the corners of each grid area (or treatment "cell"); however, pin flags and/or other field marking options will be used judiciously to prevent possible damage to buried landfill liners.

On-site personnel will perform pH analyses before each explosives treatment cycle to ensure that the soil pH is within the desired range of 5.5 to 8.5 (as prescribed by GRACE). The pH analyses will be performed in accordance with the methods described in Appendix F of this work plan amendment.

As determined by GRACE during their site-specific treatability study, WBPLF soils requiring treatment for explosives (and currently stockpiled in Trench 6 and Trench 7) are expected to require a maximum of six DARAMEND treatment cycles to achieve the 10^{-6} cumulative risk remediation criteria. The actual number of cycles necessary to achieve cleanup goals is dependent on the beginning concentration of the explosives. However, in general, each DARAMEND treatment cycle is expected to reduce the concentration of explosives by approximately one-half. For example, if the concentration of the untreated soil starts at 2,000 mg/kg explosives, the first treatment cycle should reduce that concentration to approximately 1,000 mg/kg, the second cycle should reduce it to approximately 500 mg/kg, and so on. The following steps roughly define a single DARAMEND treatment cycle for explosives-contaminated soil:

1. Distribute DARAMEND organic amendments and powdered iron (and pH adjustment chemicals, if required) uniformly over the soil treatment area;
2. Thoroughly till the DARAMEND amendments and powdered iron (and pH adjustment chemicals, if required) into the soil treatment area;

3. Collect soil samples and test for Water Holding Capacity (WHC) (first cycle only) and moisture content, then calculate required irrigation rate based upon the target moisture content (i.e., 85 percent of the WHC);
4. Irrigate soil at calculated application rate to achieve target moisture content;
5. Measure the redox potential of the soil between 12 to 36 hours after irrigation is complete to verify that the redox potential reaches a level less of than –350 millivolts; adjust irrigation and/or treatment amendment application rates (at the direction of GRACE) if necessary to achieve the target redox levels;
6. Allow the soil to stand undisturbed for the anoxic treatment phase (approximately 5 to 7 days), then collect soil samples for explosives analyses and pH determination; monitor the redox potential and moisture content of the soil to determine when the anoxic treatment phase is complete;
7. Repeat steps 1 through 6 until explosives concentrations are reduced to less than 10^{-6} cumulative risk levels.

These steps are described in additional detail in the following paragraphs and in the *Preliminary Procedures Manual* (GRACE, June 2001b), as provided in Appendix F of this work plan amendment.

Step 1 consists of uniformly distributing the DARAMEND organic amendments and iron powder over the soil treatment areas of Trench 6 and Trench 7. Also, if the pH of the WBPLF soil is unexpectedly below the desired range (5.5 to 8.5), Quicklime (calcium oxide) or hydrated lime (calcium hydroxide) will be added to the amendments distributed during this step to adjust the pH. The process of distributing the treatment amendments over the entire treatment area is expected to take approximately 1 day in Trench 6 (and approximately ½ day in Trench 7) using an LGP tractor equipped with a front-end loader. The DARAMEND organic amendments and iron powder will be delivered to the site in 1-ton sacks and will be dispersed by placing the materials in the bucket of a front-end loader and slowly discharging the materials (by gently tipping the bucket) as the vehicle is driven over the treatment area. The on-site technical representative from GRACE will supervise/direct this operation to ensure that the materials are adequately distributed, as uniformly as possible, across the entire treatment area. Based upon the results of GRACE's site-specific IAAAP-WBPLF treatability study, the application rate for the DARAMEND organic amendments is 2 percent by (wet) weight for the first treatment cycle plus 0.5 percent by (wet) weight for each additional treatment cycle. Powdered iron will be applied at a rate of 0.2 percent by (wet) weight at the onset of each treatment cycle. In accordance with GRACE protocols, these DARAMEND and iron amendment application rates may vary by +/- 10 percent without significant impact to the DARAMEND treatment process. If required, pH adjustment chemicals will be applied in accordance with the procedures outlined in the GRACE *Preliminary Procedures Manual* (provided in Appendix F of this work plan amendment).

Step 2 involves a tilling process to mix the treatment amendments with the soil. After the required amendments are evenly distributed over the treatment area, the soil tilling process will be initiated. The objective of the tilling is to thoroughly mix the amendments into the soil. To ensure this mixing process is thorough, the tilling is performed in a minimum of two directions. Initially, the tilling will take place in a north-south direction over the entire treatment area and then the soil will be tilled in an east-west direction. The on-site GRACE technical representative will direct the tilling operation until the mixing is determined to be complete. Test holes will be dug at

random locations and the soil will be visually inspected to ensure thorough mixing of the soil and treatment amendments throughout the entire 24-inch treatment lift and across the entire treatment area. The soil tilling operation is expected to take 2 to 3 days (maximum) in Trench 6 and 1 to 2 days (maximum) in Trench 7.

In **Step 3**, soil samples will be collected from each treatment area or "cell" (at a frequency of 1 sample per 300 cubic yards, or as directed by the on-site GRACE technical representative) and tested to determine the moisture content and WHC of the soil. This information will be used to calculate the amount of water to add during irrigation. The soil tests and moisture calculations will be performed by on-site personnel in accordance with details provided in the GRACE *Preliminary Procedures Manual* (provided in Appendix F of this work plan amendment). Approximate soil moisture and WHC parameters are provided in the GRACE *Preliminary Procedures Manual* based on the DARAMEND site-specific IAAAP-WBPLF treatability study. However, these QC parameters will be determined in the field to adjust for actual site conditions just before the initiation of the first treatment cycle. WHC need only be determined one time. However, soil moisture content will be determined at the beginning of each DARAMEND treatment cycle.

Step 4 involves irrigation of the treatment area to achieve the target soil moisture content (i.e., 85percent of the soil WHC), as determined in Step 3. Irrigation water will be applied to the surface of the tilled soil at a relatively slow rate to minimize run-off and to allow the irrigation water to infiltrate the entire 24-inch treatment lift. If rainfall is absorbed by the soil after determining the irrigation requirements, but before the completion of irrigation, the watering requirements will be adjusted to account for the rainfall. In general, rainfall will not substantially impact the effectiveness of treatment; however, it may cause short delays in the application of ensuing treatment steps/cycles due to difficulties getting equipment onto the wet soil. Quality control measures for the soil irrigation process will include visual inspections to ensure uniform and thorough wetting of the soil across the entire treatment area. Also, as directed by the on-site GRACE technical representative, test holes will be dug at random and/or biased locations and the soil will be checked (visually and/or with soil moisture tests) to ensure adequate wetting of the soil throughout the entire 24-inch treatment lift and across the entire treatment area. A schematic diagram of the irrigation system layout for Trench 6 and Trench 7 is provided in Figure 9. Irrigation is expected to take approximately 2 days in Trench 6 and approximately 2 days in Trench 7.

During **Step 5**, the soil redox potential will be measured during a critical period 12 to 36 hours after irrigation (i.e., during the most reductive stage of treatment) to determine the effectiveness of Steps 1, 2, and 4. At this stage of the DARAMEND explosives treatment process, the redox potential of the soil should be –350 millivolts or lower. Soil redox potentials above this –350 millivolts threshold may indicate non-optimum treatment conditions. If target-level redox potentials are not achieved at this stage, the on-site GRACE technical representative will determine whether adjustments to the DARAMEND treatment process (e.g., increased irrigation and/or amendment application rates) are required before proceeding to treatment Step 6. The soil redox potential will be measured in-situ by on-site personnel using methods described in GRACE's *Preliminary Procedures Manual* (provided in Appendix F of this work plan amendment).

During **Step 6**, the treated soil will be allowed to stand undisturbed for an estimated 5 to 7 days to complete the critical anoxic treatment phase. The redox potential and moisture content of the soil will be monitored during this period to determine when the anoxic treatment phase is complete (and to determine whether additional irrigation is required prior to the completion of the anoxic treatment phase). The on-site GRACE technical representative will determine when the anoxic treatment phase is complete, based primarily upon a combination of increasing redox levels (i.e., approaching 0 millivolts) and decreasing soil moisture. (Note that it is normal for soil moisture content to fluctuate substantially within each DARAMEND treatment cycle.) After the anoxic treatment phase is determined to be complete, soil samples will be collected for explosives analysis and pH determination. Explosives analytical results will be used to measure the progress/effectiveness of the DARAMEND soil treatment process and to determine when the treatment process has been completed. Soil samples will be collected and analyzed for explosives as previously described in this section. To ensure timely receipt of results, a 3-day turnaround time will be requested for all off-site explosives analyses. The pH of the soil will be measured to determine whether an adjustment is required during Step 1 of the next treatment cycle to bring the soil within the desired pH range (5.5 to 8.5). The pH will be determined by on-site personnel using methods described in GRACE's *Preliminary Procedures Manual* (provided in Appendix F of this work plan amendment).

Step 7 is simply a repeat of Steps 1 through 6 until explosives concentrations in the WBPLF soil are reduced to levels meeting required treatment criteria (as verified by off-site analysis of explosives samples). When the on-site GRACE technical representative determines that the anoxic treatment phase (in Step 6) is complete (and required Step 6 soil samples have been collected for analysis), the entire treatment cycle is considered complete and the next DARAMEND treatment cycle can begin (if required).

Treatment of WBPLF soil will initially begin in Trench 6, followed by treatment within Trench 7. The same treatment steps will occur in Trench 6 and Trench 7, except for a time-lag between treatment steps in the two trenches. For example, while the soil within Trench 6 is being irrigated (DARAMEND treatment Step 4), the DARAMEND treatment process will be initiated (Step 1) at Trench 7. As the treatment process in Trench 7 reaches DARAMEND treatment Step 5 or 6 (approximately), the second treatment cycle will begin in Trench 6 (if the previous treatment cycle is complete), and so on until all of the soil has been successfully treated in both trenches. After completing the last DARAMEND treatment cycle, the final round of soil samples will be collected (as previously stated in this section) and all of these samples will be sent to a USACE-certified laboratory for confirmatory analysis of explosives (to verify that the DARAMEND treatment process successfully met the required explosives treatment criteria) plus metals analyses (to determine pre-treatment TCLP concentrations for metals treatment).

Table 2 presents a brief summary of the DARAMEND soil treatment process for explosives, including relevant QC parameters for the treatment of the explosives-contaminated WBPLF soil staged in Trenches 6 and 7.

TABLE 2
DARAMEND Explosives-Contaminated Soil Treatment Process Summary

Treatment Step	Operation	Remarks/QC Parameters	Estimated Duration
1	Surface application of DARAMEND organic amendments and iron powder (and pH modifier chemicals, if required)	Uniformly distribute amendments via north-south and east-west surface applications; visually inspect to verify uniform coverage of entire treatment area. Actual amendment application rates within +/- 10 percent of target rates are acceptable.	1 day in Trench 6 0.5 day in Trench 7
2	Tilling/Mixing Process for Soil and Treatment Amendments	Till soil in north-south and east-west directions. Dig small test holes at appropriate locations and visually inspect soil to ensure thorough mixing of soil and treatment amendments throughout entire 24-inch treatment lift and across the entire treatment area.	2 to 3 days in Trench 6 1 to 2 days in Trench 7
3	Collect Soil Samples and Test for Moisture Content and Water Holding Capacity	Perform on-site testing to determine soil moisture content and WHC. Determine target moisture content and calculate required irrigation rate.	1 to 2 days
4	Irrigation of Soil Treatment Area	Add water at calculated irrigation rate to achieve target soil moisture content. Surface-apply the water slowly to minimize run-off and to allow infiltration of entire 24-inch treatment lift. Adjust irrigation rate to account for rain events. Provide visual inspections to ensure uniform and thorough wetting of soil throughout entire 24-inch treatment lift and across entire treatment area. Dig small test holes and measure soil moisture at appropriate locations to verify adequate wetting of soil.	2 days
5	In-situ Measurement of Soil Redox Potential	Verify the soil redox potential reaches –350 millivolts (or lower) during maximum reductive stage of treatment (approximately 12 to 36 hours after irrigation complete). Evaluate and implement appropriate corrective measures (e.g., increased irrigation and/or amendment rates) for the DARAMEND treatment process if redox potential does not reach target levels.	0.5 to 1.5 days
6	Anoxic Treatment Phase	Allow treated soil to stand undisturbed during anoxic treatment phase. Monitor redox potential and moisture content during this period, using results to determine when anoxic treatment phase is complete (and to determine if additional irrigation water	5 to 7 days

TABLE 2
DARAMEND Explosives-Contaminated Soil Treatment Process Summary

Treatment Step	Operation	Remarks/QC Parameters	Estimated Duration
		is required prior to end of anoxic treatment phase). Anoxic treatment phase will be judged complete based upon increasing soil redox potentials (approaching zero mV) and decreasing soil moisture levels. Collect soil samples for explosives analysis and pH determination at end of anoxic treatment phase.	
7	Repeat Steps 1 through 6 or Stop when Explosives Treatment is Complete	When anoxic treatment phase is judged complete and soil samples have been collected for analysis, next DARAMEND treatment cycle can begin (if required).	-NA-
Total estimated duration of DARAMEND treatment cycle: 11 to 17 Days (in Trench 6)			

Note: For additional DARAMEND treatment details, see Appendix F.

As with most biochemical processes, some heat is generated during the DARAMEND soil treatment process. However, due to the relatively small quantity (i.e., less than 5 percent) of organic amendment that will be applied at the IAAAP site, the overall temperature change is expected to be minimal (i.e., less than 20 degrees F). If the soil temperature falls below 50 degrees F, substantial reduction in the level of microbial activity will likely occur. Based on the current schedule, the work should be completed by early fall of 2001; therefore, ambient temperatures are not expected to significantly impact the DARAMEND soil treatment process and soil temperatures will not be monitored unless/until average daily ambient temperatures begin to approach 50 degrees F.

2.4.3 Metals Treatment Process

Initial pre-treatment and final post-treatment verification soil samples will all be sent to an off-site USACE-certified laboratory for TCLP extraction using SW-846 Method 1311 followed by metals analyses using EPA Method 6010B/7470 procedures. In accordance with standard project QC procedures, approximately 10 percent of all soil samples sent to the primary laboratory will be split and analyzed in duplicate. In addition, at the direction of the USACE project chemist, QA split samples for approximately 10 percent of the final post-treatment metals soil samples will be sent to another USACE-approved laboratory for an independent check of the primary laboratory's analytical results.

A number of treatability studies were completed on Trench 6 and Trench 7 soils from the IAAAP site for stabilization and chemical fixation of metals; however, barium was the only metal analyzed during testing. Therefore, additional treatability studies are currently being performed to determine the effectiveness of the reagents on all metals. Samples will be submitted by the vendors to a laboratory for TCLP extraction using SW-846 Method 1311; then the extract will be analyzed for metals using EPA Method 6010A. Although additional studies are being performed, CAPE is confident the following treatment process will remain unchanged; however, this section will be revised following

treatability testing, as appropriate. A treatability study report will be incorporated into this document as soon as the data is available.

A technical representative from the metals treatment vendor will be mobilized to the site before the initiation of treatment activities. The technical representative will remain on site until metals treatment has been completed. The soils will remain in the same 24-inch deep configuration and the application of metals treatment will use the same mixing and irrigation equipment as in the DARAMEND process. The metals additive(s) will be placed, mixed, and irrigated into the soils. Soils will be allowed to cure overnight at each treatment area. A single cycle is expected to treat the soils to below the LDRs. A complete description of each step is described in the following paragraph.

In Step 1, the application of the treatment additives (possibly including the synthetic gypsum presently stockpiled in Trench 7) will be dispersed evenly over the treatment areas. This operation will take approximately 1 day at each trench. Soil will be tilled in a minimum of two directions in Step 2. Tilling will begin in the north-south direction then in the east-west direction until the technical representative deems the additives are thoroughly mixed; test holes will be dug at random locations to verify complete mixing over the full 24 inches. The tilling operation is expected to take approximately 2 to 3 days at each area. Following tilling, the moisture content should be maintained between 12 to 15 percent. Samples will be collected from the treatment areas periodically to ensure that an effective moisture content is maintained. If the materials become too wet, the treatment area will be tilled; if too dry, treatment areas will be irrigated (Step 3). The time for irrigation is estimated at 2 days at each trench. Then a 24-hour treatment time will ensue (Step 4).

Samples will be collected at a frequency of one five-point composite sample per 300 cubic yards of soil. Therefore, one composite sample will be prepared and analyzed per 4050 square feet. Samples will be collected from the full treatment depth (0 to 24 inches) at each location and composited in a stainless bowl. The sampling grid will be the same grid used for explosives sampling; sample locations are shown in Figure 8. Samples will then be systematically quartered and requartered until the correct volume is achieved for each sample. These composite soil samples will be sent to a USACE-certified laboratory for TCLP extraction using SW-846 Method 1311, followed by analysis of the extract using EPA Method 6010A. A 3-day turnaround time will be requested. Upon receipt of analytical results, any grids areas that were unsuccessfully treated will be retreated. Table 3 presents the quality control measures that will be implemented during metals treatment. Details of the metals treatment process are contained within Appendix G.

TABLE 3
Quality Control Measures for Metals Treatment

Treatment Step	Operation	QC Tests/Comments	Estimated Duration
1	Application of reagents	Apply in north-south and east-west orientation and visually inspect to verify complete coverage.	1 day
2	Mixing Process	Till in north-south and east-west orientation and visually inspect to verify complete mixing. Also, dig small test holes from 0 to 24 inches at random locations to ensure proper mixing. The	2 to 3 days

TABLE 3
Quality Control Measures for Metals Treatment

Treatment Step	Operation	QC Tests/Comments	Estimated Duration
		tiller can mix to an effective depth of 26 inches.	
3	Irrigation	Visually inspect to ensure complete wetting.	2 days
4	Treatment Time	Ensure reasonable drying time.	1 days
		Total estimated duration of cycle time:	**6 to 7 Days**

Note: For additional treatment details, see Appendix G.

When the metals treatment is successfully completed, site restoration will be initiated.

2.4.4 Site Restoration and Demobilization

Following successful treatment, all WBPLF soils remaining in Trench 7 will be transferred into Trench 6; Trench 6 provides for control and long-term management of the treated soils, as specified in the ROD. Trenches 6 and 7 will then be graded, as required, to promote drainage toward the water collection systems located at the south end of each trench. Trench 6 and Trench 7 will both be prepared for winter operations via implementation of USACE-directed maintenance-minimization measures (e.g., precipitation-resistant soil covers). At the completion of site restoration, equipment and all miscellaneous facilities will be demobilized, followed by demobilization of project personnel.

3.0 PROJECT SCHEDULE

The total effort including mobilization, site preparation, explosives and metals treatment, and site restoration is expected to take approximately 3.5 months. The project schedule is presented in Figure 10. Weather contingency days are not reflected in the schedule.

4.0 REFERENCES

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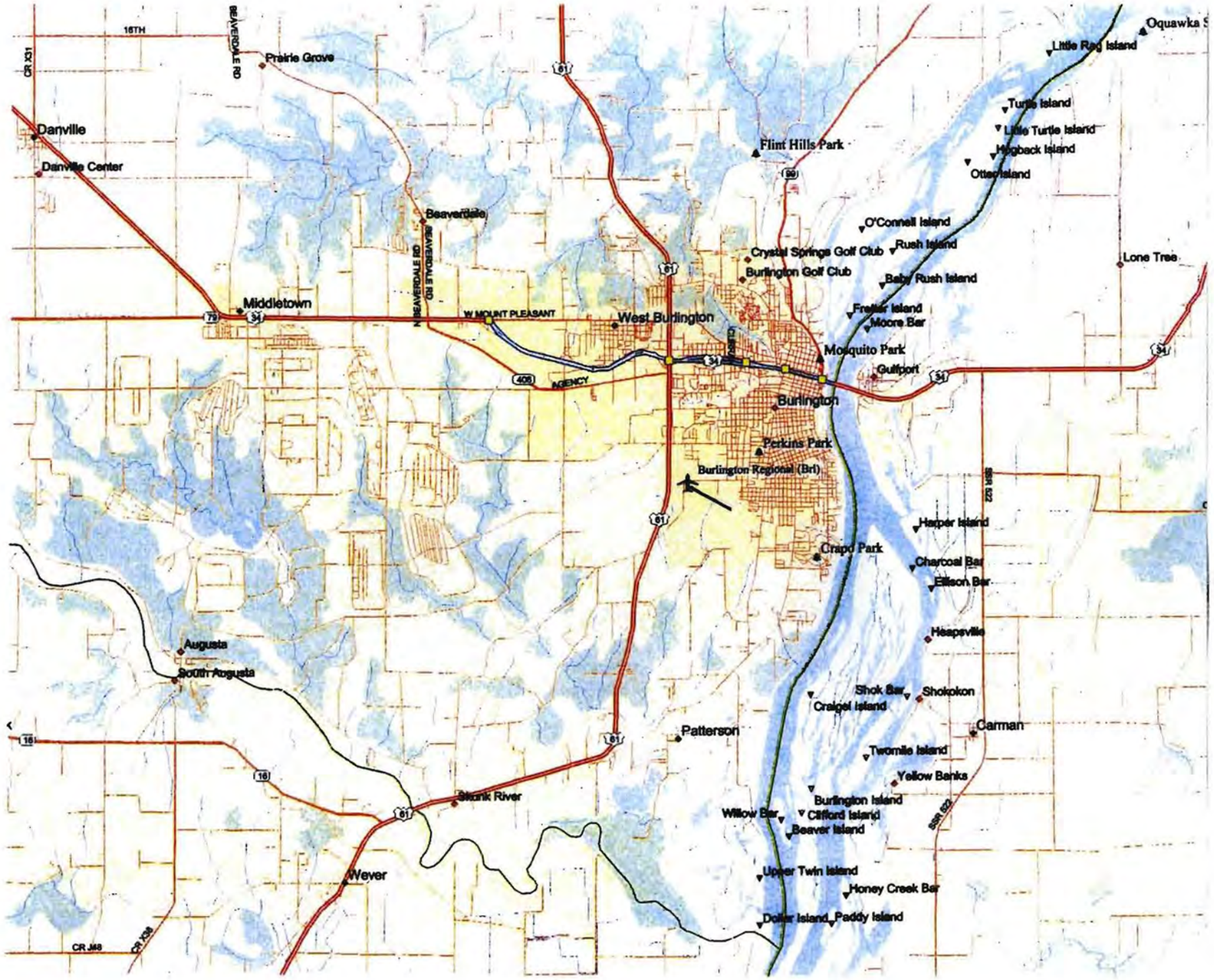
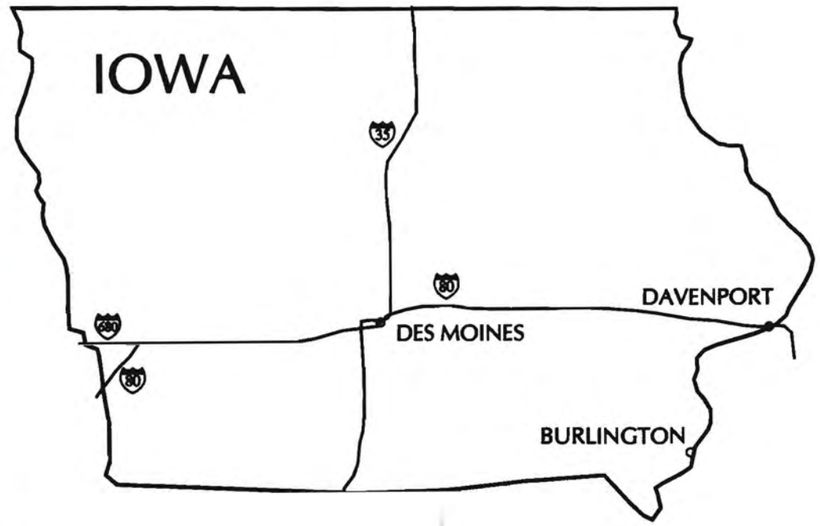


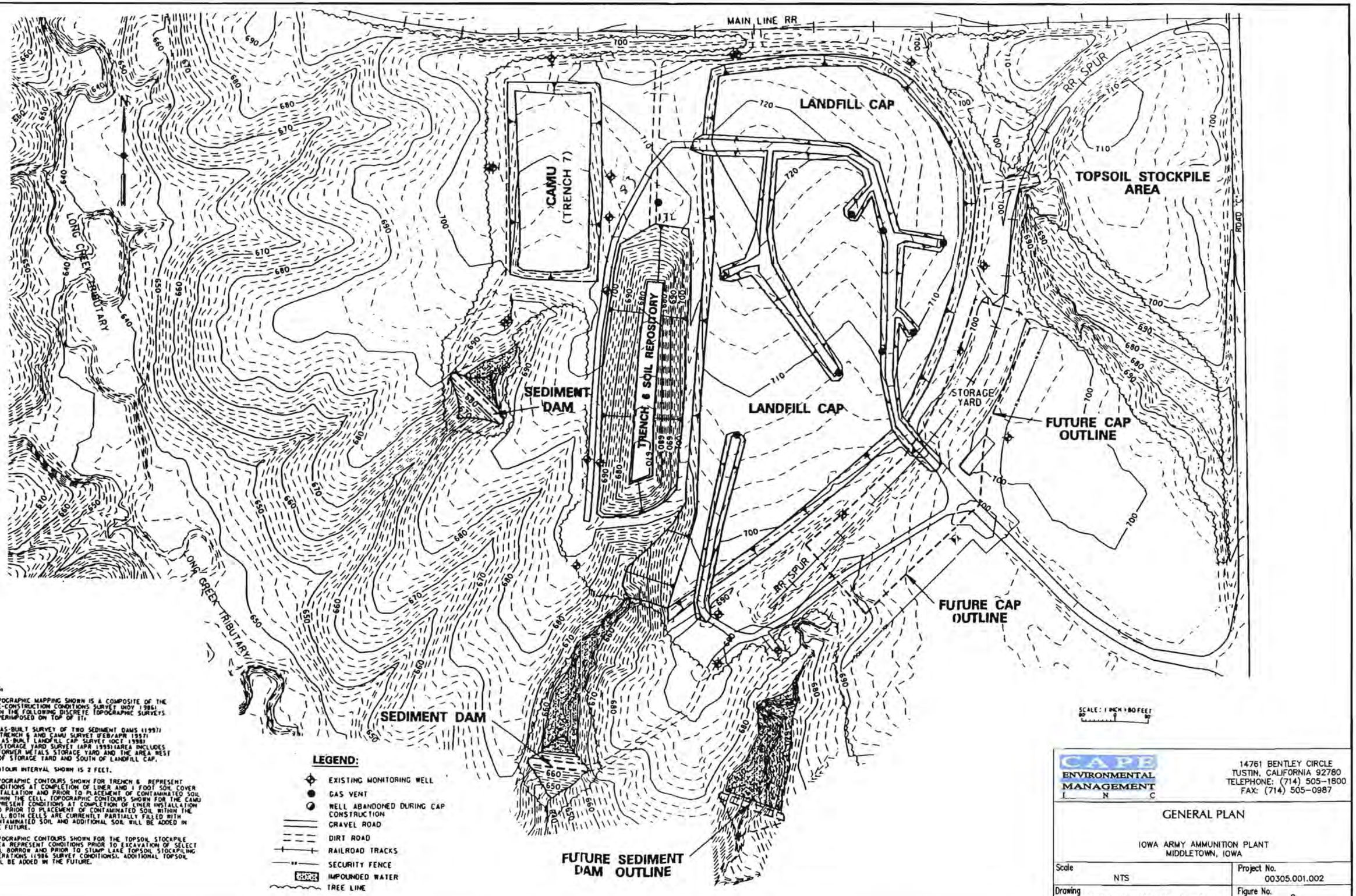


CAPE ENVIRONMENTAL MANAGEMENT INC
14761 BENTLEY CIRCLE
TUSTIN, CALIFORNIA 92780
TELEPHONE: (714) 505-1800
FAX: (714) 505-0987

LOCATION MAP

IOWA ARMY AMMUNITION PLANT
MIDDLETOWN, IOWA

Scale	Project No.
NTS	00305.001.002
Drawing \DWG\OPEN\IOWA-AAA\IOWA-STATE.DWG	Figure No. 1



NOTES:

1. TOPOGRAPHIC MAPPING SHOWN IS A COMPOSITE OF THE PRE-CONSTRUCTION CONDITIONS SURVEY (NOV 1986) WITH THE FOLLOWING DISCRETE TOPOGRAPHIC SURVEYS SUPERIMPOSED ON TOP OF IT:

   (1) AS-BUILT SURVEY OF TWO SEDIMENT DAMS (1997)
   (2) TRENCH 6 AND CAMU SURVEY (FEB/APR 1997)
   (3) AS-BUILT LANDFILL CAP SURVEY (OCT 1998)
   (4) STORAGE YARD SURVEY (APR 1998) (AREA INCLUDES FORMER METALS STORAGE YARD AND THE AREA WEST OF STORAGE YARD AND SOUTH OF LANDFILL CAP.

2. CONTOUR INTERVAL SHOWN IS 2 FEET.

3. TOPOGRAPHIC CONTOURS SHOWN FOR TRENCH 6 REPRESENT CONDITIONS AT COMPLETION OF LINER AND 1 FOOT SOIL COVER INSTALLATION AND PRIOR TO PLACEMENT OF CONTAMINATED SOIL WITHIN THE CELL. TOPOGRAPHIC CONTOURS SHOWN FOR THE CAMU REPRESENT CONDITIONS AT COMPLETION OF LINER INSTALLATION AND PRIOR TO PLACEMENT OF CONTAMINATED SOIL WITHIN THE CELL. BOTH CELLS ARE CURRENTLY PARTIALLY FILLED WITH CONTAMINATED SOIL AND ADDITIONAL SOIL WILL BE ADDED IN THE FUTURE.

4. TOPOGRAPHIC CONTOURS SHOWN FOR THE TOPSOIL STOCKPILE AREA REPRESENT CONDITIONS PRIOR TO EXCAVATION OF SELECT FILL BORROW AND PRIOR TO STUMP LAKE TOPSOIL STOCKPILING OPERATIONS (1986 SURVEY CONDITIONS). ADDITIONAL TOPSOIL WILL BE ADDED IN THE FUTURE.

LEGEND:

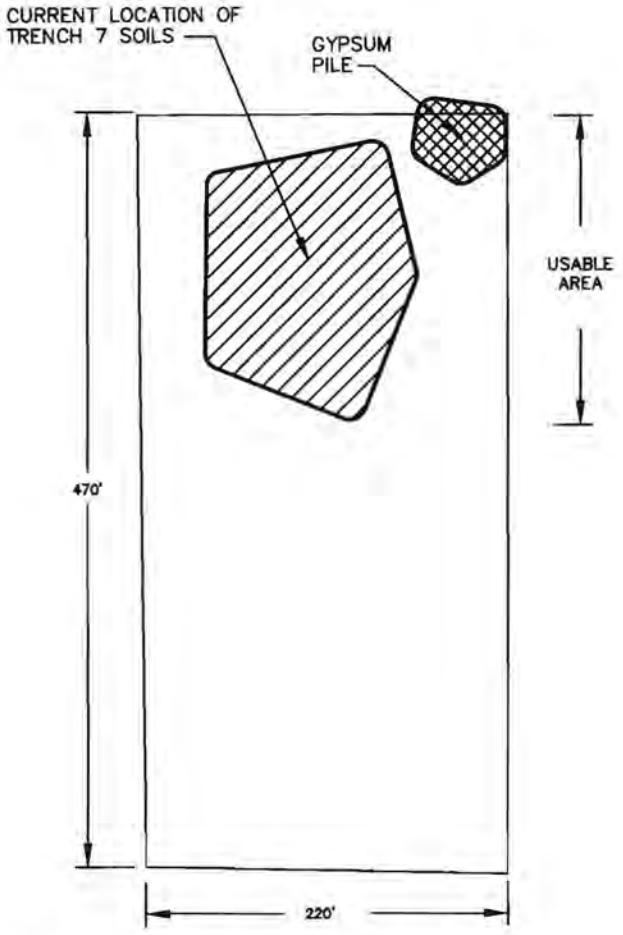
- EXISTING MONITORING WELL
- GAS VENT
- WELL ABANDONED DURING CAP CONSTRUCTION
- GRAVEL ROAD
- DIRT ROAD
- RAILROAD TRACKS
- SECURITY FENCE
- IMPOUNDED WATER
- TREE LINE

CAPE ENVIRONMENTAL MANAGEMENT I N C
14761 BENTLEY CIRCLE
TUSTIN, CALIFORNIA 92780
TELEPHONE: (714) 505-1800
FAX: (714) 505-0987

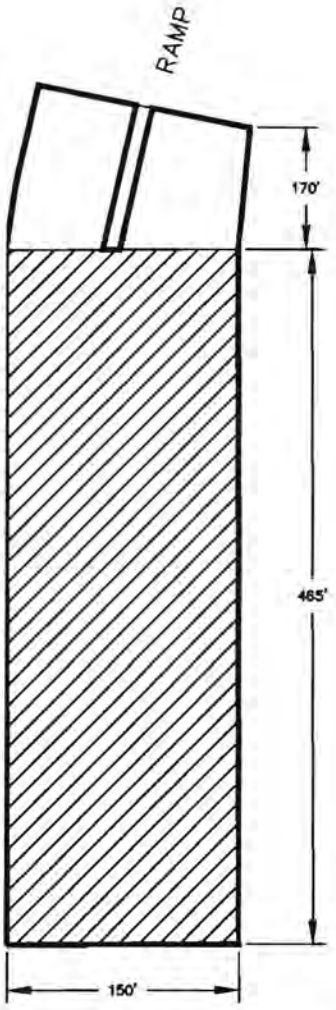
GENERAL PLAN

IOWA ARMY AMMUNITION PLANT
MIDDLETOWN, IOWA

Scale: NTS	Project No.: 00305.001.002
Drawing: \DWG\OPEN\IOWA-AAA\GENERAL PLAN.DWG	Figure No.: 2



WEST BURN PADS LANDFILL SOILS IN TRENCH 7
SOILS FOR BIOREMEDIATION & METALS
APPROX. 4,032 CUBIC YDS



WEST BURN PADS LANDFILL SOILS IN TRENCH 6
SOILS FOR BIOREMEDIATION
APPROX. 5,112 CUBIC YDS
2,556 CUBIC YARDS REQUIRING TREATMENT

LEGEND

WBPLF SOILS

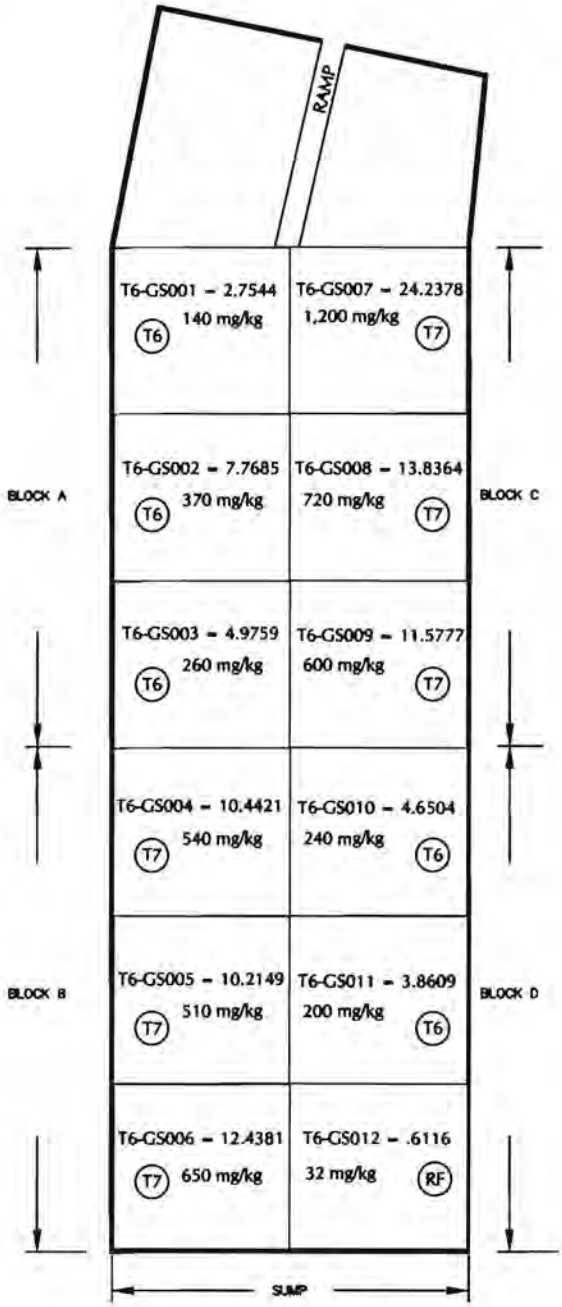
N

: VOL1\CAD\DWG\OPEN\IOWA-AAP\FIGURE1

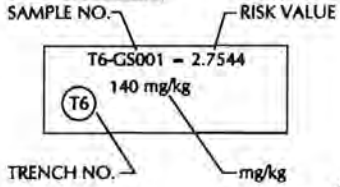
CAPE ENVIRONMENTAL MANAGEMENT INC
14761 BENTLEY CIRCLE
TUSTIN, CALIFORNIA 92780
TELEPHONE: (714) 505-1800
FAX: (714) 505-0987

PRESENT SOILS
DISPOSITION

Scale	Project No.
NOT TO SCALE	00305.001.005
Drawing: NEW-FIG3.DWG	Figure No.: 3



EXPLANATION:



RDX ARITHMETIC AVERAGE	RISK VALUE	TRENCH NO.
BLOCK A – 257 mg/kg RDX –	5.1663	– T6
*BLOCK B – 567 mg/kg RDX –	11.0317	– T7
**BLOCK C – 840 mg/kg RDX –	16.5506	– T7
BLOCK D – 157 mg/kg RDX –	3.0409	– T6

(T6) TRENCH 6 MATERIAL

(T7) TRENCH 7 MATERIAL

(RF) RANDOM FILL

* Slightly above Trench 6 criteria
**Above Trench 6 criteria

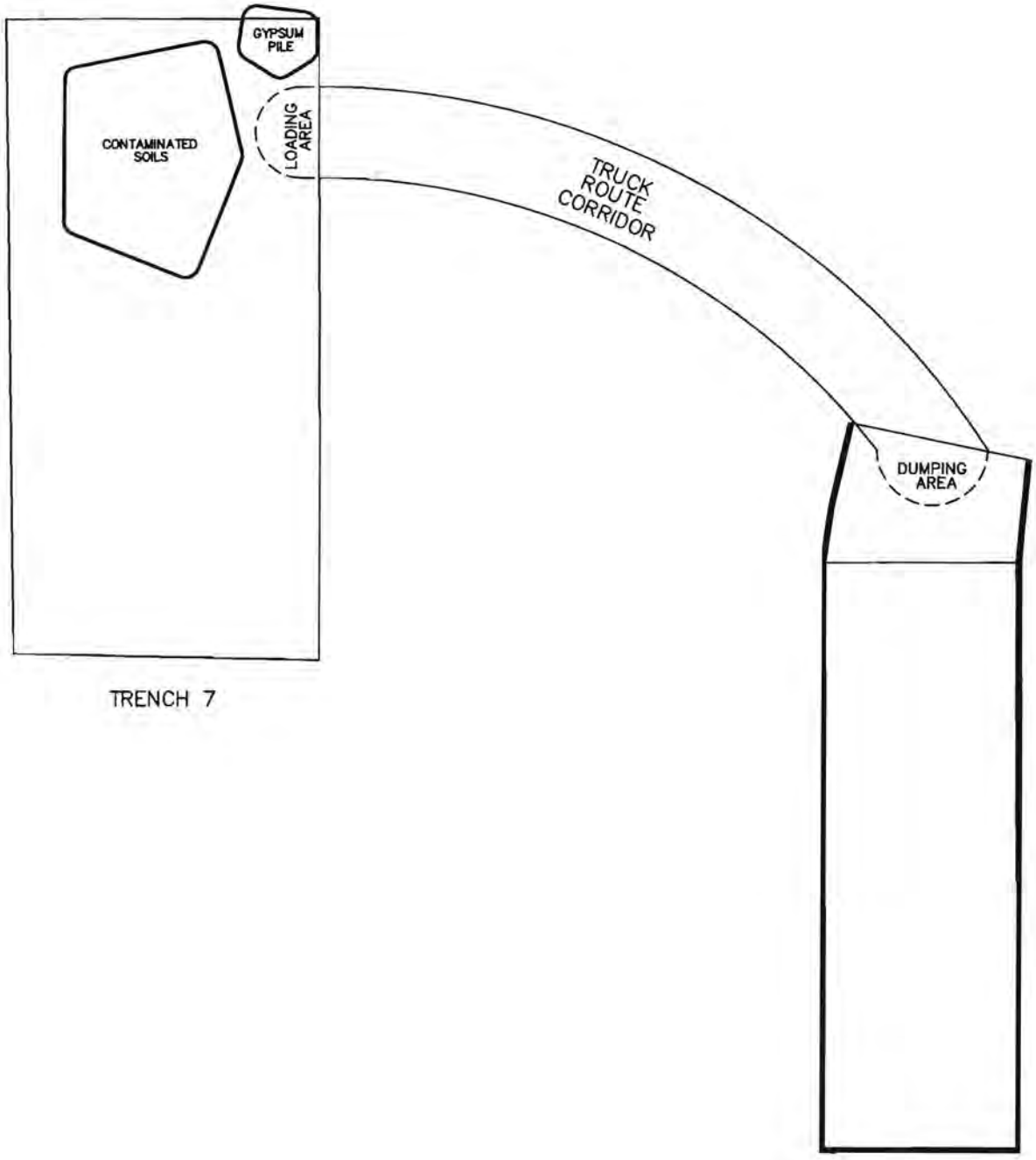
N

:VOL1\CAD\DWG\OPEN\OWA-AAP\FIGURE2

CAPE ENVIRONMENTAL MANAGEMENT INC
14761 BENTLEY CIRCLE
TUSTIN, CALIFORNIA 92780
TELEPHONE: (714) 505-1500
FAX: (714) 505-0987

TRENCH 6
RECENT ANALYTICAL RESULT RDX

Scale	Project No.
NOT TO SCALE	00305.001.005
Drawing: FIGURE3rv7-01.DWG	Figure No. 4



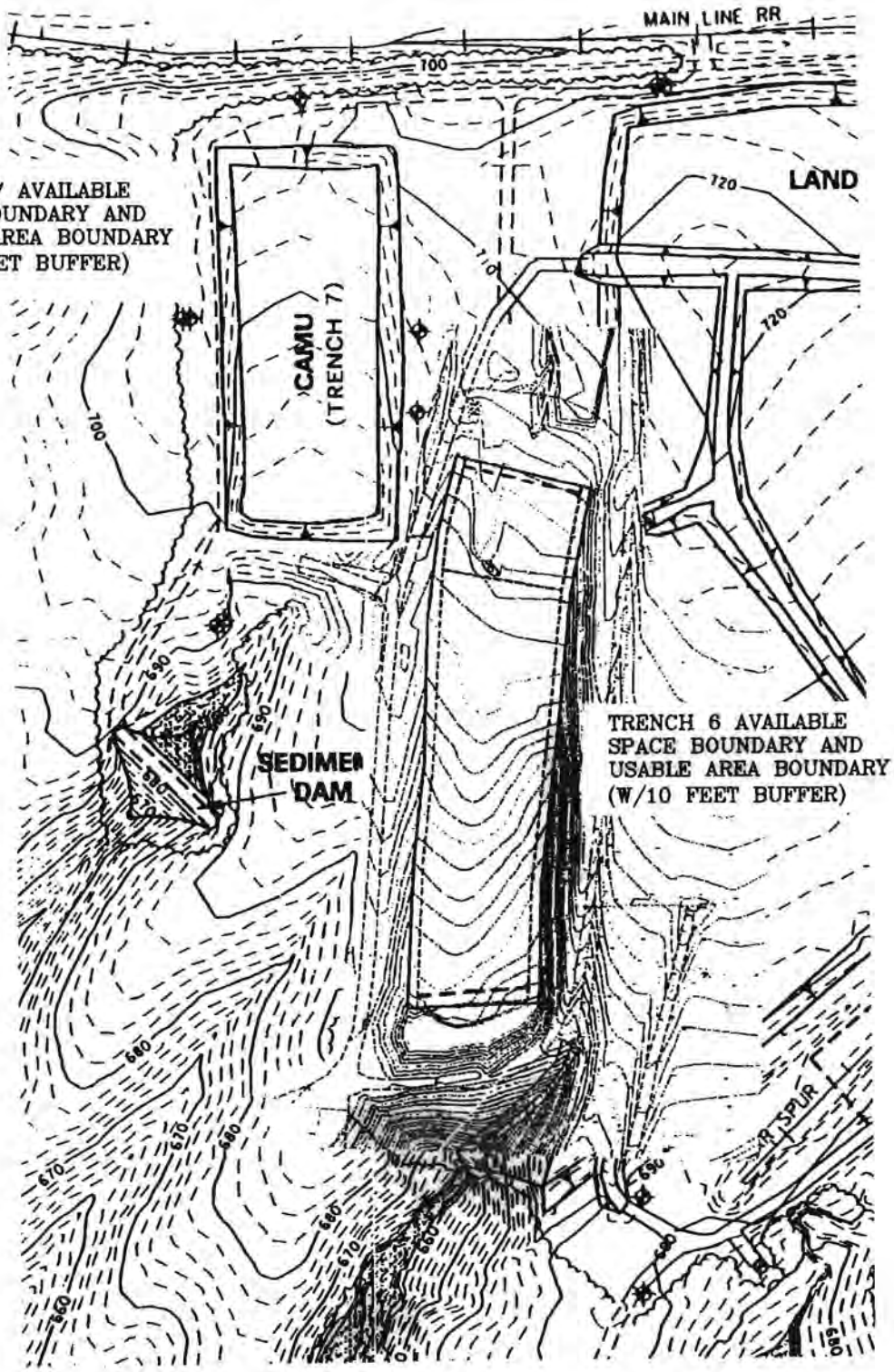
N

:\DL1\CAD\DWG\OPEN\IOWA-AAP\FIGURE4NEW

CAPE ENVIRONMENTAL MANAGEMENT INC
14761 BENTLEY CIRCLE
TUSTIN, CALIFORNIA 92780
TELEPHONE: (714) 505-1800
FAX: (714) 505-0987

SOILS TRANSPORT ROUTE
BETWEEN TRENCH 6 & 7

Scale	Project No.
NOT TO SCALE	00305.001.005
Drawing: FIGURE4NEW.DWG	Figure No.: 5



SCALE 1"=100'

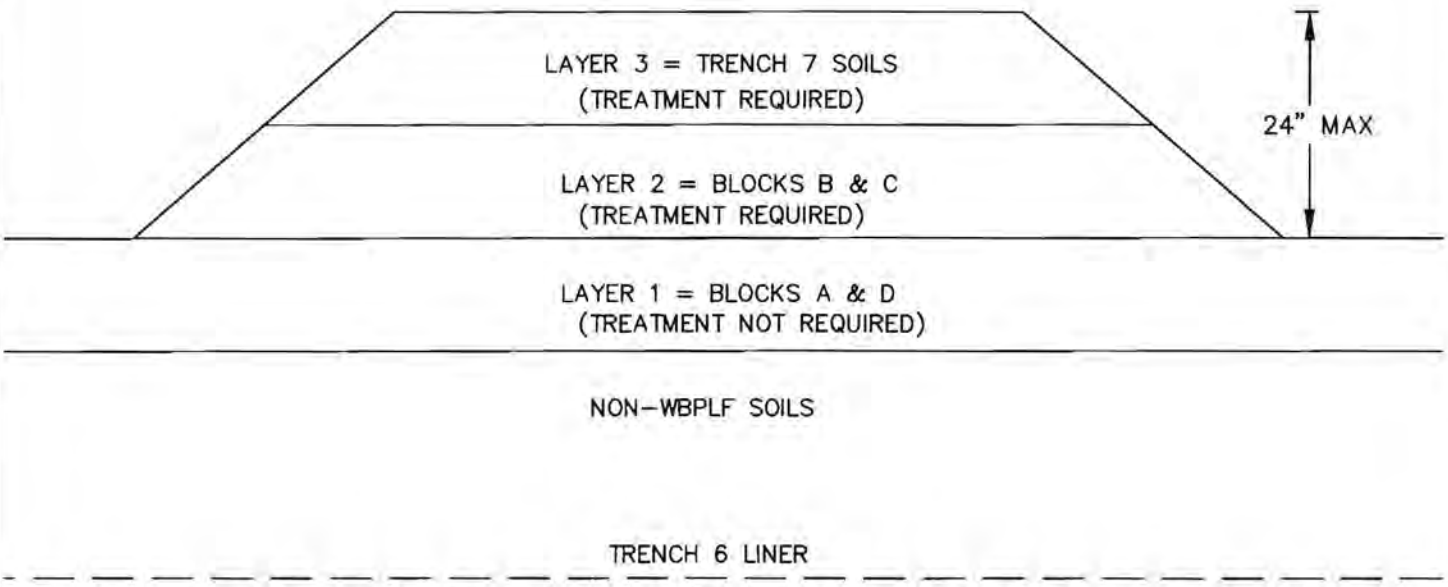
N

:VOL1\CAD\DWG\OPEN\IOWA-AAP\FIGURE3NEW

CAPE ENVIRONMENTAL MANAGEMENT INC
14781 BENTLEY CIRCLE
TUSTIN, CALIFORNIA 92780
TELEPHONE: (714) 505-1800
FAX: (714) 505-0987

TRENCH 6 & 7
BUFFER ZONES

Scale	Project No.
NOT TO SCALE	00305.001.005
Drawing: FIGURE3NEW.DWG	Figure No.: 6



: VOL1\CAD\DWG\OPEN\IOWA-AAP\FIGURE8NEW

CAPE ENVIRONMENTAL MANAGEMENT INC
14761 BENTLEY CIRCLE
TUSTIN, CALIFORNIA 92780
TELEPHONE: (714) 505-1800
FAX: (714) 505-0987

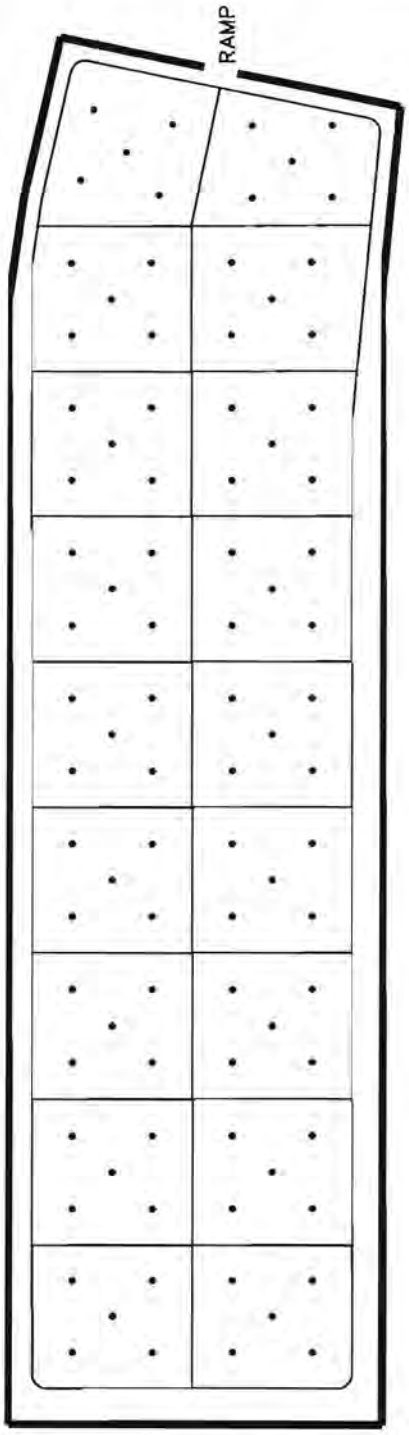
CROSS SECTION OF TREATMENT SOILS
TRENCH 6

Scale	Project No.
NOT TO SCALE	00305.001.005
Drawing: FIGURE5rv7-01.DWG	Figure No.: 7

5 GRIDS

APPROXIMATE GRID SIZE
100' X 35' X 2' = 259 cubic yards

TRENCH 7

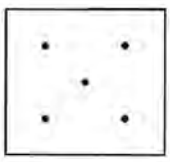


18 GRIDS

APPROXIMATE GRID SIZE
63' X 63' X 2' = 294 cubic yards

TRENCH 6

LEGEND



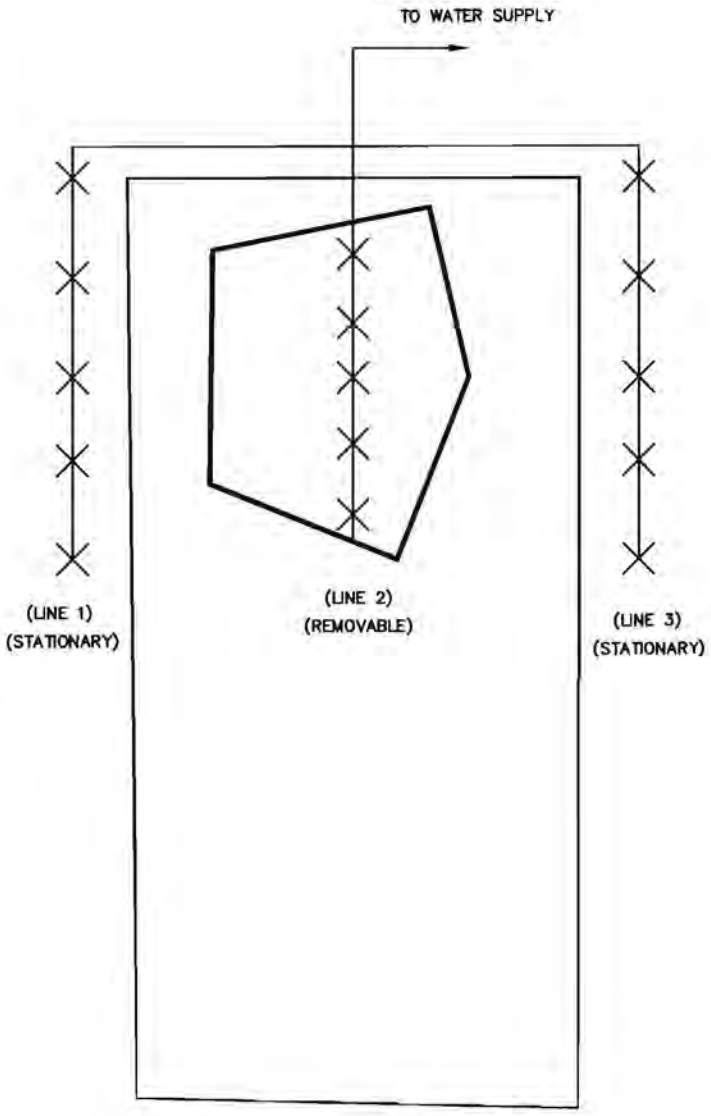
SUBSAMPLE LOCATIONS
(TO BE COMPOSITED)

:VOL1\CAD\DWG\OPEN\IOWA-AAP\FIGURE9

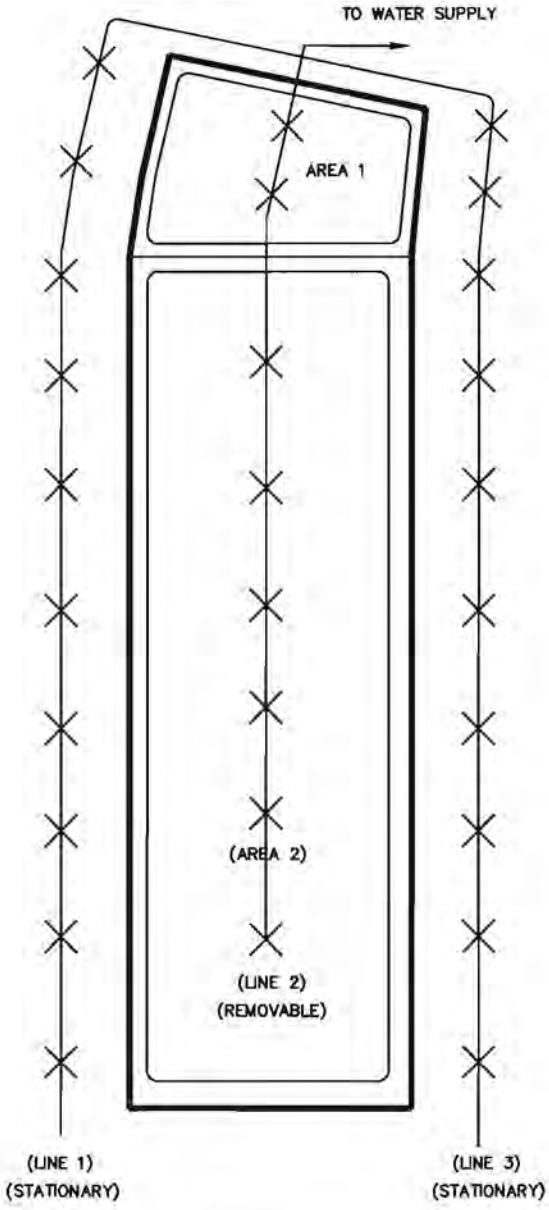
CAPE ENVIRONMENTAL MANAGEMENT INC
14761 BENTLEY CIRCLE
TUSTIN, CALIFORNIA 92780
TELEPHONE: (714) 505-1800
FAX: (714) 505-0987

SAMPLE GRID

Scale	Project No.
NOT TO SCALE	00305.001.005
Drawing: FIGURE9.DWG	Figure No.: 8



TRENCH 7



TRENCH 6

N

LEGEND

SPRINKLER LINE

SPRINKLER HEAD

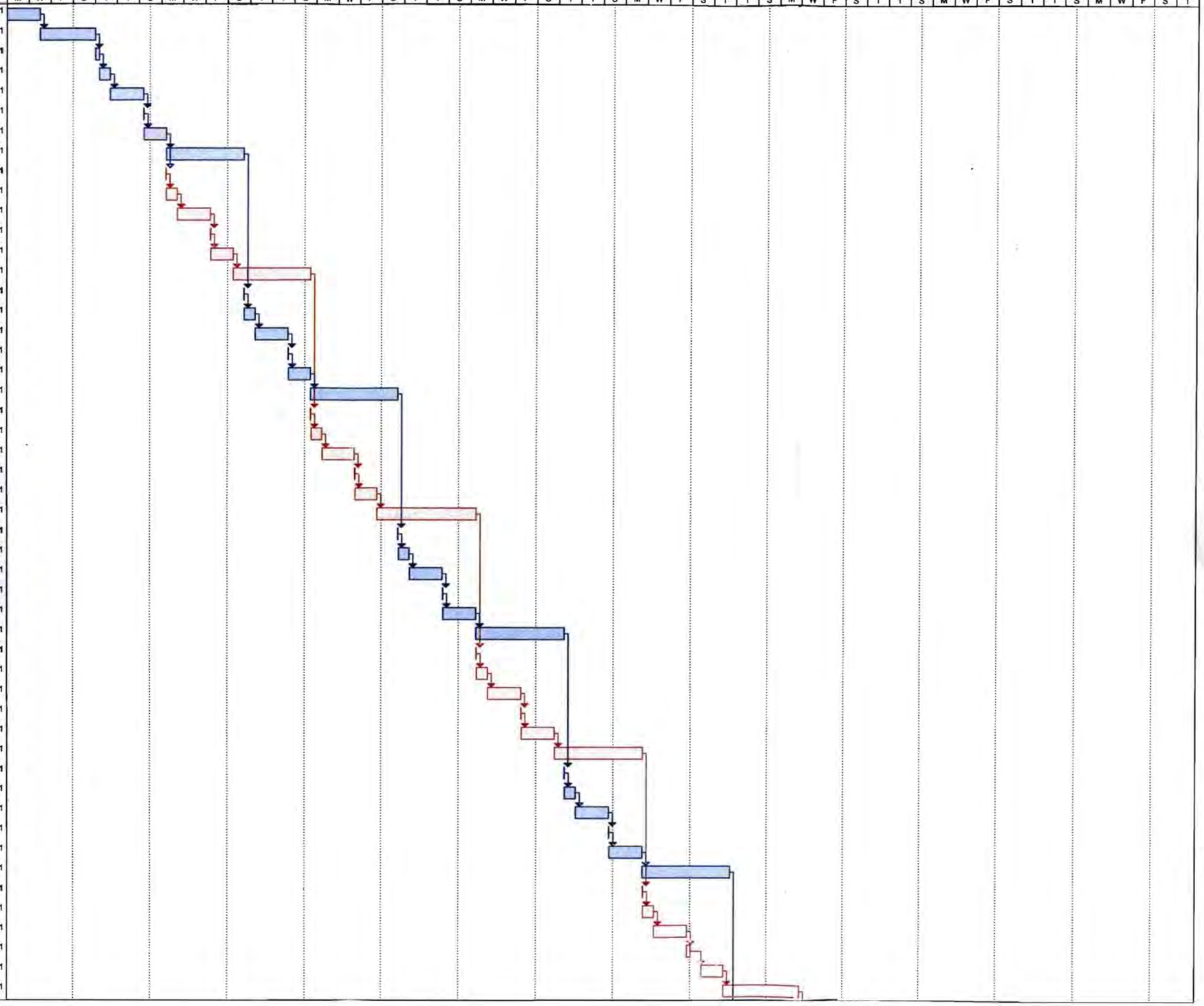
:VOL1\CAD\DWG\OPEN\OWA-AAP\FIGURE8

CAPE ENVIRONMENTAL MANAGEMENT INC
14781 BENTLEY CIRCLE
TUSTIN, CALIFORNIA 92780
TELEPHONE: (714) 505-1800
FAX: (714) 505-0987

SPRINKLER SYSTEM

Scale	Project No.
NOT TO SCALE	00305.001.005
Drawing: FIGURE8.DWG	Figure No.: 9

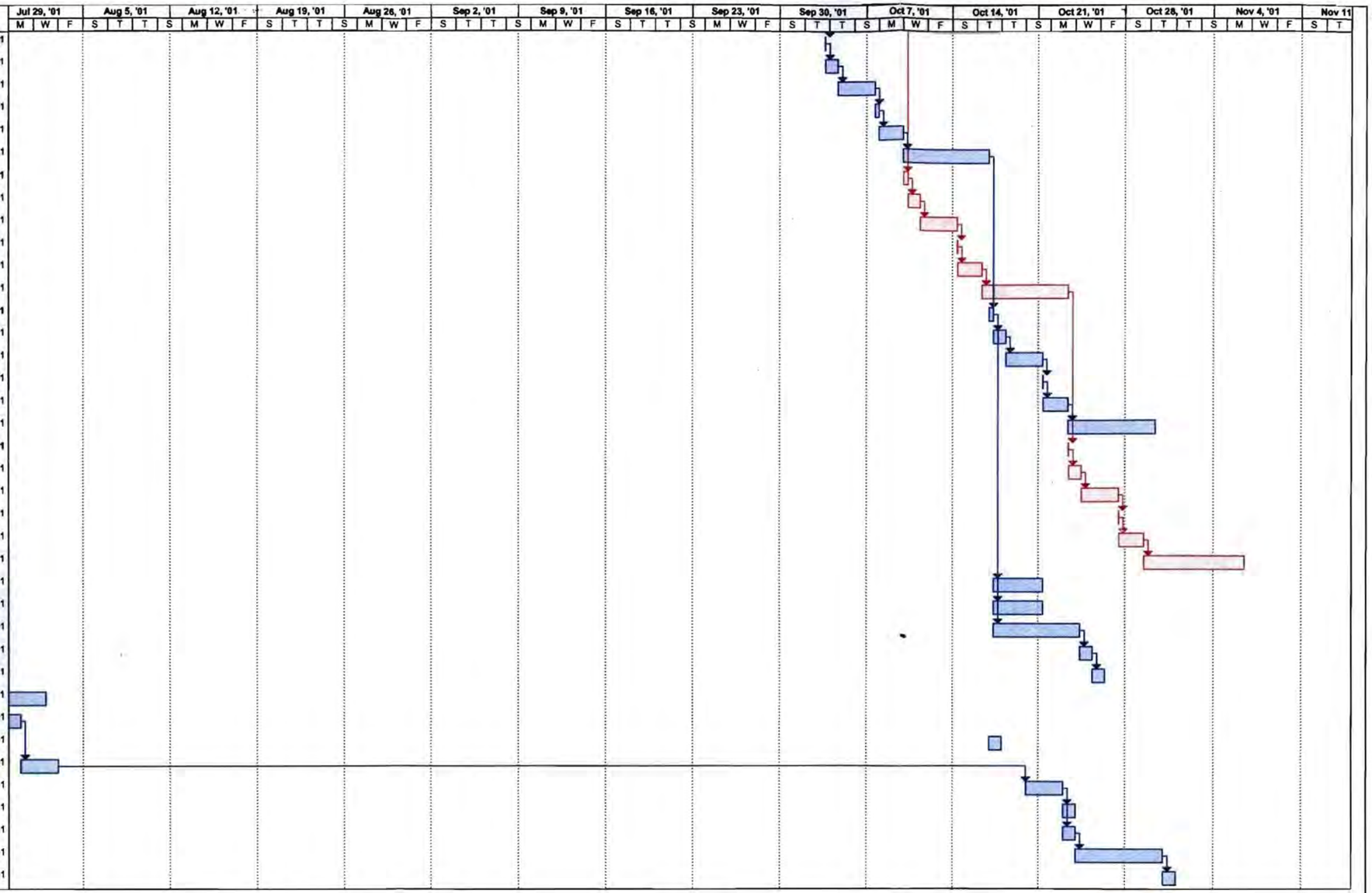
ID	Task Name	Duration	Start	Finish
1	Mobilize	3 days	Mon 7/30/01	Wed 8/1/01
2	Site Preparation	5 days	Thu 8/2/01	Mon 8/6/01
3	**First Cycle - Trench 6**	**0.1 days**	**Tue 8/7/01**	**Tue 8/7/01**
4	Apply DARAMEND amendment (organic and inorganic)	1 day	Tue 8/7/01	Wed 8/8/01
5	Thoroughly Till Soil (Both Directions)	3 days	Wed 8/8/01	Sat 8/11/01
6	Collect Soil Moisture Samples	0.1 days	Sat 8/11/01	Sat 8/11/01
7	Irrigate	2 days	Sat 8/11/01	Mon 8/13/01
8	Treatment Time	7 days	Mon 8/13/01	Mon 8/20/01
9	**First Cycle - Trench 7**	**0.1 days**	**Mon 8/13/01**	**Mon 8/13/01**
10	Apply DARAMEND amendment (organic and inorganic)	1 day	Mon 8/13/01	Tue 8/14/01
11	Thoroughly Till Soil (Both Directions)	3 days	Tue 8/14/01	Fri 8/17/01
12	Collect Soil Moisture Samples	0.1 days	Fri 8/17/01	Fri 8/17/01
13	Irrigate	2 days	Fri 8/17/01	Sun 8/19/01
14	Treatment Time	7 days	Sun 8/19/01	Sun 8/26/01
15	**Second Cycle - Trench 6**	**0.1 days**	**Mon 8/20/01**	**Mon 8/20/01**
16	Apply DARAMEND amendment (organic and inorganic)	1 day	Mon 8/20/01	Tue 8/21/01
17	Thoroughly Till Soil (Both Directions)	3 days	Tue 8/21/01	Fri 8/24/01
18	Collect Soil Moisture Samples	0.1 days	Fri 8/24/01	Fri 8/24/01
19	Irrigate	2 days	Fri 8/24/01	Sun 8/26/01
20	Treatment Time	7 days	Sun 8/26/01	Mon 9/3/01
21	**Second Cycle - Trench 7**	**0.1 days**	**Sun 8/26/01**	**Sun 8/26/01**
22	Apply DARAMEND amendment (organic and inorganic)	1 day	Sun 8/26/01	Mon 8/27/01
23	Thoroughly Till Soil (Both Directions)	3 days	Mon 8/27/01	Thu 8/30/01
24	Collect Soil Moisture Samples	0.1 days	Thu 8/30/01	Thu 8/30/01
25	Irrigate	2 days	Thu 8/30/01	Sat 9/1/01
26	Treatment Time	7 days	Sat 9/1/01	Mon 9/10/01
27	**Third Cycle - Trench 6**	**0.1 days**	**Mon 9/3/01**	**Mon 9/3/01**
28	Apply DARAMEND amendment (organic and inorganic)	1 day	Mon 9/3/01	Tue 9/4/01
29	Thoroughly Till Soil (Both Directions)	3 days	Tue 9/4/01	Fri 9/7/01
30	Collect Soil Moisture Samples	0.1 days	Fri 9/7/01	Fri 9/7/01
31	Irrigate	2 days	Fri 9/7/01	Mon 9/10/01
32	Treatment Time	7 days	Mon 9/10/01	Tue 9/18/01
33	**Third Cycle - Trench 7**	**0.1 days**	**Mon 9/10/01**	**Mon 9/10/01**
34	Apply DARAMEND amendment (organic and inorganic)	1 day	Mon 9/10/01	Tue 9/11/01
35	Thoroughly Till Soil (Both Directions)	3 days	Tue 9/11/01	Fri 9/14/01
36	Collect Soil Moisture Samples	0.1 days	Fri 9/14/01	Fri 9/14/01
37	Irrigate	2 days	Fri 9/14/01	Mon 9/17/01
38	Treatment Time	7 days	Mon 9/17/01	Tue 9/25/01
39	**Fourth Cycle - Trench 6**	**0.1 days**	**Tue 9/18/01**	**Tue 9/18/01**
40	Apply DARAMEND amendment (organic and inorganic)	1 day	Tue 9/18/01	Wed 9/19/01
41	Thoroughly Till Soil (Both Directions)	3 days	Wed 9/19/01	Sat 9/22/01
42	Collect Soil Moisture Samples	0.1 days	Sat 9/22/01	Sat 9/22/01
43	Irrigate	2 days	Sat 9/22/01	Tue 9/25/01
44	Treatment Time	7 days	Tue 9/25/01	Wed 10/3/01
45	**Fourth Cycle - Trench 7**	**0.1 days**	**Tue 9/25/01**	**Tue 9/25/01**
46	Apply DARAMEND amendment (organic and inorganic)	1 day	Tue 9/25/01	Wed 9/26/01
47	Thoroughly Till Soil (Both Directions)	3 days	Wed 9/26/01	Sat 9/29/01
48	Collect Soil Moisture Samples	0.1 days	Sat 9/29/01	Sat 9/29/01
49	Irrigate	2 days	Mon 10/1/01	Tue 10/2/01
50	Treatment Time	7 days	Wed 10/3/01	Tue 10/9/01



Project: Iowa.MPP
Date: Mon 7/23/01

Task | Milestone | Rolled Up Task | Rolled Up Progress | Project Summary | Rolled Up Split
Progress | Summary | Rolled Up Milestone | External Tasks | Split

ID	Task Name	Duration	Start	Finish
51	**Fifth Cycle - Trench 6**	**0.1 days**	**Wed 10/3/01**	**Wed 10/3/01**
52	Apply DARAMEND amendment (organic and inorganic)	1 day	Wed 10/3/01	Thu 10/4/01
53	Thoroughly Till Soil (Both Directions)	3 days	Thu 10/4/01	Sun 10/7/01
	Collect Soil Moisture Samples	0.1 days	Sun 10/7/01	Sun 10/7/01
	Irrigate	2 days	Mon 10/8/01	Tue 10/9/01
56	Treatment Time	7 days	Wed 10/10/01	Tue 10/16/01
57	**Fifth Cycle - Trench 7**	**0.1 days**	**Wed 10/10/01**	**Wed 10/10/01**
58	Apply DARAMEND amendment (organic and inorganic)	1 day	Wed 10/10/01	Thu 10/11/01
59	Thoroughly Till Soil (Both Directions)	3 days	Thu 10/11/01	Sun 10/14/01
60	Collect Soil Moisture Samples	0.1 days	Sun 10/14/01	Sun 10/14/01
61	Irrigate Area 1	2 days	Sun 10/14/01	Tue 10/16/01
62	Treatment Time	7 days	Tue 10/16/01	Tue 10/23/01
63	**Sixth Cycle - Trench 6**	**0.1 days**	**Wed 10/17/01**	**Wed 10/17/01**
64	Apply DARAMEND amendment (organic and inorganic)	1 day	Wed 10/17/01	Thu 10/18/01
65	Thoroughly Till Soil (Both Directions)	3 days	Thu 10/18/01	Sun 10/21/01
66	Collect Soil Moisture Samples	0.1 days	Sun 10/21/01	Sun 10/21/01
67	Irrigate	2 days	Sun 10/21/01	Tue 10/23/01
68	Treatment Time	7 days	Tue 10/23/01	Tue 10/30/01
69	**Sixth Cycle - Trench 7**	**0.1 days**	**Tue 10/23/01**	**Tue 10/23/01**
70	Apply DARAMEND amendment (organic and inorganic)	1 day	Tue 10/23/01	Wed 10/24/01
71	Thoroughly Till Soil (Both Directions)	3 days	Wed 10/24/01	Sat 10/27/01
72	Collect Soil Moisture Samples	0.1 days	Sat 10/27/01	Sat 10/27/01
73	Irrigate	2 days	Sat 10/27/01	Mon 10/29/01
74	Treatment Time	7 days	Mon 10/29/01	Tue 11/6/01
75	Obtain bulk density soil after DARAMEND treatment	4 days	Wed 10/17/01	Sun 10/21/01
	Set-up acceptance area for deliveries of reagent	4 days	Wed 10/17/01	Sun 10/21/01
	Obtain samples and analyze pre-treatment samples for TCLP Metals	7 days	Wed 10/17/01	Wed 10/24/01
78	Mobilize Metals Treatment Technical Representative	1 day	Wed 10/24/01	Thu 10/25/01
79	Conduct Site Training	1 day	Thu 10/25/01	Fri 10/26/01
80	Accept deliveries of Reagent	3 days	Mon 7/30/01	Wed 8/1/01
81	Apply Reagent	1 day	Mon 7/30/01	Mon 7/30/01
82	Apply Gypsum Product	1 day	Wed 10/17/01	Wed 10/17/01
83	Thoroughly till soil (both directions)	3 days	Tue 7/31/01	Thu 8/2/01
84	Maintain moisture content between 12% to 15%	3 days	Sat 10/20/01	Mon 10/22/01
85	Wait 24 hours for full reaction period	1 day	Tue 10/23/01	Tue 10/23/01
86	Collect samples for post treatment verification	1 day	Tue 10/23/01	Tue 10/23/01
87	Analyze samples for TCLP Metals	7 days	Wed 10/24/01	Tue 10/30/01
88	Demobilize	1 day	Wed 10/31/01	Wed 10/31/01



Project: Iowa.MPP
Date: Mon 7/23/01

Task | Milestone | Rolled Up Task | Rolled Up Progress | Project Summary | Rolled Up Split
Progress | Summary | Rolled Up Milestone | External Tasks | Split

APPENDIX A

RFI Document
Summary of Treatment Options

U.S. Army Corps of Engineers
Omaha District
DACAW45-97-D-0022

RFI-DC2
(Accompanying Documentation)

Cape Environmental Management Inc. (CAPE) was tasked to investigate methods of treatment of soils presently residing in Trench 6 and Trench 7 of the Inert Disposal Area (IDA) at the Iowa Army Ammunition Plant (IAAAP), located in Middletown Iowa. The soils in both trenches are contaminated with high concentrations of explosives (i.e., RDX, TNT, HMX etc.). Trench 7 also contains high concentrations of heavy metals, specifically barium and lead. Treatment options to be investigated are to effectively treat the soils for explosives as well as metals, in a cost efficient manner.

During last construction season, CAPE treated the soils in Trench 6 (approximately 2800 cubic yards) for metals using a mixture of Portland cement and synthetic gypsum. The top 18 inches in Trench 7 (approximately 800 cubic yards) was also treated unsuccessfully for metals, incorporating the same technique. Thus, the remaining soils to be treated are of two distinct types. One type is soils that contain Portland cement and synthetic gypsum as a result of the metals treatment (henceforth referred to as "treated soils"). The second type is those soils that contain no Portland cement or synthetic gypsum (henceforth referred to as "untreated soils"). The total estimated amount of soils to be treated is 6000 cubic yards.

The explosives can be treated by incineration or biological treatment. The metals can be treated by stabilization/chemical fixation or incineration. Should biological treatment be pursued, the general accepted approach is to treat the explosives through biological treatment prior to treating the metals. Bioremediation is usually performed first because the addition of alkaline reagents (e.g., Portland cement, lime, cement kiln dust, etc.) used in metal fixation can adversely affect the indigenous bacteria population due to elevated pH in soils. Metals treatment can be done prior to biological treatment if the metals treatment does not radically alter the pH of the soil. This is accomplished by mixing the soils with $CaSO_4$ (gypsum) and precipitating the barium as insoluble $BaSO_4$ (barite). No treatability studies have been performed on the BCS at IAAAP to confirm it will work.

As a first step CAPE evaluated several potential explosive contaminant treatment options. Those evaluated are listed below:

(1) Thermal Treatment (Incineration):

Discussion:

Operating Temperatures 1200 to 1600 degrees (°F) combined with the appropriate air pollution control.

This method has been approved by the EOD Board and would effectively treat both the explosives and the metals.

Analysis:

Permitting Procedures (if performed on site) are long and arduous.
Transportation costs high (if offsite incinerator is used).
Estimated Costs: $900-$1200/Cubic Yard.(per Wayne Sisk)

(2) Composting:

Discussion:

This method is highly dependent on the types of materials locally available, such as types of manure and bulking agents.

This method is also highly dependent on soil types involved because it is necessary to readily circulate air and also keep water in residence.

Thermophylic activities do not occur unless temperatures are maintained above 55 degrees (°C).

Analysis:

Composting will increase total volume of soils 1.6 to 1.8 times.

Temperatures of 55 degrees (°C) must be maintained for 12 to 20 days per layer, thus treatment could not begin until very late in the spring or summer.

Bulking agents may interfere with the metals treatment.

Though the soils must have the capacity to hold 50-60% water, a substantial rain will "drown" the system, resulting in retreatment.

Transporting "smelly" materials through town and through the base would not be a desirable situation with the local people.

Estimated Cost: $275 to $300/ Cubic Yard. (Per Wayne Sisk)

(3) Bio-Slurry

Discussion:

This method is referred to as "The Sabre Method" and was tested by the AEC at IAAAP.

Analysis:

The method required and inordinate amount of water to remain in residence for extended periods.

The information available seems to indicate that this system needed to be contained in a "Bio Reactor", hence treatment of any appreciable amount of soils would take a very large vessel or several incubations dramatically increasing costs and time.

It is also been said that some of the amendments used were very messy and odorous.

Estimated Costs: $150 to $250/Cubic Yard. (Per Wayne Sisk)

(4) Commercial/ Proprietary

Discussion:

There are several commercial products available. Through literature research and several telephone conversations the list was narrowed down. At Joliet AAP near Chicago, a "Bakeoff" occurred which defined a clear winner from several contenders. WR Grace was the winner under a product it markets called Daramend®.

Analysis:

Daramend® is readily available. It needs ample room to windrow materials and it needs to be mixed well. It produces only a slight volume increase, and treatment time is directly proportional to concentration of contaminants.

Estimated Costs: $100 to $200/Cubic Yard (Per Wayne Sisk)

(5) CAPE derived formula

Discussion:

CAPE has the in-house expertise to conduct treatability studies and self-perform the field work. We have successfully treated over 3 million cubic yards of petroleum hydrocarbon contaminated soils.

Analysis:

Unlike a vendors proprietary product, CAPE has no financial stake in the product selected, therefore any treatability studies performed by CAPE can be performed without bias towards the material or product being tested, or the outcome of those tests. In addition CAPE will evaluate the constructability in terms of a full-scale treatment such as production rates, equipment selection, sequencing, etc.

Estimated Costs: $15,000 per study

(6) Complete turnkey subcontract:

Discussion:

A subcontractor capable of performing the job from "cradle to grave". One with a proven track record. One that can fit our schedule to perform all of this work within this single upcoming construction season.

Analysis:

A turnkey subcontractor will "probably" warrant their work. However that warranty comes with an escalated cost for the subcontractors additional risk. Also the costs for CAPE to subcontract and oversee the project along with markups would substantially increase total costs. In short, CAPE has the expertise to perform equal to or better than a turnkey subcontractor does, therefore this option does not appear to add any value.

Estimated Costs: Unknown

SUMMARY

Item (1) Thermal Treatment:
Probably can be eliminated due to its exorbitant costs and political ramifications.

Item (2) Composting:
Possibly a viable option, however volume increases, possible interference of metals treatment and possible logistics concerns must be considered.

Item (3) Bio-Slurry
Probably can be eliminated due to the length of time for treatment, as well as inherent operational problems.

Item (4) Commercial/Proprietary
A viable option. Manufacturer will warranty their work. The site work can be performed/ overseen by CAPE personnel to assure quality, safety and overall cost control.

Item (5) CAPE derived formula:
A viable option. CAPE has the in-house ability to perform such tests without bias towards any one product.

Item (6) Complete turnkey subcontracting:
A possible viable option, however additional cost as previously noted will drive the price of this option artificially high. Scheduling and timing may also become an issue.

PRIORITIZED LISTING

Based on the above summary it would appear that the options are listed below in preferential order:

Most Viable: Item (4) Commercial/Proprietary
Item (5) CAPE derived formula
Item (2) Composting
Item (6) Turnkey Subcontracting
Item (5) Bio-Slurry

Least Viable: Item (1) Thermal

INFORMATION GATHERING

In order for any biological treatment to work, information on how many microorganisms are naturally present in the soils was needed. CAPE commissioned an analysis of total

Heterotrophic Plate Count using method 9215C by the Center for Environmental Microbiology Inc. The results indicate there are adequate numbers of colony forming units in both "treated soils" and "untreated soils".

At this point, CAPE solicited cost proposals for extensive treatability studies from independent laboratories, as well as potential vendors. Those participants are listed below:

Center for Environmental Microbiology (CEM)
Dr. William Frankenberger
Proposes a full scale treatability test using various admixtures - Cost $15,000

WR Grace (makers of Daramend®)
Robert Furgeson
Proposes either a treatability study using Daramend® ...Cost $16,450 or purchase total amount needed and treatability costs will be built into purchase price of Daramend®.

United Tech (laboratory)
Art Barnard
No Response

Waste Stream Technology
Chuck McPheeters
Proposes a full turnkey operation to treat explosives and metals.

In general it appears that any vendor contacted will require funds for treatability studies. What seems to be driving this cost is the large number and frequency of samples that must be subcontracted to an outside explosives lab for analysis.

- It appears that CEM could perform an accurate analysis but would not be able to assist in details of application of materials.

- WR Grace has proposed either they perform a treatability study, or purchase the amount needed and a treatability study will be included in the purchase price. They will warranty their work, and can meet our schedule.

- United Tech is considered non-responsive.

- Waste Stream Technology is presently considering providing us with a turnkey bid, they have yet to respond.

- CAPE and Mintek will dovetail the metals treatment work into the explosive treatment.

- Mintek supplies a commercial metals fixant under the name of Calciment. Kevin Rookstool of Mintek has been introduced to the U.S. Army Corps of Engineers (USACE) towards the end of the metals treatment work last construction season. Once the explosive vendor is chosen, Kevin would review and perhaps test the biotreated soil to determine the Calciment treatment ratio. Once this "recipe" is known, pricing proposals and schedules can be presented to the USACE for the whole operation.

REQUEST FOR INFORMATION:

- Should CAPE continue to pursue additional vendors for composting and commercial biotreatment for explosives? For each potential vendor, treatability studies are likely? Each study will entail a cost to the USACE regardless if performed by the vendor or CAPE.

- Should the USACE wish to pursue these additional vendors, does the USACE want to have CAPE perform independent treatability studies to ensure integrity in the process?

- Time is of the essence; based on present projections the treatability study will take 10 to 12 weeks. WR Grace has indicated that if Daramend is selected they will initiate a treatability study immediately with no up front costs. Should CAPE commission WR Grace to begin treatability study ASAP?

- Sole source procurement with WR Grace will allow the fastest startup time on the treatability study, provide an enforceable warranty without excessive costs and eliminate unnecessary pass through markups on subcontractors. Is it possible that WR Grace can be a sole source Vendor?

- If WR Grace is chosen, CAPE or the USACE should entertain the idea of monitoring Grace's treatability study such as taking splits, reviewing process, etc?

- Does the USACE want to pursue CAPE as performing it's own treatability study and deriving it's own formula?

- Further treatability with respect to high barium soil will be completed to ensure successful metals treatment. Compatibility of metals treatment with biological treatment will be evaluated. Is the USACE in accordance with this?

- The metals treatment issue in terms of using Mintek can be addressed with competitive bid and technical analysis. Is the USACE in accordance with this?

- Is the USACE interested in evaluating a non-PH dependant metal stabilization approach, the advantage to this approach is that metals treatment could possibly occur in tandem or even before biotreatment?

APPENDIX B

Cumulative Applied Formula

Analyte	Sample # T6GS001 Analytical Results	Risk Number	Sample # T6GS002 Analytical Results	Risk Number	Sample # T6GS003 Analytical Results	Risk Number	Sample # T6GS004 Analytical Results	Risk Number	Sample # T6GS005 Analytical Results	Risk Number	Sample # T6GS006 Analytical Results	Risk Number
1,3,5- Trinitrobenzene	1.9	0.01862745	7.2	0.07058824	3.1	0.03039216	14	0.1372549	7.5	0.07352941	5.4	0.05294118
1,3- Dinitrobenzene	0	0	0.2	0.00019569	0	0	0	0	0	0	0	0
2,4,6- Trinitrotoluene	17	0.08673469	11	0.05612245	4.6	0.02346939	8.7	0.04438776	88	0.44897959	15	0.07653061
2,4- Dinitrotoluene	0	0	0.03	0.00357143	0.076	0.00904762	0.41	0.04880952	0.32	0.03809524	0.21	0.025
2,6- Dinitrotoluene	0	0	0	0	0	0	0	0	0	0	0	0
2 Amino-4,6-Dinitrotoluene	0.26	0.00132653	1	0.00510204	0.58	0.00295918	1.3	0.00663265	1.5	0.00765306	1.2	0.00612245
2-Nitrotoluene	0	0	0	0	0	0	0	0	0	0	0	0
3-Nitrotoluene	0	0	0	0	0	0	0	0	0	0	0	0
4- Amino-2,6-Dinitrotoluene	0.78	0.00397959	2.1	0.01071429	1.1	0.00561224	3.9	0.01989796	2.6	0.01326531	2.2	0.01122449
4-Nitrotoluene	0	0	0	0	0	0	0	0	0	0	0	0
HMX	200	0.00392157	500	0.00980392	400	0.00784314	830	0.01627451	570	0.01117647	880	0.0172549
Nitrobenzene	0	0	0	0	0	0	0	0	0	0	0	0
RDX	140	2.64150943	370	6.98113208	260	4.90566038	540	10.1886792	510	9.62264151	650	12.2641509
Tetryl	0.46	2.2505E-05	1.6	7.8278E-05	0	0	0	0	0	0	2	9.7647E-05
Total Risk Number		**2.75612177**		**7.13730841**		**4.98498411**		**10.4619365**		**10.2153406**		**12.4533224**

Analyte	Sample # T6GS007 Analytical Results	Risk Number	Sample # T6GS008 Analytical Results	Risk Number	Sample # T6GS009 Analytical Results	Risk Number	Sample # T6GS010 Analytical Results	Risk Number	Sample # T6GS011 Analytical Results	Risk Number	Sample # T6GS012 Analytical Results	Risk Number
1,3,5- Trinitrobenzene	16	0.15686275	7.8	0.07647059	11	0.10784314	3.2	0.03137255	1	0.00980392	0.19	0.00186275
1,3- Dinitrobenzene	0	0	0	0	0	0	0	0	0	0	0	0
2,4,6- Trinitrotoluene	180	0.91836735	15	0.07653061	13	0.06632653	2.6	0.01326531	14	0.07142857	0.67	0.00341837
2,4- Dinitrotoluene	0.39	0.04642857	0.49	0.05833333	0.33	0.03928571	0	0	0	0	0	0
2,6- Dinitrotoluene	0	0	0	0	0	0	0	0	0	0	0	0
2 Amino-4,6-Dinitrotoluene	2.1	0.01071429	1.4	0.00714286	1.9	0.00969388	0.89	0.00454082	0.44	0.0022449	0	0
2-Nitrotoluene	0	0	0	0	0	0	0	0	0	0	0	0
3-Nitrotoluene	0	0	0	0	0	0	0	0	0	0	0	0
4- Amino-2,6-Dinitrotoluene	4.2	0.02142857	3.1	0.01581633	3.5	0.01785714	1.4	0.00714286	1	0.00510204	0.19	0.00096939
4-Nitrotoluene	0	0	0	0	0	0	0	0	0	0	0	0
HMX	1200	0.02352941	690	0.01352941	830	0.01627451	340	0.00666667	400	0.00784314	92	0.00180392
Nitrobenzene	0	0	0	0	0	0	0	0	0	0	0	0
RDX	1200	22.6415094	720	13.5849057	600	11.3207547	240	4.52830189	200	3.77358491	32	0.60377358
Tetryl	3	0.00014677	2.6	0.0001272	3.9	0.0001908	1.2	5.8708E-05	1.2	5.8708E-05	0	0
Total Risk Number		**23.8189871**		**13.832856**		**11.5782264**		**4.59134879**		**3.87006618**		**0.61182801**

*Needs RCB divisor

If Total risk number is <1, the cumulative risk is less than 10-6 and above the Summer's Model Criteria; soils will be placed in the Inert Landfill or the onsite RCRA landfill

If Total risk number is between 1 and 10, the cumulative risk is between 10-5 and 10-6; soils will be placed in the onsite RCRA landfill.

If Total risk number is 10 or greater, the cumulative risk is between 10-5 or greater; soils will be stockpiled for treatment.

The following changes will be made:

① Analytical Results = mg/kg

② Risk Numbers will be limited to 4 decimal points

Sample RBC Weighted Calculation

RDX mg/kg	+ HMX mg/kg	+ 2,4,6 TNT mg/kg	+ 1,3,5 TNB	+ 2,4/2,6 DNT
53 mg/kg	51000 mg/kg	196 mg/kg	102 mg/kg	8.4 mg/kg

+ NB mg/kg	+ DNB mg/kg	+ Tetryl mg/kg	+ NT mg/kg
1022 mg/kg	204 mg/kg	20440 mg/kg	20440 mg/kg

+ any other COC mg/kg / RBC mg/kg = X

If X is < 1 the cumulative risk is less than 10^{-6} and above the Summer's Model Criteria; soils will be placed in the Inert Landfill or the onsite RCRA landfill.

If X is between 1 and 10 the cumulative risk is between 10^{-5} and 10^{-6}; soils will be placed in the onsite RCRA landfill.

If X is 10 or greater the cumulative risk is 10^{-5} or greater; soils will be stockpiled for treatment.

SAMPLE # T6GS007

135 TNB = $\frac{1.9}{102}$ = .0186

246 TNT $\frac{17}{196}$ = .0867

2 Amino-4 $\frac{.26}{196}$ = .0013

4 Amino $\frac{.78}{196}$ = .0039

HMX = $\frac{200}{51000}$ = .0039

RDX = $\frac{140}{53}$ = 2.64

Tetryl = $\frac{.46}{20440}$ = .00002

Total 2.7544

SAMPLE # T6GS002

1,3,5 TNB	=	7.2 / 102	=	.7058
1,3 DNB	=	.20 / 204	=	.0009
2,4,6 TNT	=	11 / 196	=	.0561
2,6 DNB		.030 / 204	=	.0001
2 Amino		1.0 / 196	=	.0051
4 Amino		2.1 / 196	=	.0107
HMX		500 / 51000	=	.0098
RDX		370 / 53	=	6.98
Tetryl		1.6 / 20440	=	.00007
		Total		7.7685

SAMPLE # T6GS003

1,3,5 TNB	=	3.1 / 102	=	.0303
246 TNT		4.6 / 196	=	.0234
24 DNB		.076 / 204	=	.0003
2 Amino		.58 / 196	=	.0029
4 Amino		1.1 / 196	=	.0056
HMX		400 / 51000	=	.0078
RDX		260 / 53	=	4.905
		Total		4.9759

SAMPLE # T6GS004

1,3,5 TNB	=	14 / 102	=	.1372
2,4,6 TNT	=	8.7 / 196	=	.0443
2,4 DNT		.41 / 8.4	=	.0488
2 Amino		1.3 / 196	=	.0066
4 Amino		.06 / 196	=	.0003
HMX		830 / 51000	=	.01627
RDX		540 / 53	=	10.1886
		Total		10.4421

SAMPLE # T6GS005

1,3,5 TNB	=	7.5 / 102	=	.0735
2,4,6 TNT	=	88 / 196	=	.4489
2,4 DNT		.32 / 8.4	=	.0380
2 Amino		1.5 / 196	=	.0076
4 Amino		2.6 / 196	=	.0132
HMX		570 / 51000	=	.0111
RDX		510 / 53	=	9.6226
		Total		10.2149

SAMPLE # T6GS006

1,3,5 TNB	=	5.4 / 102	=	.0529
2,4,6 TNT	=	15 / 196	=	.0765
2,4 DNT		.21 / 8.4	=	.0142
2 Amino		1.2 / 196	=	.0061
4 Amino		2.2 / 196	=	.0112
HMX		880 / 51000	=	.0172
RDX		650 / 53	=	12.26
Tetryl		2.0 / 20440	=	.00009
		Total		12.4381

SAMPLE # T6GS007

1,3,5 TNB	=	16 / 102	=	.1568
2,4,6 TNT	=	180 / 196	=	.9183
2,4 DNT		.39 / 8.4	=	.4642
2 Amino		2.1 / 196	=	.0107
4 Amino		4.2 / 196	=	.0214
HMX		1200 / 51000	=	.0235
RDX		1200 / 53	=	22.6415
Tetryl		3.0 / 20440	=	.0014
		Total		24.2378

SAMPLE # T6GS008

1,3,5 TNB	=	7.8 / 102	=	.0764
2,4,6 TNT	=	15 / 196	=	.07653
2,4 DNT		.49 / 8.4	=	.0583
2 Amino		1.4 / 196	=	.0071
4 Amino		3.1 / 196	=	.0158
HMX		890 / 51000	=	.0174
RDX		720 / 53	=	13.58
Tetryl		2.6 / 20440	=	.0049
		Total		13.8364

SAMPLE # T6GS009

1,3,5 TNB	=	11 / 102	=	.1078
2,4,6 TNT	=	13 / 196	=	.0663
2,4 DNT		.33 / 8.4	=	.0392
2 Amino		1.9 / 196	=	.0096
4 Amino		3.5 / 196	=	.0178
HMX		830 / 51000	=	.0162
RDX		600 / 53	=	11.3207
Tetryl		3.9 / 20440	=	.00019
		Total		11.5777

SAMPLE # T6GS010

1,3,5 TNB	=	3.2 / 102	=	.0313
2,4,6 TNT	=	2.6 / 196	=	.0132
2 Amino		.89 / 196	=	.0045
4 Amino		1.4 / 196	=	.0071
HMX		340 / 51000	=	.0066
RDX		240 / 53	=	4.5283
Tetryl		1.2 / 20440	=	.00005
		Total		4.6504

SAMPLE # T6GS011

1,3,5 TNB	=	1.0 / 102	=	.0009
2,4,6 TNT	=	14 / 196	=	.0714
2 Amino		.44 / 196	=	.0022
4 Amino		1.0 / 196	=	.0051
HMX		400 / 51000	=	.0078
RDX		200 / 53	=	3.7735
Tetryl		1.2 / 20440	=	.00005
		Total		3.8609

SAMPLE # T6GS012

1,3,5 TNB	=	.19 / 102	=	.0018
2,4,6 TNT	=	.67 / 196	=	.0034
4 Amino		.19 / 196	=	.0009
HMX		92 / 51000	=	.0018
RDX		32 / 53	=	.6037
		Total		.6116

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FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

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S013M063

Date Printed.....: 26-APR-01 12:33

Client Name.....: Environmental Chemical Corporation
Client Ref Number....: PRJ# 5400-008-922
Sampling Site.....: IAAAP
Release Number.....: PRJ# 5400-008-922

Date Received.....: 20-APR-01 00:00

Client Sample Name: T6GS001
DCL Sample Name...: 01E00995
DCL Report Group..: 01E-0139-01

Matrix.....: SOIL
Date Sampled.....: 19-APR-01 09:35
Reporting Units...: ug/g
Report Basis.....: ☐ As Received ☒ Dried

DCL Preparation Group: G013M02P
Date Prepared.....: 22-APR-01 00:00
Preparation Method...: SW8330
Aliquot Weight/Volume: 2.0 grams
Net Weight/Volume....: Not Required

DCL Analysis Group: G013M02P
Analysis Method...: 8330
Instrument Type...: HPLC
Instrument ID.....: LC-4
Column Type.....: Ultracarb ODS
☒ Primary
☐ Confirmation

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
1,3,5-Trinitrobenzene	24-APR-01 15:03	0.0414	1.9			1	0.10
1,3-Dinitrobenzene	24-APR-01 15:03	0.0139	ND		U	1	0.10
2,4,6-Trinitrotoluene	24-APR-01 15:03	0.0306	17.			1	0.20
2,4-Dinitrotoluene	24-APR-01 15:03	0.0262	ND		U	1	0.20
2,6-Dinitrotoluene	24-APR-01 15:03	0.0564	ND		U	1	0.20
2-Amino-4,6-Dinitrotoluene	24-APR-01 15:03	0.0466	0.26			1	0.20
2-Nitrotoluene	24-APR-01 15:03	0.0772	ND		U	1	0.40
3-Nitrotoluene	24-APR-01 15:03	0.157	ND		U	1	0.40
4-Amino-2,6-Dinitrotoluene	24-APR-01 15:03	0.0690	0.78			1	0.20
4-Nitrotoluene	24-APR-01 15:03	0.115	ND		U	1	0.40
HMX	25-APR-01 16:59	0.0845	200			3	0.20
Nitrobenzene	24-APR-01 15:03	0.0391	ND		U	1	0.20
RDX	25-APR-01 16:59	0.0203	140			3	0.20
Tetryl	24-APR-01 15:03	0.0355	0.46			1	0.20

Surrogate Recoveries

Analyte	Result	Spiked Amount	Percent Recovery
3,4-Dinitrotoluene	4.72	5.00	94.4

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FORM A (TYPE I)
SINGLE METHOD ANALYSES

SAMPLE ANALYSIS DATA SHEET

S013M064

Date Printed.....: 26-APR-01 12:33

Client Name.....: Environmental Chemical Corporation
Client Ref Number....: PRJ# 5400-008-922
Sampling Site.....: IAAAP
Release Number.....: PRJ# 5400-008-922

Date Received.....: 20-APR-01 00:00

Client Sample Name: T6GS002
DCL Sample Name...: 01E00996
DCL Report Group..: 01E-0139-01

Matrix.....: SOIL
Date Sampled.....: 19-APR-01 09:53
Reporting Units...: ug/g
Report Basis.....: ☐ As Received ☒ Dried

DCL Preparation Group: G013M02P
Date Prepared.....: 22-APR-01 00:00
Preparation Method...: SW8330
Aliquot Weight/Volume: 2.0 grams
Wet Weight/Volume....: Not Required

DCL Analysis Group: G013M02P
Analysis Method...: 8330
Instrument Type...: HPLC
Instrument ID.....: LC-4
Column Type.....: Ultracarb ODS
☒ Primary
☐ Confirmation

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
1,3,5-Trinitrobenzene	24-APR-01 15:34	0.0414	7.2			1	0.10
1,3-Dinitrobenzene	24-APR-01 15:34	0.0139	0.20			1	0.10
2,4,6-Trinitrotoluene	24-APR-01 15:34	0.0306	11.			1	0.20
2,4-Dinitrotoluene	24-APR-01 15:34	0.0262	0.030		J	1	0.20
2,6-Dinitrotoluene	24-APR-01 15:34	0.0564	ND		U	1	0.20
2-Amino-4,6-Dinitrotoluene	24-APR-01 15:34	0.0466	1.0			1	0.20
2-Nitrotoluene	24-APR-01 15:34	0.0772	ND		U	1	0.40
3-Nitrotoluene	24-APR-01 15:34	0.157	ND		U	1	0.40
4-Amino-2,6-Dinitrotoluene	24-APR-01 15:34	0.0600	2.1			1	0.20
4-Nitrotoluene	24-APR-01 15:34	0.115	ND		U	1	0.40
HMX	25-APR-01 17:30	0.0845	500			10	0.20
Nitrobenzene	24-APR-01 15:34	0.0391	ND		U	1	0.20
RDX	25-APR-01 17:30	0.0203	370			10	0.20
Tetryl	24-APR-01 15:34	0.0355	1.6			1	0.20

Surrogate Recoveries

Analyte	Result	Spiked Amount	Percent Recovery
3,4-Dinitrotoluene	4.91	5.00	98.3

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FORM A (TYPE I)
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SAMPLE ANALYSIS DATA SHEET

Form RLIMS63A-V1.3
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G013M065

Date Printed.....: 26-APR-01 12:33

Client Name.....: Environmental Chemical Corporation
Client Ref Number....: PRJ# 5400-008-922
Sampling Site.....: IAAAP
Release Number.....: PRJ# 5400-008-922

Date Received.....: 20-APR-01 00:00

Client Sample Name: T6GS003
DCL Sample Name...: 01E00997
DCL Report Group..: 01E-0139-01

Matrix.....: SOIL
Date Sampled.....: 19-APR-01 10:11
Reporting Units...: ug/g
Report Basis.....: ☐As Received ☒Dried

DCL Preparation Group: G013M02P
Date Prepared.....: 22-APR-01 00:00
Preparation Method...: SW8330
Aliquot Weight/Volume: 2.0 grams
Wet Weight/Volume....: Not Required

DCL Analysis Group: G013M02P
Analysis Method...: 8330
Instrument Type...: HPLC
Instrument ID.....: LC-4
Column Type.....: Ultracarb ODS
☒Primary
☐Confirmation

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
1,3,5-Trinitrobenzene	24-APR-01 16:05	0.0414	3.1			1	0.10
1,3-Dinitrobenzene	24-APR-01 16:05	0.0139	ND		U	1	0.10
2,4,6-Trinitrotoluene	24-APR-01 16:05	0.0306	4.6			1	0.20
2,4-Dinitrotoluene	24-APR-01 16:05	0.0262	0.076		J	1	0.20
2,6-Dinitrotoluene	24-APR-01 16:05	0.0564	ND		U	1	0.20
2-Amino-4,6-Dinitrotoluene	24-APR-01 16:05	0.0466	0.58			1	0.20
2-Nitrotoluene	24-APR-01 16:05	0.0772	ND		U	1	0.40
3-Nitrotoluene	24-APR-01 16:05	0.157	ND		U	1	0.40
4-Amino-2,6-Dinitrotoluene	24-APR-01 16:05	0.0600	1.1			1	0.20
4-Nitrotoluene	24-APR-01 16:05	0.115	ND		U	1	0.40
HMX	25-APR-01 18:01	0.0845	400			5	0.20
Nitrobenzene	24-APR-01 16:05	0.0391	ND		U	1	0.20
RDX	25-APR-01 18:01	0.0203	260			5	0.20
Tetryl	24-APR-01 16:05	0.0355	ND		U	1	0.20

Surrogate Recoveries

Analyte	Result	Spiked Amount	Percent Recovery
3,4-Dinitrotoluene	4.93	5.00	98.6

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SAMPLE ANALYSIS DATA SHEET

Form RLIMS63A-V1.3
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S013M066

Date Printed.....: 26-APR-01 12:33

Client Name.....: Environmental Chemical Corporation
Client Ref Number....: PRJ# 5400-008-922
Sampling Site.....: IAAAP
Release Number.....: PRJ# 5400-008-922

Date Received.....: 20-APR-01 00:00

Client Sample Name: T6DS004
DCL Sample Name...: 01E00998
DCL Report Group..: 01E-0139-01

Matrix.....: SOIL
Date Sampled.....: 19-APR-01 10:30
Reporting Units...: ug/g
Report Basis.....: ☐ As Received ☒ Dried

DCL Preparation Group: G013M02P
Date Prepared.....: 22-APR-01 00:00
Preparation Method...: SW8330
Aliquot Weight/Volume: 2.0 grams
Wet Weight/Volume....: Wet Required

DCL Analysis Group: G013M02P
Analysis Method...: 8330
Instrument Type...: HPLC
Instrument ID.....: LC-4
Column Type.....: Ultracarb ODS
☒ Primary
☐ Confirmation

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
1,3,5-Trinitrobenzene	24-APR-01 16:36	0.0414	14.			1	0.10
1,3-Dinitrobenzene	24-APR-01 16:36	0.0139	ND		U	1	0.10
2,4,6-Trinitrotoluene	24-APR-01 16:36	0.0306	8.7			1	0.20
2,4-Dinitrotoluene	24-APR-01 16:36	0.0262	0.41			1	0.20
2,6-Dinitrotoluene	24-APR-01 16:36	0.0564	ND		U	1	0.20
2-Amino-4,6-Dinitrotoluene	24-APR-01 16:36	0.0466	1.3			1	0.20
2-Nitrotoluene	24-APR-01 16:36	0.0772	ND		U	1	0.40
3-Nitrotoluene	24-APR-01 16:36	0.157	ND		U	1	0.40
4-Amino-2,6-Dinitrotoluene	24-APR-01 16:36	0.0600	3.9			1	0.20
4-Nitrotoluene	24-APR-01 16:36	0.115	ND		U	1	0.40
HMX	25-APR-01 18:31	0.0845	830			10	0.20
Nitrobenzene	24-APR-01 16:36	0.0391	ND		U	1	0.20
RDX	25-APR-01 18:31	0.0203	540			10	0.20
Tetryl	24-APR-01 16:36	0.0355	ND		U	1	0.20

Surrogate Recoveries

Analyte	Result	Spiked Amount	Percent Recovery
3,4-Dinitrotoluene	4.95	5.00	99.0

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SAMPLE ANALYSIS DATA SHEET

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S013M067

Date Printed.....: 26-APR-01 12:33

Client Name.....: Environmental Chemical Corporation
Client Ref Number....: PRJ# 5400-008-922
Sampling Site.....: IAAAP
Release Number.....: PRJ# 5400-008-922

Date Received.....: 20-APR-01 00:00

Client Sample Name: T6G5005
DCL Sample Name...: 01E00999
DCL Report Group..: 01E-0139-01

Matrix.....: SOIL
Date Sampled.....: 19-APR-01 10:52
Reporting Units...: ug/g
Report Basis.....: ☐As Received ☒Dried

DCL Preparation Group: G013M02P
Date Prepared.....: 22-APR-01 00:00
Preparation Method...: SW8330
Aliquot Weight/Volume: 2.0 grams
Wet Weight/Volume....: Not Required

DCL Analysis Group: G013M02P
Analysis Method...: 8330
Instrument Type...: HPLC
Instrument ID.....: LC-4
Column Type.....: Ultracarb ODS
☒Primary
☐Confirmation

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
1,3,5-Trinitrobenzene	24-APR-01 17:06	0.0414	7.5			1	0.10
1,3-Dinitrobenzene	24-APR-01 17:06	0.0139	ND		U	1	0.10
2,4,6-Trinitrotoluene	24-APR-01 17:06	0.0306	88.			1	0.20
2,4-Dinitrotoluene	24-APR-01 17:06	0.0262	0.32			1	0.20
2,6-Dinitrotoluene	24-APR-01 17:06	0.0564	ND		U	1	0.20
2-Amino-4,6 Dinitrotoluene	24-APR-01 17:06	0.0466	1.5			1	0.20
2-Nitrotoluene	24-APR-01 17:06	0.0772	ND		U	1	0.40
3-Nitrotoluene	24-APR-01 17:06	0.157	ND		U	1	0.40
4-Amino-2,6-Dinitrotoluene	24-APR-01 17:06	0.0600	2.6			1	0.20
4-Nitrotoluene	24-APR-01 17:06	0.115	ND		U	1	0.40
HMX	25-APR-01 19:02	0.0845	570			10	0.20
Nitrobenzene	24-APR-01 17:06	0.0391	ND		U	1	0.20
RDX	25-APR-01 19:02	0.0203	510			10	0.20
Tetryl	24-APR-01 17:06	0.0355	ND		U	1	0.20

Surrogate Recoveries

Analyte	Result	Spiked Amount	Percent Recovery
3,4-Dinitrotoluene	4.35	5.00	87.1

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04260115102504

S013M068

Date Printed.....: 26-APR-01 15:10

Client Name.....: Environmental Chemical Corporation
Client Ref Number....: PRJ# 5400-008-922
Sampling Site.....: IAAAP
Release Number.....: PRJ# 5400-008-922

Date Received.....: 20-APR-01 00:00

Client Sample Name: T6GS006
DCL Sample Name...: 01E01000
DCL Report Group..: 01E-0139-01

Matrix.....: SOIL
Date Sampled.....: 19-APR-01 11:20
Reporting Units...: ug/g
Report Basis.....: ☐ As Received ☒ Dried

DCL Preparation Group: G013M02P
Date Prepared.....: 22-APR-01 00:00
Preparation Method...: SW8330
Aliquot Weight/Volume: 2.0 grams
Wet Weight/Volume....: Not Required

DCL Analysis Group: G013M02P
Analysis Method...: 8330
Instrument Type...: HPLC
Instrument ID.....: LC-4
Column Type.....: Ultracarb ODS
☒ Primary
☐ Confirmation

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
1,3,5-Trinitrobenzene	24-APR-01 17:37	0.0414	5.4			1	0.10
1,3-Dinitrobenzene	24-APR-01 17:37	0.0139	ND		U	1	0.10
2,4,6-Trinitrotoluene	24-APR-01 17:37	0.0306	15.			1	0.20
2,4-Dinitrotoluene	24-APR-01 17:37	0.0262	0.21			1	0.20
2,6-Dinitrotoluene	24-APR-01 17:37	0.0564	ND		U	1	0.20
2-Amino-4,6-Dinitrotoluene	24-APR-01 17:37	0.0466	1.2			1	0.20
2-Nitrotoluene	24-APR-01 17:37	0.0772	ND		U	1	0.40
3-Nitrotoluene	24-APR-01 17:37	0.157	ND		U	1	0.40
4-Amino-2,6-Dinitrotoluene	24-APR-01 17:37	0.0600	2.2			1	0.20
4-Nitrotoluene	24-APR-01 17:37	0.115	ND		U	1	0.40
HMX	25-APR-01 19:33	0.0845	880			10	0.20
Nitrobenzene	24-APR-01 17:37	0.0391	ND		U	1	0.20
RDX	25-APR-01 19:33	0.0203	650			10	0.20
Tetryl	24-APR-01 17:37	0.0355	2.0			1	0.20

Surrogate Recoveries

Analyte	Result	Spiked Amount	Percent Recovery
3,4-Dinitrotoluene	5.01	5.00	100.

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S013M069

Date Printed.....: 26-APR-01 12:33

Client Name.....: Environmental Chemical Corporation
Client Ref Number....: PRJ# 5400-008-922
Sampling Site.....: IAAAP
Release Number.....: PRJ# 5400-008-922

Date Received.....: 20-APR-01 00:00

Client Sample Name: I6GS007
DCL Sample Name...: 01E01001
DCL Report Group..: 01E-0139-01

Matrix.....: SOIL
Date Sampled.....: 19-APR-01 11:41
Reporting Units...: ug/g
Report Basis.....: ☐ As Received ☒ Dried

DCL Preparation Group: G013M02P
Date Prepared.....: 22-APR-01 00:00
Preparation Method...: SW8330
Aliquot Weight/Volume: 2.0 grams
Net Weight/Volume....: Not Required

DCL Analysis Group: G013M02P
Analysis Method...: 8330
Instrument Type....: HPLC
Instrument ID.....: LC-4
Column Type.....: Ultrasorb ODS
☒ Primary
☐ Confirmation

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
1,3,5-Trinitrobenzene	26-APR-01 18:38	0.0414	16.			1	0.10
1,3-Dinitrobenzene	26-APR-01 18:38	0.0139	ND		U	1	0.10
2,4,6-Trinitrotoluene	25-APR-01 20:34	0.0306	180			20	0.20
2,4-Dinitrotoluene	26-APR-01 18:38	0.0262	0.39			1	0.20
2,6-Dinitrotoluene	26-APR-01 18:38	0.0564	ND		U	1	0.20
2-Amino-4,6-Dinitrotoluene	26-APR-01 18:38	0.0466	2.1			1	0.20
2-Nitrotoluene	26-APR-01 18:38	0.0772	ND		U	1	0.40
3-Nitrotoluene	26-APR-01 18:38	0.157	ND		U	1	0.40
4-Amino-2,6-Dinitrotoluene	26-APR-01 18:38	0.0600	4.2			1	0.20
4-Nitrotoluene	26-APR-01 18:38	0.115	ND		U	1	0.40
HMX	25-APR-01 20:34	0.0845	1200			20	0.20
Nitrobenzene	26-APR-01 18:38	0.0391	ND		U	1	0.20
RDX	25-APR-01 20:34	0.0203	1200			20	0.20
Tetryl	26-APR-01 18:38	0.0355	3.0			1	0.20

Surrogate Recoveries

Analyte	Result	Spiked Amount	Percent Recovery
3,4-Dinitrotoluene	4.00	5.00	80.1

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S013M06B

Date Printed.....: 26-APR-01 12:33

Client Name.....: Environmental Chemical Corporation
Client Ref Number....: PRJ# 5400-008-922
Sampling Site.....: YAAAP
Release Number.....: PRJ# 5400-008-922

Date Received.....: 20-APR-01 00:00

Client Sample Name: T6GS008
DCL Sample Name...: 01E01002
DCL Report Group..: 01E-0139-01

Matrix.....: SOIL
Date Sampled.....: 19-APR-01 12:03
Reporting Units...: ug/g
Report Basis.....: ☐ As Received ☒ Dried

DCL Preparation Group: G013M02P
Date Prepared.....: 22-APR-01 00:00
Preparation Method...: SW8330
Aliquot Weight/Volume: 2.0 grams
Wet Weight/Volume....: Not Required

DCL Analysis Group: G013M02P
Analysis Method...: 8330
Instrument Type...: HPLC
Instrument ID.....: LC-4
Column Type.....: Ultrasarb ODS
☒ Primary
☐ Confirmation

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
1,3,5-Trinitrobenzene	24-APR-01 19:09	0.0414	7.8			1	0.10
1,3-Dinitrobenzene	24-APR-01 19:09	0.0139	ND		U	1	0.10
2,4,6-Trinitrotoluene	24-APR-01 19:09	0.0306	15.			1	0.20
2,4-Dinitrotoluene	24-APR-01 19:09	0.0262	0.49			1	0.20
2,6-Dinitrotoluene	24-APR-01 19:09	0.0564	ND		U	1	0.20
2-Amino-4,6-Dinitrotoluene	24-APR-01 19:09	0.0466	1.4			1	0.20
2-Nitrotoluene	24-APR-01 19:09	0.0772	ND		U	1	0.40
3-Nitrotoluene	24-APR-01 19:09	0.157	ND		U	1	0.40
4-Amino-2,6-Dinitrotoluene	24-APR-01 19:09	0.0600	3.1			1	0.20
4-Nitrotoluene	24-APR-01 19:09	0.115	ND		U	1	0.40
HMX	25-APR-01 21:05	0.0845	890			10	0.20
Nitrobenzene	24-APR-01 19:09	0.0391	ND		U	1	0.20
RDX	25-APR-01 21:05	0.0203	720			10	0.20
Tetryl	24-APR-01 19:09	0.0355	2.6			1	0.20

Surrogate Recoveries

Analyte	Result	Spiked Amount	Percent Recovery
3,4-Dinitrotoluene	5.07	5.00	101.

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S013M06C

Date Printed.....: 26-APR-01 12:33

Client Name.....: Environmental Chemical Corporation
Client Ref Number....: PRJ# 5400-008-922
Sampling Site.....: IAAAP
Release Number.....: PRJ# 5400-008-922

Date Received.....: 20-APR-01 00:00

Client Sample Name: Y6GS009
DCL Sample Name...: 01E01083
DCL Report Group..: 01E-0139-01

Matrix.....: SOIL
Date Sampled.....: 19-APR-01 13:14
Reporting Units...: ug/g
Report Basis.....: ☐ As Received ☒ Dried

DCL Preparation Group: G013M02P
Date Prepared.....: 22-APR-01 00:00
Preparation Method...: SW8330
Aliquot Weight/Volume: 2.0 grams
Wet Weight/Volume....: Not Required

DCL Analysis Group: G013M02P
Analysis Method...: 8330
Instrument Type...: HPLC
Instrument ID.....: LC-4
Column Type.....: Ultracarb ODS
☒ Primary
☐ Confirmation

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
1,3,5-Trinitrobenzene	24-APR-01 19:40	0.0414	11.			1	0.10
1,3-Dinitrobenzene	24-APR-01 19:40	0.0139	ND		U	1	0.10
2,4,6-Trinitrotoluene	24-APR-01 19:40	0.0306	13.			1	0.20
2,4-Dinitrotoluene	24-APR-01 19:40	0.0262	0.33			1	0.20
2,6-Dinitrotoluene	24-APR-01 19:40	0.0564	ND		U	1	0.20
2-Amino-4,6-Dinitrotoluene	24-APR-01 19:40	0.0468	1.9			1	0.20
2-Nitrotoluene	24-APR-01 19:40	0.0772	ND		U	1	0.40
3-Nitrotoluene	24-APR-01 19:40	0.157	ND		U	1	0.40
4-Amino-2,6-Dinitrotoluene	24-APR-01 19:40	0.0600	3.5			1	0.20
4-Nitrotoluene	24-APR-01 19:40	0.115	ND		U	1	0.40
HMX	25-APR-01 21:36	0.0845	830			10	0.20
Nitrobenzene	24-APR-01 19:40	0.0391	ND		U	1	0.20
RDX	25-APR-01 21:36	0.0203	600			10	0.20
Tetryl	24-APR-01 19:40	0.0355	3.9			1	0.20

Surrogate Recoveries

Analyte	Result	Spiked Amount	Percent Recovery
3,4-Dinitrotoluene	4.89	5.00	97.9

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S013M06D

Date Printed.....: 26-APR-01 12:33

Client Name.....: Environmental Chemical Corporation
Client Ref Number....: PRJ# 5400-008-922
Sampling Site.....: IAAAP
Release Number.....: PRJ# 5400-008-922

Date Received.....: 20-APR-01 00:00

Client Sample Name: XGGG010
DCL Sample Name...: 01M01004
DCL Report Group..: 01E-0139-01

Matrix.....: SOIL
Date Sampled.....: 19-APR-01 13:36
Reporting Units...: ug/g
Report Basis.....: ☐ As Received ☒ Dried

DCL Preparation Group: G013M02P
Date Prepared.....: 22-APR-01 00:00
Preparation Method...: SW8330
Aliquot Weight/Volume: 2.0 grams
Wet Weight/Volume....: Wet Required

DCL Analysis Group: G013M02P
Analysis Method...: 8330
Instrument Type...: HPLC
Instrument ID.....: LC-4
Column Type.....: Ultrascarb ODS
☒ Primary
☐ Confirmation

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
1,3,5-Trinitrobenzene	24-APR-01 20:11	0.0414	3.2			1	0.10
1,3-Dinitrobenzene	24-APR-01 20:11	0.0139	ND		U	1	0.10
2,4,6-Trinitrotoluene	24-APR-01 20:11	0.0306	2.6			1	0.20
2,4-Dinitrotoluene	24-APR-01 20:11	0.0262	ND		U	1	0.20
2,6-Dinitrotoluene	24-APR-01 20:11	0.0564	ND		U	1	0.20
2 Amino-4,6-Dinitrotoluene	24-APR-01 20:11	0.0466	0.89			1	0.20
2-Nitrotoluene	24-APR-01 20:11	0.0772	ND		U	1	0.40
3-Nitrotoluene	24-APR-01 20:11	0.157	ND		U	1	0.40
4-Amino-2,6-Dinitrotoluene	24-APR-01 20:11	0.0600	1.4			1	0.20
4-Nitrotoluene	24-APR-01 20:11	0.115	ND		U	1	0.40
HMX	25-APR-01 22:06	0.0845	340			5	0.20
Nitrobenzene	24-APR-01 20:11	0.0391	ND		U	1	0.20
RDX	25-APR-01 22:06	0.0203	240			5	0.20
Tetryl	24-APR-01 20:11	0.0355	1.2			1	0.20

Surrogate Recoveries

Analyte	Result	Spiked Amount	Percent Recovery
3,4-Dinitrotoluene	5.02	5.00	100.

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S013M067

Date Printed.....: 26-APR-01 12:33

Client Name.....: Environmental Chemical Corporation
Client Ref Number....: PRJ# 5400-008-922
Sampling Site.....: IAAAP
Release Number.....: PRJ# 5400-008-922

Date Received.....: 20-APR-01 00:00

Client Sample Name: T6GS011
DCL Sample Name...: 01E01005
DCL Report Group..: 01E-0139-01

Matrix.....: SOIL
Date Sampled.....: 19-APR-01 13:51
Reporting Units...: ug/g
Report Basis.....: ☐ As Received ☒ Dried

DCL Preparation Group: G013M02P
Date Prepared.....: 22-APR-01 00:00
Preparation Method...: SW8330
Aliquot Weight/Volume: 2.0 grams
Net Weight/Volume....: Not Required

DCL Analysis Group: G013M02P
Analysis Method...: 8330
Instrument Type...: HPLC
Instrument ID.....: LC-4
Column Type.....: Ultrasarb ODS
☒ Primary
☐ Confirmation

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
1,3,5-Trinitrobenzene	24-APR-01 20:41	0.0414	1.0			1	0.10
1,3-Dinitrobenzene	24-APR-01 20:41	0.0139	ND		U	1	0.10
2,4,6-Trinitrotoluene	24-APR-01 20:41	0.0306	14.			1	0.20
2,4-Dinitrotoluene	24-APR-01 20:41	0.0262	ND		U	1	0.20
2,6-Dinitrotoluene	24-APR-01 20:41	0.0564	ND		U	1	0.20
2-Amino-4,6-Dinitrotoluene	24-APR-01 20:41	0.0466	0.64			1	0.20
2-Nitrotoluene	24-APR-01 20:41	0.0772	ND		U	1	0.40
3-Nitrotoluene	24-APR-01 20:41	0.157	ND		U	1	0.40
4-Amino-2,6-Dinitrotoluene	24-APR-01 20:41	0.0600	1.0			1	0.20
4-Nitrotoluene	24-APR-01 20:41	0.115	ND		U	1	0.40
HMX	25-APR-01 22:37	0.0845	400			5	0.20
Nitrobenzene	24-APR-01 20:41	0.0391	ND		U	1	0.20
RDX	25-APR-01 22:37	0.0203	200			5	0.20
Tetryl	24-APR-01 20:41	0.0355	1.2			1	0.20

Surrogate Recoveries

Analyte	Result	Spiked Amount	Percent Recovery
3,4-Dinitrotoluene	4.74	5.00	94.8

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S013M06J

Date Printed.....: 26-APR-01 12:33

Client Name.....: Environmental Chemical Corporation
Client Ref Number....: PRJ# 5400-008-922
Sampling Site.....: IAAAP
Release Number.....: PRJ# 5400-008-922

Date Received.....: 20-APR-01 00:00

Client Sample Name: T6GS012
DCL Sample Name...: 01E01006
DCL Report Group..: 01E-0139-01

Matrix.....: SOIL
Date Sampled.....: 19-APR-01 14:09
Reporting Units...: ug/g
Report Basis.....: ☐ As Received ☒ Dried

DCL Preparation Group: G013M02P
Date Prepared.....: 24-APR-01 22:14
Preparation Method...: SW8330
Aliquot Weight/Volume: 2.0 grams
Wet Weight/Volume....: Wet Required

DCL Analysis Group: G013M02P
Analysis Method...: 8330
Instrument Type...: HPLC
Instrument ID.....: LC-4
Column Type.....: Ultracarb ODS
☒ Primary
☐ Confirmation

Analytical Results

Analyte	Date Analyzed	MDL	Result	Comment	Qual.	Dilution	CRDL
1,3,5-Trinitrobenzene	24-APR-01 22:14	0.0414	0.19			1	0.10
1,3-Dinitrobenzene	24-APR-01 22:14	0.0139	ND		U	1	0.10
2,4,6-Trinitrotoluene	24-APR-01 22:14	0.0306	0.67			1	0.20
2,4-Dinitrotoluene	24-APR-01 22:14	0.0262	ND		U	1	0.20
2,6-Dinitrotoluene	24-APR-01 22:14	0.0564	ND		U	1	0.20
2 Amino-4,6-Dinitrotoluene	24-APR-01 22:14	0.0466	ND		U	1	0.20
2-Nitrotoluene	24-APR-01 22:14	0.0772	ND		U	1	0.40
3-Nitrotoluene	24-APR-01 22:14	0.157	ND		U	1	0.40
4-Amino-2,6-Dinitrotoluene	24-APR-01 22:14	0.0600	0.19		J	1	0.20
4-Nitrotoluene	24-APR-01 22:14	0.115	ND		U	1	0.40
HMX	24-APR-01 22:14	0.0845	92.			1	0.20
Nitrobenzene	24-APR-01 22:14	0.0391	ND		U	1	0.20
RDX	24-APR-01 22:14	0.0203	32.			1	0.20
Tetryl	24-APR-01 22:14	0.0355	ND		U	1	0.20

Surrogate Recoveries

Analyte	Result	Spiked Amount	Percent Recovery
3,4-Dinitrotoluene	4.93	5.00	98.7

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APPENDIX C

GRACE Treatability Study

GRACE Bioremediation Technologies (GRACE) conducted a bench-scale treatability investigation to determine the effectiveness of DARAMEND® bioremediation technology for treatment of soil containing nitroaromatic explosive compounds from the Iowa Army Ammunition Plant (IAAAP), Middletown, Iowa. This document represents the final report submitted by GRACE summarizing results from the treatability investigation.

The investigation focused on evaluation of the efficacy of bioremediation treatments involving tillage/aeration, irrigation, and addition of DARAMEND® and additional nutrient amendments to the impacted soil from the IAAAP site. Two treatability investigations were conducted over a period of 56 days during which time five sampling events were conducted. A third investigation was conducted over a period of 42 days to investigate the influence of DARAMEND treatment on contaminant concentrations and quality of soil leachates, during which 5 sampling events were conducted. Samples were sent to GP Environmental Services located in Gaithersburg, MD, U.S.A., for determination of total nitroaromatic concentrations in the soil and, where applicable, in leachate samples.

Results from the treatability investigation indicated that DARAMEND® technology would provide an effective approach to remediation of nitroaromatic-impacted soils. In the first study, over 92% removal of nitroaromatic compounds was observed following 42 treatment days in response to the most effective DARAMEND treatment, and over 98% removal was observed in the second treatability investigation following 56 days of the most effective DARAMEND treatment.

Based on these results and GRACE's extensive experience with full-scale application of the technology, we conclude that DARAMEND bioremediation technology would provide an effective approach for treatment of nitroaromatic explosive compounds in the Iowa AAP and recommend consideration of the technology for full-scale application.

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1.0 INTRODUCTION

1.1 Project Background

The potential for bioremediation of soil containing nitroaromatic explosive compounds is being investigated by Cape Environmental Management Inc. (CAPE), for a site at the Iowa Army Ammunition Plant in Burlington, Iowa (the Site). As part of this investigation, GRACE Bioremediation Technologies (GRACE) was retained to complete a bench-scale treatability investigation and identify bioremediation treatments capable of improving the rate and extent of removal of the nitroaromatic compounds.

1.2 Overview of the Proposed Technology

The focus of the treatability investigation was evaluation of the efficacy of GRACE's patented DARAMEND® bioremediation technology for removal of nitroaromatic explosives, particularly TNT, HMX, RDX, and TNB, from soil. Briefly, the DARAMEND technology enhances and promotes natural bioremediation rates by adjusting conditions in a waste matrix to stimulate biodegradation of target compounds by indigenous microorganisms. The key component of GRACE's approach to bioremediation is the DARAMEND soil amendment. DARAMEND soil amendments are solid-phase organic materials manufactured from natural plant fibers, and added on a waste/contaminant-specific basis. No microbial inoculation is conducted.

For removal of nitroaromatic compounds, the technology also involves the application of a zero-valent metal, along with DARAMEND amendment. The combination of amendments and a high soil moisture content create anoxic conditions in the soil environment, which contribute to enhanced reduction of nitro groups. The result is an increased rate of biodegradation of nitroaromatic compounds in soil.

2.0 PROJECT SCOPE AND OBJECTIVES

The overall objective of the treatability investigation was to determine the effectiveness of DARAMEND for enhancing removal of TNB, TNT, HMX and RDX, four complex nitroaromatic explosive compounds, from the subject soil. Specific objectives were to:

- characterize the impacted soil with respect to physical/chemical properties known to affect biodegradation of the target compounds;
- verify the feasibility of bioremediation;
- determine the optimal bioremediation treatment parameters (i.e., moisture, aeration, rate of DARAMEND application, pH modification);
- estimate the rate of degradation of the target compounds in the soil under optimal treatment conditions; and
- estimate the residual concentration of target compounds achievable following treatment.

3.0 MATERIALS AND METHODS

3.1 Soil Collection/Preparation and Characterization

Two soil samples were shipped by CAPE; one in an unlabelled plastic bucket, the other divided into three metal cans labeled "treated soil" ("treated soil" has been pretreated for metals). The samples arrived at GRACE's laboratory facility on February 26, 2001. Upon arrival, they were visually inspected, entered into the sample log database, and a project logbook was created. A single subsample of each was collected for archive, and stored at 4°C. The soils were prepared for use in the treatability investigation by passive air-drying under a fumehood, manually pulverizing large clumps, sieving (4.75 mm), and homogenizing for 15 minutes using a stainless steel universal blender. The prepared soils were stored in 20-L pails at <4°C in the dark, until needed for set-up of the treatability investigation.

Triplicate subsamples of each prepared soil were submitted, under chain-of-custody, to GPL Laboratories, Gaithersburg, Maryland (GPL), for analysis of nitroaromatic explosives using EPA Method 8330. Single subsamples of each prepared soil were submitted, also under chain-of-custody, to Maxxam Analytics Inc., Mississauga,

All samples were submitted, under chain-of-custody, to GPL, for analysis of nitroaromatic explosive concentrations following EPA Method 8330 protocol. Single composite samples from each Control and selected treatments were also submitted, under chain-of-custody, to GPL for a modified TCLP extraction protocol (using water as the solvent), and EPA Method 8330 analysis for total explosive compounds in the leachate. In the second treatability investigation, DARAMEND amendment applications were continued on a single treatment, for an additional two weeks. Following the eighth week of treatment, composite samples from this treatment and the Control were submitted, under chain-of-custody, for analysis of nitroaromatic explosives by GPL.

A third experiment was prepared to investigate the effect of multiple DARAMEND amendment applications on the nitroaromatic explosive concentrations in soil leachate. The test consisted of DARAMEND amendment and powdered metal added to 1 kg of non-pretreated soil contained in a microcosm jar. Single soil samples were collected prior to the initial amendment application and one day after amendment application during cycles 1, 2, 4, and 6. The samples were submitted, under chain-of-custody, to GPL for TCLP-leachate analysis for nitroaromatic explosives (see above), selected metals (Fe, Mn) and hardness. Following completion of the sixth treatment cycle, triplicate 200g samples from this microcosm were collected for the following leachate test:

> Soil was packed loosely in a Buchner funnel lined with glass wool. Water (2L) was percolated through the soil, collected and submitted under chain-of-custody, for analysis of total suspended solids, total dissolved solids and the paint filter test by GPES.

4.0 RESULTS AND DISCUSSION

4.1 Soil Characterization

The results of initial soil characterization analyses, for the two prepared soils, are summarized in Table 1. Metal concentrations were not considered to be a barrier with respect to microbiological activity in the soil. Biological activity may have been limited

by the high pH, particularly in the pretreated soil.

4.2 Analytical Results

Initial concentrations of nitroaromatic explosive compounds in the two prepared soils are summarized in Tables 2 (non-pretreated soil) and 3 (pretreated soil). The prepared non-pretreated soil contained 1,973 mg/kg total explosive compounds, predominantly RDX (1,032 mg/kg), HMX (761 mg/kg), TNT (98 mg/kg) and TNB (62 mg/kg) (Table 2). The prepared, pretreated soil contained 4,138 mg/kg total explosive compounds including RDX (2,170 mg/kg), HMX (722 mg/kg), TNT (1,191 mg/kg) and TNB (47 mg/kg).

First Treatability Investigation

Results of soil analyses for the first treatability investigation, using the non-pretreated soil, are summarized in Figure 1. Results of analyses conducted after 1, 2, 3, and 6 weeks (7, 14, 21, and 42 days) of treatment indicate that concentrations of all nitroaromatic explosives in the soil decreased steadily throughout the treatability investigation as a result of DARAMEND treatment. In the most effective treatment (Treatment 1), the total explosive compound concentration was reduced by 92%, from 1,973 mg/kg to 149 mg/kg (Figure 1). In contrast, limited removal (26%) was observed in the Control. Concentrations of each individual compound in the Control and Treatment 1, on day 42, are shown in Table 4.

Second Treatability Investigation

The results of soil analyses for the second treatability investigation, using the pretreated soil, are summarized in Figure 2. Concentrations of all nitroaromatic explosives decreased steadily throughout the investigation in response to DARAMEND® treatment. In response to the most effective DARAMEND treatment (i.e., Treatment 6), the concentration of total explosive compounds was reduced by 98%, from 4,138 mg/kg to 75 mg/kg, following 56 days of treatment (Figure 2). Limited removal (36%) was observed in the Control during the eight-week period. Concentrations of each individual compound in the Control and Treatment 6, on day 56, are shown in Table 4.

Leachate Analyses

Results of the leachate analyses from the first and second treatability investigations are shown in Table 5. The final results were reported as µg explosive compounds per litre of water. In both treatability investigations, the total µg/L of explosives was reduced considerably in the treated microcosms relative to the Control. These results indicate that the DARAMEND amendment would not increase leaching of organic explosive compounds.

Results of TCLP-leachate analyses for explosive compounds performed on samples collected during the third treatability investigation are shown in Table 6. The total explosives concentration detected in soil leachate collected at the beginning of the investigation was 29,922 µg/L. One day following the first application of DARAMEND amendment, the concentration of total explosive compounds in the leachate was 18,309 µg/L.

As there would not have been adequate time for substantial biodegradation to take place in the 24 hours after treatment began, before the sample was collected, this data suggests that DARAMEND amendment served to reduce leaching of nitroaromatic explosive compounds from the soil. To further support these conclusions, leachate explosive concentrations were found to have decreased with each sequential DARAMEND amendment application. Following the sixth treatment cycle, the concentration of total explosive compounds had been reduced from an initial value of 29,922 µg/L to 1,128 µg/L in response to DARAMEND treatment, representing a 96.2% reduction (Table 6).

Results of TCLP-leachate analyses for Fe, Mn and hardness performed on samples collected during the third treatability investigation are shown in Table 7. Results indicated that the Fe concentration in soil leachate remained below the detection limit of 1,500 µg/L over the duration of the 6 treatment cycles. Results suggested that the Mn concentration gradually increased from an initial concentration of less than 50 µg/L to 673 µg/L following 6 treatment cycles. The hardness in the soil leachate samples also appeared to gradually increase in response to DARAMEND treatment from an initial

value of 5.3 mg eq $CaCO_3$/L to 11.6 mg eq $CaCO_3$/L following 6 treatment cycles.

Results of final leachate analyses for total dissolved solids (TDS), total suspended solids (TSS), and paint filter test are shown in Table 8. Results indicated that the mean TDS and TSS concentrations in the soil leachate following 6 treatment cycles were 307 mg/L and 292 mg/L, respectively. In addition, results indicated that all 3 replicate samples had paint filter test values of 100% free liquid.

4.3 Data Quality

The quality of analytical data obtained on day 42 of each treatability investigation was evaluated by determining the coefficient of variation (CoV, the standard deviation divided by the mean) for each treatment, including the Control. In general, data quality was good with the majority of CoV values falling below 50%. Lower CoV values were observed for treatments in which explosive compound concentrations were lowest, indicating that as biodegradation progressed concentrations of explosives compounds in the soil became more homogeneous.

5.0 SUMMARY AND RECOMMENDATIONS

Results of the treatability investigation indicated that DARAMEND bioremediation would provide an effective means of treatment for nitroaromatic explosives in the IAAAP soil. With respect to the stated objectives of the project (Section 2.0), the following summary of results is provided:

- The non-pretreated soil contained a total explosive concentration of 1,973 mg/kg, consisting of predominantly TNB, TNT, RDX, and HMX. The pretreated soil contained the same predominant compounds and a total explosive concentration of 4,138 mg/kg. The pH of the soil was deemed a possible barrier to bioremediation.
- The ability of various DARAMEND treatments to enhance removal of nitroaromatic explosives was evaluated during the 42 and 56-day investigations. Significant reductions in explosive concentrations were observed in response to all DARAMEND treatments during the course of the investigation.
- Explosive concentrations in the non-pretreated soil were reduced from 1,973 mg/kg to 149 mg/kg in 42 days, in response to the most effective treatment.

- Explosive concentrations in the pretreated soil were reduced from 4,138 mg/kg to 75 mg/kg in 56 days, in response to the most effective treatment.
- DARAMEND amendment was not found to increase leaching of nitroaromatic explosive compounds from the soil. Results suggested that DARAMEND amendment reduced leaching of these compounds into water.

Based on these results, we conclude that DARAMEND bioremediation technology would provide an effective approach for treatment of nitroaromatic explosive compounds in the IAAAP and recommend consideration of the technology for full-scale application.

FIGURES

FINAL REPORT: BENCH-SCALE DARAMEND® BIOREMEDIATION TREATABILITY INVESTIGATION OF IAAAP SOIL.

Figure 1: Influence of DARAMEND Treatment on Total Explosive Compound Concentrations in Non-Pretreated (Study 1) IAAAP Soil Following 42 Days of Treatment.

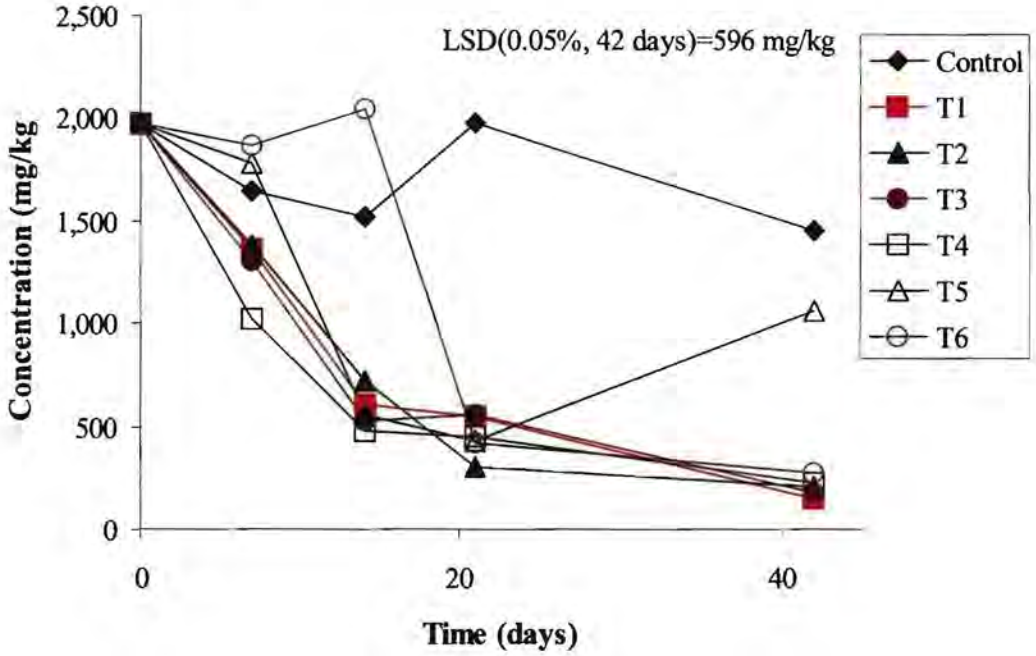
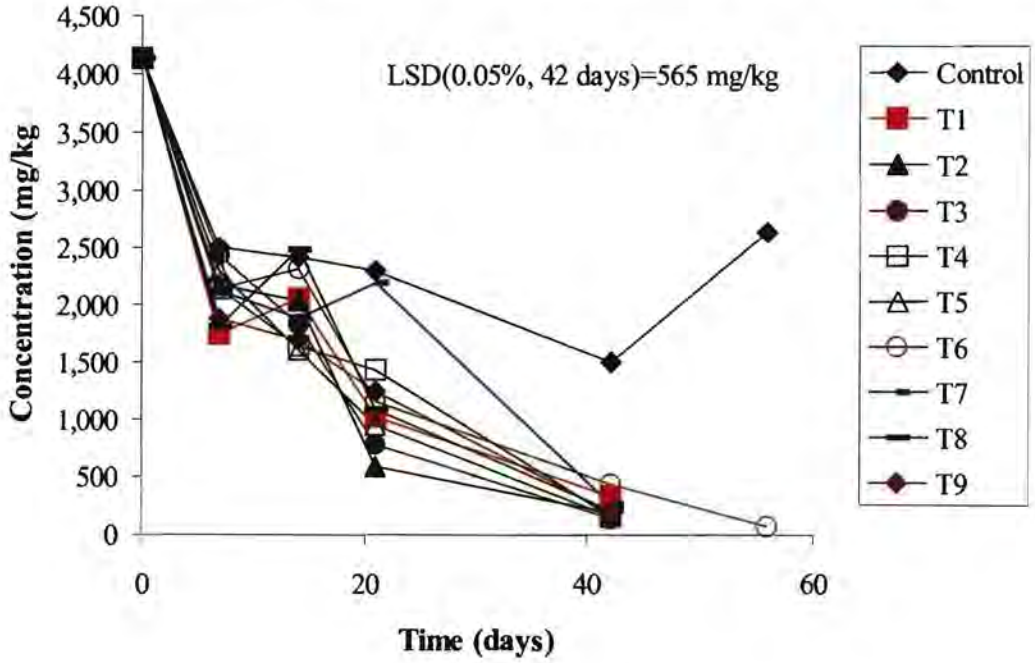


Figure 2: Influence of DARAMEND Treatment on Total Explosive Compound Concentrations in Pretreated (Study 2) IAAAP Soil Following 56 days of Treatment.



TABLES

FINAL REPORT: BENCH-SCALE DARAMEND® BIOREMEDIATION TREATABILITY INVESTIGATION OF IAAAP SOIL.

Table 1: Initial Physical and Chemical Characteristics of the Non-Pretreated and Pretreated IAAAP soils.

Parameter	Non-Pretreated Soil (Study 1)	Pretreated Soil (Study 2)
pH (standard units)	8.25	9.39
Soil water holding capacity (mL/100g)	52.0	45.7
Aluminum	10,300	10,200
Arsenic	6	4
Cadmium	4.6	2.5
Chromium	54.3	37.2
Copper	2150	403
Iron	25,000	15,800
Lead	424	131
Manganese	510	412
Nickel	56.2	29.7
Zinc	2,120	794

All values are mg/kg concentrations on a dry weight basis unless otherwise specified.
Metal analysis performed by Maxxam Analytics Inc.; all other analysis performed by Grace Bioremediation Technologies.
BDL = below detection limit.

Table 2: Initial Explosive Compound Concentrations in the Non-Pretreated (Study 1) Soil.

Parameter	Concentration (mg/kg)				
Replicate No.	1	2	3	Mean	CoV[1] (%)
1,3,5-Trinitrobenzene	62.2	69.1	56.1	62.5	10.4
1,3-Dinitrobenzene	BDL	BDL	BDL	BDL	N/A
2,4,6-Trinitrotoluene	119	112	64.1	98.4	30.4
2,4-Dinitrotoluene	1.6	0.6	0.7	1.0	59.3
2,6-Dinitrotoluene	BDL	6.9	BDL	2.3	173
2-Amino-4,6-dinitrotoluene	9.3	4.3	5.4	6.3	41.9
4-Amino-2,6-dinitrotoluene	8.2	4.9	5.4	6.1	29.0
HMX	867	799	618	761	16.9
Nitrobenzene	BDL	BDL	BDL	BDL	N/A
RDX	1,200	1,060	836	1,032	17.8
Tetryl	BDL	BDL	9.7	3.2	173
m-nitrotoluene	BDL	BDL	BDL	BDL	N/A
o-nitrotoluene	BDL	BDL	BDL	BDL	N/A
p-nitrotoluene	BDL	BDL	BDL	BDL	N/A
Total Explosive Compounds	2,267	2,057	1,595	**1,973**	**17.4**

[1] CoV = Coefficient of Variation = Standard deviation / Mean
BDL – Below Detection Limits
N/A – Not Applicable

Table 3: Initial Explosive Compound Concentrations in the Pretreated (Study 2) Soil.

Parameter	Concentration (mg/kg)				
Replicate No.	1	2	3	Mean	CoV[1] (%)
1,3,5-Trinitrobenzene	35.9	26.9	77.9	46.9	58.0
1,3-Dinitrobenzene	BDL	BDL	BDL	BDL	N/A
2,4,6-Trinitrotoluene	3,150	117	306	1,191	143
2,4-Dinitrotoluene	3.7	1.0	1.1	1.9	77.6
2,6-Dinitrotoluene	BDL	BDL	BDL	BDL	N/A
2-Amino-4,6-dinitrotoluene	5.4	2.5	3.7	3.8	37.5
4-Amino-2,6-dinitrotoluene	BDL	2.8	5.3	4.0	44.1
HMX	761	492	912	722	29.5
Nitrobenzene	BDL	BDL	BDL	BDL	N/A
RDX	2,640	1,540	2,330	2,170	26.1
Tetryl	BDL	BDL	BDL	BDL	N/A
m-nitrotoluene	BDL	BDL	BDL	BDL	N/A
o-nitrotoluene	BDL	BDL	BDL	BDL	N/A
p-nitrotoluene	BDL	BDL	BDL	BDL	N/A
Total Explosive Compounds	6,596	2,182	3,636	**4,138**	**54.4**

[1] CoV = Coefficient of Variation = Standard deviation / Mean
BDL – Below Detection Limits
N/A – Not Applicable

Table 4: Final Concentrations of Individual Explosive Compounds in the Control and Most Effective Treatments from each Treatability Investigation.

Parameter	Concentration (mg/kg)			
	Non-Pretreated Soil (Study 1)[1]		*Pretreated Soil (Study 2)*[2]	
	Control	*Treatment 1*	*Control*	*Treatment 6*
1,3,5-Trinitrobenzene	64.0	2.5	21.5	13.7
1,3-Dinitrobenzene	0.7	0.8	0.89	0.37
2,4,6-Trinitrotoluene	56.4	5.5	204	8.74
2,4-Dinitrotoluene	2.1	0.4	0.88	0.49
2,6-Dinitrotoluene	BDL	BDL	BDL	BDL
2-Amino-4,6-dinitrotoluene	8.5	1.3	1.2	1.82
4-Amino-2,6-dinitrotoluene	7.9	0.9	3.35	2.32
HMX	571	130	675	33.2
Nitrobenzene	0.1	BDL	0.25	0.081
RDX	743	7.0	1,730	14.2
Tetryl	BDL	0.8	4.25	BDL
m-nitrotoluene	BDL	BDL	BDL	BDL
o-nitrotoluene	BDL	BDL	BDL	BDL
p-nitrotoluene	BDL	BDL	BDL	BDL
Total Explosive Compounds	**1,454**	**149**	**2,641**	**75.0**

[1] Values are the average of triplicate measurements. Analyses performed by GPL Laboratories.

[2] Values were obtained from a single composite sample. Analyses performed by GPL Laboratories.

Table 5: Influence of DARAMEND Treatment on Total Explosive Compound Concentrations in Non-Pretreated Soil Leachate (Study 1) and Pretreated Soil Leachate (Study 2) from IAAAP.

Sample	Total Explosives in Leachate (μg/L)
Non-pretreated (Study 1)	
Control	28787
Treatment 1	2072
Treatment 2	1207
Pretreated (Study 2)	
Control	34775
Treatment 1	3057
Treatment 2	2892

Analysis performed by GPL Laboratories.

Table 6: Influence of DARAMEND Treatment on Explosive Compound Concentrations in IAAAP Soil Leachate from the Third Treatability Investigation.

Parameter	Explosive Compounds in Leachate (µg/L)				
Time (cycles)	Initial	1	2	4	6
1,3,5-Trinitrobenzene	439	40	21	2	2
1,3-Dinitrobenzene	1	2	5	4	4
2,4,6-Trinitrotoluene	2,040	551	1,530	1,000	1
2,4-Dinitrotoluene	BDL	BDL	BDL	BDL	BDL
2,6-Dinitrotoluene	BDL	BDL	BDL	BDL	BDL
2-Amino-4,6-dinitrotoluene	8	20	19	25	BDL
4-Amino-2,6-dinitrotoluene	4	26	34	89	4
HMX	2,530	2,170	2,320	2,690	931
Nitrobenzene	BDL	BDL	BDL	BDL	BDL
RDX	24,900	15,500	6,340	765	186
Tetryl	BDL	BDL	BDL	BDL	BDL
m-nitrotoluene	BDL	BDL	BDL	BDL	BDL
o-nitrotoluene	BDL	BDL	BDL	BDL	BDL
p-nitrotoluene	BDL	BDL	BDL	BDL	BDL
Total Explosive Compounds	**29,922**	**18,309**	**10,270**	**4,575**	**1,128**

Analysis performed by GPL Laboratories.

Table 7: Influence of DARAMEND Treatment on Fe, Mn, and Hardness Values in IAAAP Soil Leachate Samples from the Third Treatability Investigation.

Parameter	Concentration				
Time (cycles)	Initial	1	2	4	6
Fe (µg/L)	<1,500	<1,500	<1,500	<1,500	<1,500
Mn (µg/L)	<50	134	250	739	673
Hardness (mg eq $CaCO_3$/L)	5.3	6.2	6.8	10.6	11.6

Table 8: Total Dissolved and Suspended Solids in Soil Leachate Samples from the Third Treatability Investigation.

Parameter	Result			
Replicate No.	1	2	3	Mean
TDS (mg/L)	282	274	364	307
TSS (mg/L)	314	322	240	292
% Free Liquid	100	100	100	100

TDS = total dissolved solids
TSS = total suspended solids

APPENDIX A

FINAL REPORT: BENCH-SCALE DARAMEND® BIOREMEDIATION TREATABILITY INVESTIGATION OF IAAAP SOIL.

TREATABILITY INVESTIGATION 1 : NON-PRETREATED SOIL

GRACE Sample No.	Description
22125	Non-pretreated soil, selected metals
22126 - 22128	Non-pretreated soil, t=0 explosives; 3 replicates
22192	t = 7 days Control, explosives analysis
22193	t = 7 days Treatment 1, explosives analysis
22194	t = 7 days Treatment 2, explosives analysis
22195	t = 7 days Treatment 3, explosives analysis
22196	t = 7 days Treatment 4, explosives analysis
22197	t = 7 days Treatment 5, explosives analysis
22198	t = 7 days Treatment 6, explosives analysis
22292	t = 14 days Control, explosives analysis
22293	t = 14 days Treatment 1, explosives analysis
22294	t = 14 days Treatment 2, explosives analysis
22295	t = 14 days Treatment 3, explosives analysis
22296	t = 14 days Treatment 4, explosives analysis
22297	t = 14 days Treatment 5, explosives analysis
22298	t = 14 days Treatment 6, explosives analysis
22367	t = 21 days Control, explosives analysis
22368	t = 21 days Treatment 1, explosives analysis
22369	t = 21 days Treatment 2, explosives analysis
22370	t = 21 days Treatment 3, explosives analysis
22371	t = 21 days Treatment 4, explosives analysis
22372	t = 21 days Treatment 5, explosives analysis
22373	t = 21 days Treatment 6, explosives analysis
22599 – 22601	t = 42 days Control, explosives analysis; 3 replicates
22602 – 22604	t = 42 days Treatment 1, explosives analysis; 3 replicates
22605 – 22607	t = 42 days Treatment 2, explosives analysis; 3 replicates
22608 – 22010	t = 42 days Treatment 3, explosives analysis; 3 replicates
22611 – 22613	t = 42 days Treatment 4, explosives analysis; 3 replicates
22614 – 22616	t = 42 days Treatment 5, explosives analysis; 3 replicates
22617 – 22619	t = 42 days Treatment 6, explosives analysis; 3 replicates

TREATABILITY INVESTIGATION 2 : PRETREATED SOIL

GRACE Sample No.	Description
22053	Pretreated soil, selected metals
22054 – 22056	Pretreated soil, t=0 explosives; 3 replicates
22182	t = 7 days Control, explosives analysis
22183	t = 7 days Treatment 1, explosives analysis
22184	t = 7 days Treatment 2, explosives analysis
22185	t = 7 days Treatment 3, explosives analysis
22186	t = 7 days Treatment 4, explosives analysis
22187	t = 7 days Treatment 5, explosives analysis
22188	t = 7 days Treatment 6, explosives analysis
22189	t = 7 days Treatment 7, explosives analysis
22190	t = 7 days Treatment 8, explosives analysis
22191	t = 7 days Treatment 9, explosives analysis
22273	t = 14 days Control, explosives analysis
22274	t = 14 days Treatment 1, explosives analysis
22275	t = 14 days Treatment 2, explosives analysis
22276	t = 14 days Treatment 3, explosives analysis
22277	t = 14 days Treatment 4, explosives analysis
22278	t = 14 days Treatment 5, explosives analysis
22279	t = 14 days Treatment 6, explosives analysis
22280	t = 14 days Treatment 7, explosives analysis
22281	t = 14 days Treatment 8, explosives analysis
22282	t = 14 days Treatment 9, explosives analysis
22357	t = 21 days Control, explosives analysis
22358	t = 21 days Treatment 1, explosives analysis
22359	t = 21 days Treatment 2, explosives analysis
22360	t = 21 days Treatment 3, explosives analysis
22361	t = 21 days Treatment 4, explosives analysis
22362	t = 21 days Treatment 5, explosives analysis
22363	t = 21 days Treatment 6, explosives analysis
22364	t = 21 days Treatment 7, explosives analysis
22365	t = 21 days Treatment 8, explosives analysis
22366	t = 21 days Treatment 9, explosives analysis
22569 – 22571	t = 42 days Control, explosives analysis; 3 replicates
22572 – 22574	t = 42 days Treatment 1, explosives analysis; 3 replicates
22575 – 22577	t = 42 days Treatment 2, explosives analysis; 3 replicates
22578 – 22580	t = 42 days Treatment 3, explosives analysis; 3 replicates
22581 – 22583	t = 42 days Treatment 4, explosives analysis; 3 replicates

22584 – 22586	t = 42 days Treatment 5, explosives analysis; 3 replicates
22587 – 22589	t = 42 days Treatment 6, explosives analysis; 3 replicates
22590 – 22592	t = 42 days Treatment 7, explosives analysis; 3 replicates
22593 – 22595	t = 42 days Treatment 8, explosives analysis; 3 replicates
22596 – 22598	t = 42 days Treatment 9, explosives analysis; 3 replicates
22716	t = 56 days Control, explosives analysis
22717	t = 56 days Treatment 6, explosives analysis

LEACHATE ANALYSES

GRACE Sample No.	Description
22668	Study 1 Control, TCLP extraction and explosives analysis
22669	Study 1 Treatment 1, TCLP extraction and explosives analysis
22670	Study 1 Treatment 2, TCLP extraction and explosives analysis
22671	Study 2 Control, TCLP extraction and explosives analysis
22672	Study 1 Treatment 1, TCLP extraction and explosives analysis
22673	Study 1 Treatment 2, TCLP extraction and explosives analysis
22674	t = 0, TCLP extraction and explosives, Fe, Mn and hardness analyses
22675	t = 1 cycle, TCLP extraction and explosives, Fe, Mn and hardness analyses
22676	t = 2 cycles, TCLP extraction and explosives, Fe, Mn and hardness analyses
22677	t = 4 cycles, TCLP extraction and explosives, Fe, Mn and hardness analyses
22678	t = 6 cycles, TCLP extraction and explosives, Fe, Mn and hardness analyses
23393 - 23395	TDS, TSS and Paint filter test; 3 replicates

Maxxam Analytics Inc

REPORT DATE: 2001/03/06

PROJECT #: 10
MAXXAM JOB #: A1046

RESULTS OF CHEMICAL ANALYSES OF SOLID

Maxxam ID		527592	527593					
COC Number		1093	1093					
Sampling Date		2001/02/28	2001/03/01					

Parameter	Units	22053	22125	MDL	SPIKED BLANK %REC	METHOD BLANK	MATRIX SPIKE %REC	QC %REC
Arsenic (As)	ug/g	4	6	1	103	<1	96	103
Aluminum (Al)	ug/g	10200	10300	2.5	N/A	<2.5	N/A	100
Chromium (Cr)	ug/g	37.2	54.3	0.5	N/A	<0.5	119	99
Copper (Cu)	ug/g	403	2150	0.3	N/A	<0.3	N/A	98
Iron (Fe)	ug/g	15800	25000	0.5	N/A	<0.5	N/A	103
Lead (Pb)	ug/g	131	424	2.5	N/A	<2.5	N/A	100
Manganese (Mn)	ug/g	412	510	0.1	N/A	<0.1	N/A	99
Nickel (Ni)	ug/g	29.7	56.2	1	N/A	<1	101	99
Zinc (Zn)	ug/g	794	2120	0.3	N/A	<0.3	N/A	100
Cadmium (Cd)	ug/g	2.5	4.6	0.3	N/A	<0.3	97	100

treated untreated

N/A = Not Applicable
MDL = METHOD DETECTION LIMIT
QC = QC Standard

Summary of Analytical Results

Client ID 22126
GPL ID: 103024-004-01-1/1
Matrix: Soil
Date Collected: Mar-01-2001
Date Received: Mar-05-2001

Prep Method: EXT_SW8330
Prep Date: Mar-06-2001
Prep Time: 11:58
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-12-2001
Time Analyzed 11:34
Analyst: Shukla Sarker

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	41400	200	ug/kg		1
1,3-Dinitrobenzene	BQL	200	ug/kg	U	1
2,4,6-Trinitrotoluene	80500	200	ug/kg		1
2,4-Dinitrotoluene	1640	200	ug/kg		1
2,6-Dinitrotoluene	BQL	200	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	9310	200	ug/kg		1
4-Amino-2,6-Dinitrotoluene	8170	200	ug/kg		1
HMX	571000	400	ug/kg		1
Nitrobenzene	BQL	200	ug/kg	U	1
RDX	762000	400	ug/kg		1
Tetryl	BQL	400	ug/kg	U	1
m-Nitrotoluene	BQL	400	ug/kg	U	1
o-Nitrotoluene	BQL	400	ug/kg	U	1
p-Nitrotoluene	BQL	400	ug/kg	U	1

untreated

Summary of Analytical Results

Client ID 22127
GPL ID: 103024-005-01-1/1
Matrix: Soil
Date Collected: Mar-01-2001
Date Received: Mar-05-2001

Prep Method: EXT_SW8330
Prep Date: Mar-06-2001
Prep Time: 11:58
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-12-2001
Time Analyzed 12:03
Analyst: Shukla Sarker

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	46600	200	ug/kg		1
1,3-Dinitrobenzene	BQL	200	ug/kg	U	1
2,4,6-Trinitrotoluene	77100	200	ug/kg		1
2,4-Dinitrotoluene	587	200	ug/kg		1
2,6-Dinitrotoluene	6900	200	ug/kg		1
2-Amino-4,6-Dinitrotoluene	4280	200	ug/kg		1
4-Amino-2,6-Dinitrotoluene	4880	200	ug/kg		1
HMX	532000	400	ug/kg		1
Nitrobenzene	BQL	200	ug/kg	U	1
RDX	694000	400	ug/kg		1
Tetryl	BQL	400	ug/kg	U	1
m-Nitrotoluene	BQL	400	ug/kg	U	1
o-Nitrotoluene	BQL	400	ug/kg	U	1
p-Nitrotoluene	BQL	400	ug/kg	U	1

Summary of Analytical Results

Client ID 22128
GPL ID: 103024-006-01-1/1
Matrix: Soil
Date Collected: Mar-01-2001
Date Received: Mar-05-2001

Prep Method: EXT_SW8330
Prep Date: Mar-06-2001
Prep Time: 11:58
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-12-2001
Time Analyzed 12:32
Analyst: Shukla Sarker

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	50100	200	ug/kg		1
1,3-Dinitrobenzene	BQL	200	ug/kg	U	1
2,4,6-Trinitrotoluene	58900	200	ug/kg		1
2,4-Dinitrotoluene	700	200	ug/kg		1
2,6-Dinitrotoluene	BQL	200	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	5360	200	ug/kg		1
4-Amino-2,6-Dinitrotoluene	5350	200	ug/kg		1
HMX	552000	400	ug/kg		1
Nitrobenzene	BQL	200	ug/kg	U	1
RDX	722000	400	ug/kg		1
Tetryl	9720	400	ug/kg		1
m-Nitrotoluene	BQL	400	ug/kg	U	1
o-Nitrotoluene	BQL	400	ug/kg	U	1
p-Nitrotoluene	BQL	400	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22192
GPL ID: 103106-001-01-1/1
Matrix: Soil
Date Collected: Mar-12-2001
Date Received: Mar-13-2001

Prep Method: EXT_SW8330
Prep Date: Mar-16-2001
Prep Time: 09:08
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-22-2001
Time Analyzed 18:54
Analyst: Shukla Sarker

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	58700	100	ug/kg		1
1,3-Dinitrobenzene	1540	100	ug/kg		1
2,4,6-Trinitrotoluene	97200	100	ug/kg		1
2,4-Dinitrotoluene	1420	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	6180	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	7520	100	ug/kg		1
HMX	575000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	741000	200	ug/kg		1
Tetryl	5920	200	ug/kg		1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22193
GPL ID: 103106-002-01-1/1
Matrix: Soil
Date Collected: Mar-12-2001
Date Received: Mar-13-2001

Prep Method: EXT_SW8330
Prep Date: Mar-16-2001
Prep Time: 09:08
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-22-2001
Time Analyzed 19:51
Analyst: Shukla Sarker

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	68300	100	ug/kg		1
1,3-Dinitrobenzene	1500	100	ug/kg		1
2,4,6-Trinitrotoluene	104000	100	ug/kg		1
2,4-Dinitrotoluene	3730	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	5910	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	11200	100	ug/kg		1
HMX	552000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	475000	200	ug/kg		1
Tetryl	7420	200	ug/kg		1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22194
GPL ID: 103106-003-01-1/1
Matrix: Soil
Date Collected: Mar-12-2001
Date Received: Mar-13-2001

Prep Method: EXT_SW8330
Prep Date: Mar-16-2001
Prep Time: 09:08
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-22-2001
Time Analyzed 20:48
Analyst: Shukla Sarker

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	26800	100	ug/kg		1
1,3-Dinitrobenzene	883	100	ug/kg		1
2,4,6-Trinitrotoluene	71900	100	ug/kg		1
2,4-Dinitrotoluene	603	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	4290	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	6190	100	ug/kg		1
HMX	555000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	612000	200	ug/kg		1
Tetryl	6100	200	ug/kg		1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22195
GPL ID: 103106-004-01-1/1
Matrix: Soil
Date Collected: Mar-12-2001
Date Received: Mar-13-2001

Prep Method: EXT_SW8330
Prep Date: Mar-16-2001
Prep Time: 09:08
Prep Chemist: Shila Solcimani

Analytical Method: SW8330
Date Analyzed: Mar-22-2001
Time Analyzed 22:42
Analyst: Shukla Sarker

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	27400	100	ug/kg		1
1,3-Dinitrobenzene	1150	100	ug/kg		1
2,4,6-Trinitrotoluene	34600	100	ug/kg		1
2,4-Dinitrotoluene	1440	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	5220	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	6870	100	ug/kg		1
HMX	566000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	444000	200	ug/kg		1
Tetryl	7960	200	ug/kg		1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22196
GPL ID: 103106-005-01-1/1
Matrix: Soil
Date Collected: Mar-12-2001
Date Received: Mar-13-2001

Prep Method: EXT_SW8330
Prep Date: Mar-16-2001
Prep Time: 09:08
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-22-2001
Time Analyzed 23:39
Analyst: Shukla Sarker

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	23300	100	ug/kg		1
1,3-Dinitrobenzene	1090	100	ug/kg		1
2,4,6-Trinitrotoluene	81400	100	ug/kg		1
2,4-Dinitrotoluene	1430	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	5350	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	9530	100	ug/kg		1
HMX	540000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	398000	200	ug/kg		1
Tetryl	6380	200	ug/kg		1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22197
GPL ID: 103106-006-01-1/1
Matrix: Soil
Date Collected: Mar-12-2001
Date Received: Mar-13-2001

Prep Method: EXT_SW8330
Prep Date: Mar-16-2001
Prep Time: 09:08
Prep Chemist: Shila Solcimani

Analytical Method: SW8330
Date Analyzed: Mar-23-2001
Time Analyzed 00:36
Analyst: Shukla Sarker

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	96100	100	ug/kg		1
1,3-Dinitrobenzene	1560	100	ug/kg		1
2,4,6-Trinitrotoluene	113000	100	ug/kg		1
2,4-Dinitrotoluene	2190	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	7370	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	12000	100	ug/kg		1
HMX	650000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	678000	200	ug/kg		1
Tetryl	9120	200	ug/kg		1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22198
GPL ID: 103106-007-01-1/1
Matrix: Soil
Date Collected: Mar-12-2001
Date Received: Mar-13-2001

Prep Method: EXT_SW8330
Prep Date: Mar-16-2001
Prep Time: 09:08
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-23-2001
Time Analyzed 01:33
Analyst: Shukla Sarker

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	83300	100	ug/kg		1
1,3-Dinitrobenzene	1150	100	ug/kg		1
2,4,6-Trinitrotoluene	264000	100	ug/kg		1
2,4-Dinitrotoluene	3750	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	6770	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	13500	100	ug/kg		1
HMX	615000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	848000	200	ug/kg		1
Tetryl	6540	200	ug/kg		1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

...L LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22292
CPL ID: 103192-001-01-1/1
Matrix: Soil
Date Collected: Mar-19-2001
Date Received: Mar-20-2001

Prep Method: EXT_SW8330
Prep Date: Mar-22-2001
Prep Time: 07:49
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-28-2001
Time Analyzed 11:35
Analyst: Dayuan Han

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	42100	100	ug/kg		1
1,3-Dinitrobenzene	.727	100	ug/kg		1
2,4,6-Trinitrotoluene	87700	100	ug/kg		1
2,4-Dinitrotoluene	1910	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	6180	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	6000	100	ug/kg		1
HMX	518000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	731000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22293
GPL ID: 103192-002-01-1/1
Matrix: Soil
Date Collected: Mar-19-2001
Date Received: Mar-20-2001

Prep Method: EXT_SW8330
Prep Date: Mar-22-2001
Prep Time: 07:49
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-28-2001
Time Analyzed 12:32
Analyst: Dayuan Han

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	42800	100	ug/kg		1
1,3-Dinitrobenzene	1160	100	ug/kg		1
2,4,6-Trinitrotoluene	33900	100	ug/kg		1
2,4-Dinitrotoluene	1660	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	3750	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	6930	100	ug/kg		1
HMX	382000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	192000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22294
GPL ID: 103192-003-01-1/1
Matrix: Soil
Date Collected: Mar-19-2001
Date Received: Mar-20-2001

Prep Method: EXT_SW8330
Prep Date: Mar-22-2001
Prep Time: 07:49
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-28-2001
Time Analyzed 13:29
Analyst: Dayuan Han

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	25200	100	ug/kg		1
1,3-Dinitrobenzene	1210	100	ug/kg		1
2,4,6-Trinitrotoluene	33400	100	ug/kg		1
2,4-Dinitrotoluene	1270	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	6600	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	7140	100	ug/kg		1
HMX	417000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	174000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22295
GPL ID: 103192-004-01-1/1
Matrix: Soil
Date Collected: Mar-19-2001
Date Received: Mar-20-2001

Prep Method: EXT_SW8330
Prep Date: Mar-22-2001
Prep Time: 07:49
Prep Chemist: Shila Solelmani

Analytical Method: SW8330
Date Analyzed: Mar-28-2001
Time Analyzed 15:23
Analyst: Dayuan Han

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	15700	100	ug/kg		1
1,3-Dinitrobenzene	.802	100	ug/kg		1
2,4,6-Trinitrotoluene	15800	100	ug/kg		1
2,4-Dinitrotoluene	.368	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	3650	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	4640	100	ug/kg		1
HMX	376000	200	ug/kg		1
Nitrobenzene	54.8	100	ug/kg	J	1
RDX	65700	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	.148	200	ug/kg	J	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22296
GPL ID: 103192-005-01-1/1
Matrix: Soil
Date Collected: Mar-19-2001
Date Received: Mar-20-2001

Prep Method: EXT_SW8330
Prep Date: Mar-22-2001
Prep Time: 07:49
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-28-2001
Time Analyzed 16:20
Analyst: Dayuan Han

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	13800	100	ug/kg		1
1,3-Dinitrobenzene	.761	100	ug/kg		1
2,4,6-Trinitrotoluene	10800	100	ug/kg		1
2,4-Dinitrotoluene	BQL	100	ug/kg	U	1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	3360	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	3610	100	ug/kg		1
HMX	390000	200	ug/kg		1
Nitrobenzene	.161	100	ug/kg		1
RDX	44600	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	.153	200	ug/kg	J	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22297
GPL ID: 103192-006-01-1/1
Matrix: Soil
Date Collected: Mar-19-2001
Date Received: Mar-20-2001

Prep Method: EXT_SW8330
Prep Date: Mar-22-2001
Prep Time: 07:49
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-28-2001
Time Analyzed 17:17
Analyst: Dayuan Han

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	9590	100	ug/kg		1
1,3-Dinitrobenzene	.630	100	ug/kg		1
2,4,6-Trinitrotoluene	16600	100	ug/kg		1
2,4-Dinitrotoluene	.357	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	3790	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	4030	100	ug/kg		1
HMX	393000	200	ug/kg		1
Nitrobenzene	.127	100	ug/kg		1
RDX	88500	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	.210	200	ug/kg		1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22298
GPL ID: 103192-007-01-1/1
Matrix: Soil
Date Collected: Mar-19-2001
Date Received: Mar-20-2001

Prep Method: EXT_SW8330
Prep Date: Mar-22-2001
Prep Time: 07:49
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-28-2001
Time Analyzed 18:14
Analyst: Dayuan Han

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	7290	100	ug/kg		1
1,3-Dinitrobenzene	.553	100	ug/kg		1
2,4,6-Trinitrotoluene	897000	100	ug/kg		1
2,4-Dinitrotoluene	.965	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	4880	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
HMX	399000	200	ug/kg		1
Nitrobenzene	.066.5	100	ug/kg	J	1
RDX	61300	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	. 257	200	ug/kg		1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22367
GPL ID: 103280-001-01-1/1
Matrix: Soil
Date Collected: Mar-26-2001
Date Received: Mar-29-2001

Prep Method: EXT_SW8330
Prep Date: Mar-31-2001
Prep Time: 10:51
Prep Chemist: Veena Telhan

Analytical Method: SW8330
Date Analyzed: Apr-04-2001
Time Analyzed 22:01
Analyst: Shukla Sarker

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	31100	100	ug/kg		1
1,3-Dinitrobenzene	.661	100	ug/kg		1
2,4,6-Trinitrotoluene	33500	100	ug/kg		1
2,4-Dinitrotoluene	.764	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	4270	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	3880	100	ug/kg		1
HMX	573000	200	ug/kg		1
Nitrobenzene	.149	100	ug/kg		1
RDX	631000	200	ug/kg		1
Tetryl	3750	200	ug/kg		1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22368
GPL ID: 103280-002-01-1/1
Matrix: Soil
Date Collected: Mar-26-2001
Date Received: Mar-29-2001

Prep Method: EXT_SW8330
Prep Date: Mar-31-2001
Prep Time: 10:51
Prep Chemist: Veena Telhan

Analytical Method: SW8330
Date Analyzed: Apr-04-2001
Time Analyzed 23:55
Analyst: Shukla Sarker

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	13400	100	ug/kg		1
1,3-Dinitrobenzene	.246	100	ug/kg		1
2,4,6-Trinitrotoluene	8440	100	ug/kg		1
2,4-Dinitrotoluene	.602	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	5540	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	7470	100	ug/kg		1
HMX	379000	200	ug/kg		1
Nitrobenzene	.671	100	ug/kg		1
RDX	61900	200	ug/kg		1
Tetryl	5560	200	ug/kg		1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22369
GPL ID: 103280-003-01-1/1
Matrix: Soil
Date Collected: Mar-26-2001
Date Received: Mar-29-2001

Prep Method: EXT_SW8330
Prep Date: Mar-31-2001
Prep Time: 10:51
Prep Chemist: Veena Telhan

Analytical Method: SW8330
Date Analyzed: Apr-05-2001
Time Analyzed 00:52
Analyst: Shukla Sarker

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	22700	100	ug/kg		1
1,3-Dinitrobenzene	536	100	ug/kg		1
2,4,6-Trinitrotoluene	9200	100	ug/kg		1
2,4-Dinitrotoluene	438	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1990	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2430	100	ug/kg		1
HMX	228000	200	ug/kg		1
Nitrobenzene	191	100	ug/kg		1
RDX	30800	200	ug/kg		1
Tetryl	3620	200	ug/kg		1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

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Client ID 22370
GPL ID: 103280-004-01-1/1
Matrix: Soil
Date Collected: Mar-26-2001
Date Received: Mar-29-2001

Prep Method: EXT_SW8330
Prep Date: Mar-31-2001
Prep Time: 10:51
Prep Chemist: Veena Telhan

Analytical Method: SW8330
Date Analyzed: Apr-05-2001
Time Analyzed 01:49
Analyst: Shukla Sarker

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	16800	100	ug/kg		1
1,3-Dinitrobenzene	779	100	ug/kg		1
2,4,6-Trinitrotoluene	62000	100	ug/kg		1
2,4-Dinitrotoluene	2580	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	7160	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	5850	100	ug/kg		1
HMX	287000	200	ug/kg		1
Nitrobenzene	67.1	100	ug/kg	J	1
RDX	65000	200	ug/kg		1
Tetryl	2770	200	ug/kg		1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22371
GPL ID: 103280-005-01-1/1
Matrix: Soil
Date Collected: Mar-26-2001
Date Received: Mar-29-2001

Prep Method: EXT_SW8330
Prep Date: Mar-31-2001
Prep Time: 10:51
Prep Chemist: Veena Telhan

Analytical Method: SW8330
Date Analyzed: Apr-05-2001
Time Analyzed 02:47
Analyst: Shukla Sarker

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	16700	100	ug/kg		1
1,3-Dinitrobenzene	236	100	ug/kg		1
2,4,6-Trinitrotoluene	8210	100	ug/kg		1
2,4-Dinitrotoluene	202	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	4000	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	3680	100	ug/kg		1
HMX	294000	200	ug/kg		1
Nitrobenzene	99.0	100	ug/kg	J	1
RDX	60300	200	ug/kg		1
Tetryl	3350	200	ug/kg		1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22372
GPL ID: 103280-006-01-1/1
Matrix: Soil
Date Collected: Mar-26-2001
Date Received: Mar-29-2001

Prep Method: EXT_SW8330
Prep Date: Mar-31-2001
Prep Time: 10:51
Prep Chemist: Veena Telhan

Analytical Method: SW8330
Date Analyzed: Apr-05-2001
Time Analyzed 03:44
Analyst: Shukla Sarker

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	28700	100	ug/kg		1
1,3-Dinitrobenzene	365	100	ug/kg		1
2,4,6-Trinitrotoluene	12100	100	ug/kg		1
2,4-Dinitrotoluene	487	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	4160	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2810	100	ug/kg		1
HMX	253000	200	ug/kg		1
Nitrobenzene	215	100	ug/kg		1
RDX	87800	200	ug/kg		1
Tetryl	4790	200	ug/kg		1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22373
GPL ID: 103280-007-01-1/1
Matrix: Soil
Date Collected: Mar-26-2001
Date Received: Mar-29-2001

Prep Method: EXT_SW8330
Prep Date: Mar-31-2001
Prep Time: 10:51
Prep Chemist: Veena Telhan

Analytical Method: SW8330
Date Analyzed: Apr-05-2001
Time Analyzed 05:38
Analyst: Shukla Sarker

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	19300	100	ug/kg		1
1,3-Dinitrobenzene	507	100	ug/kg		1
2,4,6-Trinitrotoluene	17200	100	ug/kg		1
2,4-Dinitrotoluene	472	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	2860	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2390	100	ug/kg		1
HMX	260000	200	ug/kg		1
Nitrobenzene	240	100	ug/kg		1
RDX	87400	200	ug/kg		1
Tetryl	4020	200	ug/kg		1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22599
GPL ID: 104135-001-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:41

Analytical Method: SW8330
Date Analyzed: 04/23/01
Time Analyzed 11:14

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3-Dinitrobenzene	1020	100	ug/kg		1
2,4-Dinitrotoluene	1280	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	12300	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	14300	100	ug/kg		1
Nitrobenzene	56.6	100	ug/kg	J	1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22599
GPL ID: 104135-001-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:41

Analytical Method: SW8330
Date Analyzed: 05/04/01
Time Analyzed 21:51

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	114000	10000	ug/kg		100
2,4,6-Trinitrotoluene	32900	10000	ug/kg		100
HMX	611000	20000	ug/kg		100
RDX	810000	20000	ug/kg		100

Summary of Analytical Results

Client ID 22600
GPL ID: 104135-002-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:41

Analytical Method: SW8330
Date Analyzed: 04/23/01
Time Analyzed 12:11

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3-Dinitrobenzene	674	100	ug/kg		1
2,4-Dinitrotoluene	1230	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	5710	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	5110	100	ug/kg		1
Nitrobenzene	84.9	100	ug/kg	J	1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22600
GPL ID: 104135-002-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:41

Analytical Method: SW8330
Date Analyzed: 05/01/01
Time Analyzed 03:38

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	21000	10000	ug/kg		100
2,4,6-Trinitrotoluene	110000	10000	ug/kg		100
HMX	475000	20000	ug/kg		100
RDX	647000	20000	ug/kg		100

Summary of Analytical Results

Client ID 22601
GPL ID: 104135-003-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:41

Analytical Method: SW8330
Date Analyzed: 04/23/01
Time Analyzed 13:08

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3-Dinitrobenzene	581	100	ug/kg		1
2,4-Dinitrotoluene	2520	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	6540	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	4770	100	ug/kg		1
Nitrobenzene	63.8	100	ug/kg	J	1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22601
GPL ID: 104135-003-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:41

Analytical Method: SW8330
Date Analyzed: 05/04/01
Time Analyzed 22:20

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
2,4,6-Trinitrotoluene	26300	10000	ug/kg		100
HMX	627000	20000	ug/kg		100
RDX	773000	20000	ug/kg		100

Summary of Analytical Results

Client ID 22602
GPL ID: 104135-004-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:41

Analytical Method: SW8330
Date Analyzed: 04/23/01
Time Analyzed 14:05

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	1960	100	ug/kg		1
1,3-Dinitrobenzene	850	100	ug/kg		1
2,4,6-Trinitrotoluene	4930	100	ug/kg		1
2,4-Dinitrotoluene	489	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1190	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	1050	100	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	11300	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22602
GPL ID: 104135-004-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:41

Analytical Method: SW8330
Date Analyzed: 05/04/01
Time Analyzed 22:48

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
HMX	170000	2000	ug/kg		10

Summary of Analytical Results

Client ID 22603
GPL ID: 104135-005-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:41

Analytical Method: SW8330
Date Analyzed: 04/23/01
Time Analyzed 16:35

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	2860	100	ug/kg		1
1,3-Dinitrobenzene	761	100	ug/kg		1
2,4,6-Trinitrotoluene	2540	100	ug/kg		1
2,4-Dinitrotoluene	319	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1230	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	883	100	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	4900	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22603
GPL ID: 104135-005-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:41

Analytical Method: SW8330
Date Analyzed: 05/01/01
Time Analyzed 06:00

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
HMX	69400	2000	ug/kg		10

Summary of Analytical Results

Client ID 22604
GPL ID: 104135-006-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:41

Analytical Method: SW8330
Date Analyzed: 04/23/01
Time Analyzed 17:32

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	2560	100	ug/kg		1
1,3-Dinitrobenzene	890	100	ug/kg		1
2,4,6-Trinitrotoluene	9060	100	ug/kg		1
2,4-Dinitrotoluene	449	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1500	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	898	100	ug/kg		1
Nitrobenzene	48.7	100	ug/kg	J	1
RDX	4810	200	ug/kg		1
Tetryl	2280	200	ug/kg		1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22604
GPL ID: 104135-006-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:41

Analytical Method: SW8330
Date Analyzed: 05/01/01
Time Analyzed 06:29

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
HMX	150000	2000	ug/kg		10

Summary of Analytical Results

Client ID 22605
GPL ID: 104135-007-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:41

Analytical Method: SW8330
Date Analyzed: 04/23/01
Time Analyzed 18:29

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	12600	100	ug/kg		1
1,3-Dinitrobenzene	744	100	ug/kg		1
2,4,6-Trinitrotoluene	19800	100	ug/kg		1
2,4-Dinitrotoluene	884	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	3070	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2910	100	ug/kg		1
Nitrobenzene	83.2	100	ug/kg	J	1
RDX	26300	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

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Client ID 22605
GPL ID: 104135-007-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:41

Analytical Method: SW8330
Date Analyzed: 05/04/01
Time Analyzed 23:17

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
HMX	136000	2000	ug/kg		10

Summary of Analytical Results

Client ID 22606
GPL ID: 104135-008-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:41

Analytical Method: SW8330
Date Analyzed: 04/23/01
Time Analyzed 19:26

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	23500	100	ug/kg		1
1,3-Dinitrobenzene	586	100	ug/kg		1
2,4,6-Trinitrotoluene	8640	100	ug/kg		1
2,4-Dinitrotoluene	1120	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	2720	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2870	100	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

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Client ID 22606
GPL ID: 104135-008-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:41

Analytical Method: SW8330
Date Analyzed: 05/01/01
Time Analyzed 07:26

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
HMX	108000	2000	ug/kg		10
RDX	78500	2000	ug/kg		10

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22607
GPL ID: 104135-009-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:41

Analytical Method: SW8330
Date Analyzed: 04/23/01
Time Analyzed 20:23

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	22300	100	ug/kg		1
1,3-Dinitrobenzene	928	100	ug/kg		1
2,4,6-Trinitrotoluene	12100	100	ug/kg		1
2,4-Dinitrotoluene	1270	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	7030	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	6720	100	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22607
GPL ID: 104135-009-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:41

Analytical Method: SW8330
Date Analyzed: 05/04/01
Time Analyzed 23:45

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
HMX	119000	2000	ug/kg		10
RDX	29200	2000	ug/kg		10

Summary of Analytical Results

Client ID 22608
GPL ID: 104135-010-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:41

Analytical Method: SW8330
Date Analyzed: 04/23/01
Time Analyzed 22:17

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	17100	100	ug/kg		1
1,3-Dinitrobenzene	618	100	ug/kg		1
2,4,6-Trinitrotoluene	24200	100	ug/kg		1
2,4-Dinitrotoluene	775	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	3020	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	3360	100	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	26600	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22608
GPL ID: 104135-010-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:41

Analytical Method: SW8330
Date Analyzed: 05/05/01
Time Analyzed 00:14

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
HMX	156000	2000	ug/kg		10

Summary of Analytical Results

Client ID 22609
GPL ID: 104135-011-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:41

Analytical Method: SW8330
Date Analyzed: 04/23/01
Time Analyzed 23:14

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	5980	100	ug/kg		1
1,3-Dinitrobenzene	591	100	ug/kg		1
2,4,6-Trinitrotoluene	6220	100	ug/kg		1
2,4-Dinitrotoluene	1430	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	3050	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2480	100	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	5270	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22609
GPL ID: 104135-011-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:41

Analytical Method: SW8330
Date Analyzed: 05/05/01
Time Analyzed 00:42

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
HMX	112000	2000	ug/kg		10

Summary of Analytical Results

Client ID 22610
GPL ID: 104136-001-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:42

Analytical Method: SW8330
Date Analyzed: 04/24/01
Time Analyzed 17:36

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	5020	100	ug/kg		1
1,3-Dinitrobenzene	296	100	ug/kg		1
2,4,6-Trinitrotoluene	9150	100	ug/kg		1
2,4-Dinitrotoluene	447	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	2080	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2630	100	ug/kg		1
HMX	106000	200	ug/kg		1
Nitrobenzene	238	100	ug/kg		1
RDX	16100	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22611
GPL ID: 104136-002-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:42

Analytical Method: SW8330
Date Analyzed: 04/24/01
Time Analyzed 18:33

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	14400	100	ug/kg		1
1,3-Dinitrobenzene	365	100	ug/kg		1
2,4,6-Trinitrotoluene	6750	100	ug/kg		1
2,4-Dinitrotoluene	478	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	3030	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2900	100	ug/kg		1
HMX	152000	200	ug/kg		1
Nitrobenzene	190	100	ug/kg		1
RDX	59100	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22612
GPL ID: 104136-003-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:42

Analytical Method: SW8330
Date Analyzed: 04/24/01
Time Analyzed 19:30

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	14000	100	ug/kg		1
1,3-Dinitrobenzene	437	100	ug/kg		1
2,4,6-Trinitrotoluene	52100	100	ug/kg		1
2,4-Dinitrotoluene	768	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	3870	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	4460	100	ug/kg		1
HMX	171000	200	ug/kg		1
Nitrobenzene	535	100	ug/kg		1
RDX	47400	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22613
GPL ID: 104136-004-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:42

Analytical Method: SW8330
Date Analyzed: 04/24/01
Time Analyzed 20:27

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	4300	100	ug/kg		1
1,3-Dinitrobenzene	183	100	ug/kg		1
2,4,6-Trinitrotoluene	3800	100	ug/kg		1
2,4-Dinitrotoluene	BQL	100	ug/kg	U	1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1300	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	1280	100	ug/kg		1
HMX	85000	200	ug/kg		1
Nitrobenzene	246	100	ug/kg		1
RDX	9000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22614
GPL ID: 104136-005-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:42

Analytical Method: SW8330
Date Analyzed: 04/24/01
Time Analyzed 22:21

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	26800	100	ug/kg		1
1,3-Dinitrobenzene	544	100	ug/kg		1
2,4,6-Trinitrotoluene	175000	100	ug/kg		1
2,4-Dinitrotoluene	1100	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	4650	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2630	100	ug/kg		1
HMX	132000	200	ug/kg		1
Nitrobenzene	105	100	ug/kg		1
RDX	102000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22615
GPL ID: 104136-006-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:42

Analytical Method: SW8330
Date Analyzed: 04/24/01
Time Analyzed 23:18

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	2840	100	ug/kg		1
1,3-Dinitrobenzene	210	100	ug/kg		1
2,4,6-Trinitrotoluene	769000	100	ug/kg		1
2,4-Dinitrotoluene	BQL	100	ug/kg	U	1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	7260	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	6120	100	ug/kg		1
HMX	243000	200	ug/kg		1
Nitrobenzene	184	100	ug/kg		1
RDX	944000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22616
GPL ID: 104136-007-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:42

Analytical Method: SW8330
Date Analyzed: 04/25/01
Time Analyzed 00:15

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	25300	100	ug/kg		1
1,3-Dinitrobenzene	1520	100	ug/kg		1
2,4,6-Trinitrotoluene	910000	100	ug/kg		1
2,4-Dinitrotoluene	3140	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	9320	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	6050	100	ug/kg		1
HMX	120000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	58000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22617
GPL ID: 104136-008-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:42

Analytical Method: SW8330
Date Analyzed: 04/25/01
Time Analyzed 01:12

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	7870	100	ug/kg		1
1,3-Dinitrobenzene	327	100	ug/kg		1
2,4,6-Trinitrotoluene	7180	100	ug/kg		1
2,4-Dinitrotoluene	BQL	100	ug/kg	U	1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	3870	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	5940	100	ug/kg		1
HMX	105000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	11900	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22618
GPL ID: 104136-009-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:42

Analytical Method: SW8330
Date Analyzed: 04/25/01
Time Analyzed 02:09

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	26900	100	ug/kg		1
1,3-Dinitrobenzene	461	100	ug/kg		1
2,4,6-Trinitrotoluene	8660	100	ug/kg		1
2,4-Dinitrotoluene	1950	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	4620	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	4240	100	ug/kg		1
HMX	200000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	45600	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22619
GPL ID: 104136-010-01-1/1
Matrix: Soil
Date Collected: 04/16/01
Date Received: 04/17/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:42

Analytical Method: SW8330
Date Analyzed: 04/25/01
Time Analyzed 04:03

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	29400	100	ug/kg		1
1,3-Dinitrobenzene	422	100	ug/kg		1
2,4,6-Trinitrotoluene	9880	100	ug/kg		1
2,4-Dinitrotoluene	973	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	2790	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	3770	100	ug/kg		1
HMX	188000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	78800	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

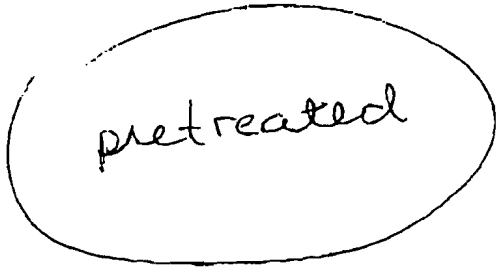
Summary of Analytical Results

Client ID 22054
GPL ID: 103024-001-01-1/1
Matrix: Soil
Date Collected: Feb-28-2001
Date Received: Mar-05-2001

Prep Method: EXT_SW8330
Prep Date: Mar-06-2001
Prep Time: 11:58
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-12-2001
Time Analyzed 10:09
Analyst: Shukla Sarker

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	26700	200	ug/kg		1
1,3-Dinitrobenzene	BQL	200	ug/kg	U	1
2,4,6-Trinitrotoluene	1060000	200	ug/kg		1
2,4-Dinitrotoluene	3670	200	ug/kg		1
2,6-Dinitrotoluene	BQL	200	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	5350	200	ug/kg		1
4-Amino-2,6-Dinitrotoluene	BQL	200	ug/kg	U	1
HMX	557000	400	ug/kg		1
Nitrobenzene	BQL	200	ug/kg	U	1
RDX	1160000	400	ug/kg		1
Tetryl	BQL	400	ug/kg	U	1
m-Nitrotoluene	BQL	400	ug/kg	U	1
o-Nitrotoluene	BQL	400	ug/kg	U	1
p-Nitrotoluene	BQL	400	ug/kg	U	1



150

Summary of Analytical Results

Client ID 22055
GPL ID: 103024-002-01-1/1
Matrix: Soil
Date Collected: Feb-28-2001
Date Received: Mar-05-2001

Prep Method: EXT_SW8330
Prep Date: Mar-06-2001
Prep Time: 11:58
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-12-2001
Time Analyzed 10:37
Analyst: Shukla Sarker

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	26400	200	ug/kg		1
1,3-Dinitrobenzene	BQL	200	ug/kg	U	1
2,4,6-Trinitrotoluene	115000	200	ug/kg		1
2,4-Dinitrotoluene	909	200	ug/kg		1
2,6-Dinitrotoluene	BQL	200	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	2490	200	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2780	200	ug/kg		1
HMX	493000	400	ug/kg		1
Nitrobenzene	BQL	200	ug/kg	U	1
RDX	1020000	400	ug/kg		1
Tetryl	BQL	400	ug/kg	U	1
m-Nitrotoluene	BQL	400	ug/kg	U	1
o-Nitrotoluene	BQL	400	ug/kg	U	1
p-Nitrotoluene	BQL	400	ug/kg	U	1

Summary of Analytical Results

Client ID 22056
GPL ID: 103024-003-01-1/1
Matrix: Soil
Date Collected: Feb-28-2001
Date Received: Mar-05-2001

Prep Method: EXT_SW8330
Prep Date: Mar-06-2001
Prep Time: 11:58
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-12-2001
Time Analyzed 11:06
Analyst: Shukla Sarker

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	51800	200	ug/kg		1
1,3-Dinitrobenzene	BQL	200	ug/kg	U	1
2,4,6-Trinitrotoluene	204000	200	ug/kg		1
2,4-Dinitrotoluene	1130	200	ug/kg		1
2,6-Dinitrotoluene	BQL	200	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	3670	200	ug/kg		1
4-Amino-2,6-Dinitrotoluene	5300	200	ug/kg		1
HMX	590000	400	ug/kg		1
Nitrobenzene	BQL	200	ug/kg	U	1
RDX	1060000	400	ug/kg		1
Tetryl	BQL	400	ug/kg	U	1
m-Nitrotoluene	BQL	400	ug/kg	U	1
o-Nitrotoluene	BQL	400	ug/kg	U	1
p-Nitrotoluene	BQL	400	ug/kg	U	1

Summary of Analytical Results

Client ID 22182
GPL ID: 103083-001-01-1/1
Matrix: Soil
Date Collected: Mar-09-2001
Date Received: Mar-12-2001

Prep Method: EXT_SW8330
Prep Date: Mar-14-2001
Prep Time: 12:13
Prep Chemist: Shila Solcimani

Analytical Method: SW8330
Date Analyzed: Mar-21-2001
Time Analyzed 18:21
Analyst: Dayuan Han

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	42300	100	ug/kg		1
1,3-Dinitrobenzene	1230	100	ug/kg		1
2,4,6-Trinitrotoluene	41700	100	ug/kg		1
2,4-Dinitrotoluene	773	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	3420	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	4020	100	ug/kg		1
HMX	595000	200	ug/kg		1
Nitrobenzene	200	100	ug/kg		1
RDX	1030000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22183
GPL ID: 103083-002-01-1/1
Matrix: Soil
Date Collected: Mar-09-2001
Date Received: Mar-12-2001

Prep Method: EXT_SW8330
Prep Date: Mar-14-2001
Prep Time: 12:13
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-21-2001
Time Analyzed 19:18
Analyst: Dayuan Han

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	6230	95.2	ug/kg		1
1,3-Dinitrobenzene	891	95.2	ug/kg		1
2,4,6-Trinitrotoluene	69500	95.2	ug/kg		1
2,4-Dinitrotoluene	386	95.2	ug/kg		1
2,6-Dinitrotoluene	BQL	95.2	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1730	95.2	ug/kg		1
4-Amino-2,6-Dinitrotoluene	BQL	95.2	ug/kg	U	1
HMX	493000	190	ug/kg		1
Nitrobenzene	239	95.2	ug/kg		1
RDX	908000	190	ug/kg		1
Tetryl	525	190	ug/kg		1
m-Nitrotoluene	BQL	190	ug/kg	U	1
o-Nitrotoluene	BQL	190	ug/kg	U	1
p-Nitrotoluene	BQL	190	ug/kg	U	1

Summary of Analytical Results

Client ID 22184
GPL ID: 103083-003-01-1/1
Matrix: Soil
Date Collected: Mar-09-2001
Date Received: Mar-12-2001

Prep Method: EXT_SW8330
Prep Date: Mar-14-2001
Prep Time: 12:13
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-21-2001
Time Analyzed 20:15
Analyst: Dayuan Han

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	18300	100	ug/kg		1
1,3-Dinitrobenzene	900	100	ug/kg		1
2,4,6-Trinitrotoluene	24000	100	ug/kg		1
2,4-Dinitrotoluene	BQL	100	ug/kg	U	1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	4170	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	6460	100	ug/kg		1
HMX	532000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	985000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22185
GPL ID: 103083-004-01-1/1
Matrix: Soil
Date Collected: Mar-09-2001
Date Received: Mar-12-2001

Prep Method: EXT_SW8330
Prep Date: Mar-14-2001
Prep Time: 12:13
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-21-2001
Time Analyzed 21:12
Analyst: Dayuan Han

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	11100	100	ug/kg		1
1,3-Dinitrobenzene	2080	100	ug/kg		1
2,4,6-Trinitrotoluene	74100	100	ug/kg		1
2,4-Dinitrotoluene	558	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	2680	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
HMX	503000	200	ug/kg		1
Nitrobenzene	341	100	ug/kg		1
RDX	1030000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	325	200	ug/kg		1

Summary of Analytical Results

Client ID 22186
GPL ID: 103083-005-01-1/1
Matrix: Soil
Date Collected: Mar-09-2001
Date Received: Mar-12-2001

Prep Method: EXT_SW8330
Prep Date: Mar-14-2001
Prep Time: 12:13
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-21-2001
Time Analyzed 23:06
Analyst: Dayuan Han

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	23600	100	ug/kg		1
1,3-Dinitrobenzene	1100	100	ug/kg		1
2,4,6-Trinitrotoluene	73000	100	ug/kg		1
2,4-Dinitrotoluene	BQL	100	ug/kg	U	1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	4870	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	4150	100	ug/kg		1
HMX	505000	200	ug/kg		1
Nitrobenzene	474	100	ug/kg		1
RDX	982000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22187
GPL ID: 103083-006-01-1/1
Matrix: Soil
Date Collected: Mar-09-2001
Date Received: Mar-12-2001

Prep Method: EXT_SW8330
Prep Date: Mar-14-2001
Prep Time: 12:13
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-22-2001
Time Analyzed 00:03
Analyst: Dayuan Han

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	11900	100	ug/kg		1
1,3-Dinitrobenzene	1450	100	ug/kg		1
2,4,6-Trinitrotoluene	90200	100	ug/kg		1
2,4-Dinitrotoluene	BQL	100	ug/kg	U	1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	4280	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
HMX	516000	200	ug/kg		1
Nitrobenzene	262	100	ug/kg		1
RDX	1000000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	550	200	ug/kg		1

Summary of Analytical Results

Client ID 22188
GPL ID: 103083-007-01-1/1
Matrix: Soil
Date Collected: Mar-09-2001
Date Received: Mar-12-2001

Prep Method: EXT_SW8330
Prep Date: Mar-14-2001
Prep Time: 12:13
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-22-2001
Time Analyzed 01:00
Analyst: Dayuan Han

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	9470	100	ug/kg		1
1,3-Dinitrobenzene	900	100	ug/kg		1
2,4,6-Trinitrotoluene	20900	100	ug/kg		1
2,4-Dinitrotoluene	BQL	100	ug/kg	U	1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	5580	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	3600	100	ug/kg		1
HMX	535000	200	ug/kg		1
Nitrobenzene	305	100	ug/kg		1
RDX	995000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22189
GPL ID: 103083-008-01-1/1
Matrix: Soil
Date Collected: Mar-09-2001
Date Received: Mar-12-2001

Prep Method: EXT_SW8330
Prep Date: Mar-14-2001
Prep Time: 12:13
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-22-2001
Time Analyzed 01:57
Analyst: Dayuan Han

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	13800	100	ug/kg		1
1,3-Dinitrobenzene	1690	100	ug/kg		1
2,4,6-Trinitrotoluene	19500	100	ug/kg		1
2,4-Dinitrotoluene	BQL	100	ug/kg	U	1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	4900	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	1240	100	ug/kg		1
HMX	522000	200	ug/kg		1
Nitrobenzene	468	100	ug/kg		1
RDX	982000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	336	200	ug/kg		1
p-Nitrotoluene	BQL	200	ug/kg	U	1

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Summary of Analytical Results

Client ID 22190
GPL ID: 103083-009-01-1/1
Matrix: Soil
Date Collected: Mar-09-2001
Date Received: Mar-12-2001

Prep Method: EXT_SW8330
Prep Date: Mar-14-2001
Prep Time: 12:13
Prep Chemist: Shila Solcimani

Analytical Method: SW8330
Date Analyzed: Mar-22-2001
Time Analyzed 02:54
Analyst: Dayuan Han

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	9250	100	ug/kg		1
1,3-Dinitrobenzene	579	100	ug/kg		1
2,4,6-Trinitrotoluene	47800	100	ug/kg		1
2,4-Dinitrotoluene	BQL	100	ug/kg	U	1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	2630	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	4270	100	ug/kg		1
HMX	500000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	977000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22191
GPL ID: 103083-010-01-1/1
Matrix: Soil
Date Collected: Mar-09-2001
Date Received: Mar-12-2001

Prep Method: EXT_SW8330
Prep Date: Mar-14-2001
Prep Time: 12:13
Prep Chemist: Shila Soleimani

Analytical Method: SW8330
Date Analyzed: Mar-22-2001
Time Analyzed 04:48
Analyst: Dayuan Han

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	27300	100	ug/kg		1
1,3-Dinitrobenzene	1130	100	ug/kg		1
2,4,6-Trinitrotoluene	28300	100	ug/kg		1
2,4-Dinitrotoluene	BQL	100	ug/kg	U	1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	4270	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	5860	100	ug/kg		1
HMX	499000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	965000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL Laboratories

1C
SEMIVOLATILE ORGANICS ANALYSES DATA SHEET

EPA SAMPLE NO. 62
22273

Lab Name : GPL Laboratories Contract:
Lab Code : GPL Case No.: SAS No. SDG No. 103164
Matrix : SOLID Lab Sample Id: 103164-001-01-1/1
Sample wt/vol: 2 (g/ml): g Lab File ID: LCA6877
Level : (Low/Med) LOW Date Received: Mar. 17, 2001
% Moisture: 0 Decanted: (Y/N) N Date Extracted: Mar. 20, 2001
Concentrated Extract Volume: 20000 Date Analyzed: Mar. 27, 2001
Injection Volume: ~~2.0~~ 100 SD 03/26/01 (µl L) Dilution Factor: 1.0
GPC Cleanup (Y/N): N Ph: N/A Extraction : (Type) EXT_SW8330

CONCENTRATION UNIT
(ug/Kg ug/kg

CAS NO.	COMPOUND		Q
99-35-4	1,3,5-Trinitrobenzene	48000	
99-65-0	1,3-Dinitrobenzene	1700	
118-96-7	2,4,6-Trinitrotoluene	49000	
121-14-2	2,4-Dinitrotoluene	910	
606-20-2	2,6-Dinitrotoluene, 2,6-DNT	100	U
35572-78-2	2-Amino-4,6-Dinitrotoluene	3600	
19406-51-0	4-Amino-2,6-Dinitrotoluene	3500	
2691-41-0	HMX	520000	
99-08-1	m-Nitrotoluene	200	U
98-95-3	Nitrobenzene	100	U
88-72-2	o-Nitrotoluene	200	U
99-99-0	p-Nitrotoluene	200	U
121-82-4	RDX	1000000	
479-45-8	Tetryl	200	U

GPL Laboratories

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SEMIVOLATILE ORGANICS ANALYSES DATA SHEET

EPA SAMPLE NO.

22274

Lab Name : GPL Laboratories | Contract:

Lab Code : GPL | Case No.: | SAS No. | SDG No. 103164

Matrix : SOLID | Lab Sample Id: 103164-002-01-1/1

Sample wt/vol: 2 (g/ml): g | Lab File ID: LCA6881

Level : (Low/Med) LOW | Date Received: Mar. 17, 2001

% Moisture: 0 | Decanted: (Y/N) N | Date Extracted: Mar. 20, 2001

Concentrated Extract Volume: 20000 | Date Analyzed: Mar. 27, 2001

Injection Volume: 2.0 lee ss osjuc/e/ (µL) | Dilution Factor: 1.0

GPC Cleanup (Y/N): N | Ph: N/A | Extraction : (Type) EXT_SW8330

CONCENTRATION UNIT
(ug/Kg ug/kg

CAS NO.	COMPOUND		Q
99-35-4	1,3,5-Trinitrobenzene	8100	
99-65-0	1,3-Dinitrobenzene	1100	
118-96-7	2,4,6-Trinitrotoluene	110000	
121-14-2	2,4-Dinitrotoluene	820	
606-20-2	2,6-Dinitrotoluene, 2,6-DNT	100	U
35572-78-2	2-Amino-4,6-Dinitrotoluene	2900	
19406-51-0	4-Amino-2,6-Dinitrotoluene	4600	
2691-41-0	HMX	460000	
99-08-1	m-Nitrotoluene	200	U
98-95-3	Nitrobenzene	100	U
88-72-2	o-Nitrotoluene	200	U
99-99-0	p-Nitrotoluene	200	U
121-82-4	RDX	940000	
479-45-8	Tetryl	200	U

GPL Laboratories

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SEMIVOLATILE ORGANICS ANALYSES DATA SHEET

EPA SAMPLE NO. 22275

164

Lab Name : GPL Laboratories | Contract:

Lab Code : GPL | Case No.: | SAS No. | SDG No. 103164

Matrix : SOLID | Lab Sample Id: 103164-003-01-1/1

Sample wt/vol: 2 (g/ml): g | Lab File ID: LCA6883

Level : (Low/Med) LOW | Date Received: Mar. 17, 2001

% Moisture: 0 Decanted: (Y/N) N | Date Extracted: Mar. 20, 2001

Concentrated Extract Volume: 20000 | Date Analyzed: Mar. 27, 2001

Injection Volume: ~~2.0~~ 100 SS 03/26/01 (µL) | Dilution Factor: 1.0

GPC Cleanup (Y/N): N Ph: N/A | Extraction : (Type) EXT_SW8330

CONCENTRATION UNIT
(ug/Kg ug/kg

CAS NO.	COMPOUND		Q
99-35-4	1,3,5-Trinitrobenzene	39000	
99-65-0	1,3-Dinitrobenzene	1100	
118-96-7	2,4,6-Trinitrotoluene	15000	
121-14-2	2,4-Dinitrotoluene	640	
606-20-2	2,6-Dinitrotoluene, 2,6-DNT	100	U
35572-78-2	2-Amino-4,6-Dinitrotoluene	670	
19406-51-0	4-Amino-2,6-Dinitrotoluene	4500	
2691-41-0	HMX	330000	
99-08-1	m-Nitrotoluene	200	U
98-95-3	Nitrobenzene	100	U
88-72-2	o-Nitrotoluene	200	U
99-99-0	p-Nitrotoluene	200	U
121-82-4	RDX	920000	
479-45-8	Tetryl	200	U

GPL Laboratories

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SEMIVOLATILE ORGANICS ANALYSES DATA SHEET

EPA SAMPLE NO.

22276

Lab Name : GPL Laboratories Contract:

Lab Code : GPL Case No.: SAS No. SDG No. 103164

Matrix : SOLID Lab Sample Id: 103164-004-01-1/1

Sample wt/vol: 2 (g/ml): g Lab File ID: LCA6885

Level : (Low/Med) LOW Date Received: Mar. 17, 2001

% Moisture: 0 Decanted: (Y/N) N Date Extracted: Mar. 20, 2001

Concentrated Extract Volume: 20000 Date Analyzed: Mar. 28, 2001

Injection Volume: ~~2.0~~ 1.0 55 3/28/01 (µ L) Dilution Factor: 1.0

GPC Cleanup (Y/N): N Ph: N/A Extraction : (Type) EXT_SW8330

CONCENTRATION UNIT
(ug/Kg ug/kg

CAS NO.	COMPOUND		Q
99-35-4	1,3,5-Trinitrobenzene	22000	
99-65-0	1,3-Dinitrobenzene	720	
118-96-7	2,4,6-Trinitrotoluene	15000	
121-14-2	2,4-Dinitrotoluene	650	
606-20-2	2,6-Dinitrotoluene, 2,6-DNT	100	U
35572-78-2	2-Amino-4,6-Dinitrotoluene	3600	
19406-51-0	4-Amino-2,6-Dinitrotoluene	4600	
2691-41-0	HMX	420000	
99-08-1	m-Nitrotoluene	200	U
98-95-3	Nitrobenzene	100	U
88-72-2	o-Nitrotoluene	200	U
99-99-0	p-Nitrotoluene	200	U
121-82-4	RDX	950000	
479-45-8	Tetryl	200	U

GPL Laboratories

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SEMIVOLATILE ORGANICS ANALYSES DATA SHEET

EPA SAMPLE NO. 166
22277

Lab Name : GPL Laboratories | Contract:
Lab Code : GPL | Case No.: | SAS No. | SDG No. 103164
Matrix : SOLID | Lab Sample Id: 103164-005-01-1/1
Sample wt/vol: 2 (g/ml): g | Lab File ID: LCA6887
Level : (Low/Med) LOW | Date Received: Mar. 17, 2001
% Moisture: 0 Decanted: (Y/N) N | Date Extracted: Mar. 20, 2001
Concentrated Extract Volume: 20000 | Date Analyzed: Mar. 28, 2001
Injection Volume: ~~2.0~~ 1.0 3/28/01 (µ L) | Dilution Factor: 1.0
GPC Cleanup (Y/N): N Ph: N/A | Extraction : (Type) EXT_SW8330

CONCENTRATION UNIT
(ug/Kg ug/kg

CAS NO.	COMPOUND		Q
99-35-4	1,3,5-Trinitrobenzene	20000	
99-65-0	1,3-Dinitrobenzene	620	
118-96-7	2,4,6-Trinitrotoluene	38000	
121-14-2	2,4-Dinitrotoluene	650	
606-20-2	2,6-Dinitrotoluene, 2,6-DNT	100	U
35572-78-2	2-Amino-4,6-Dinitrotoluene	2700	
19406-51-0	4-Amino-2,6-Dinitrotoluene	3900	
2691-41-0	HMX	42000	
99-08-1	m-Nitrotoluene	200	U
98-95-3	Nitrobenzene	100	U
88-72-2	o-Nitrotoluene	200	U
99-99-0	p-Nitrotoluene	200	U
121-82-4	RDX	82000	
479-45-8	Tetryl	200	U

GPL Laboratories

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SEMIVOLATILE ORGANICS ANALYSES DATA SHEET

EPA SAMPLE NO.
22278

Lab Name : GPL Laboratories Contract:

Lab Code : GPL Case No.: SAS No. SDG No. 103164

Matrix : SOLID Lab Sample Id: 103164-006-01+1/1

Sample wt/vol: 2 (g/ml): g Lab File ID: LCA6889

Level : (Low/Med) LOW Date Received: Mar. 17, 2001

% Moisture: 0 Decanted: (Y/N) N Date Extracted: Mar. 20, 2001

Concentrated Extract Volume: 20000 Date Analyzed: Mar. 28, 2001

Injection Volume: ~~2.0~~ / 1.0 3/26/01 (µ L) Dilution Factor: 1.0

GPC Cleanup (Y/N): N Ph: N/A Extraction : (Type) EXT_SW8330

CONCENTRATION UNIT
(ug/Kg ug/kg

CAS NO.	COMPOUND		Q
99-35-4	1,3,5-Trinitrobenzene	12000	
99-65-0	1,3-Dinitrobenzene	1200	
118-96-7	2,4,6-Trinitrotoluene	21000	
121-14-2	2,4-Dinitrotoluene	1400	
606-20-2	2,6-Dinitrotoluene, 2,6-DNT	100	U
35572-78-2	2-Amino-4,6-Dinitrotoluene	910	
19406-51-0	4-Amino-2,6-Dinitrotoluene	2200	
2691-41-0	HMX	490000	
99-08-1	m-Nitrotoluene	200	U
98-95-3	Nitrobenzene	100	U
88-72-2	o-Nitrotoluene	200	U
99-99-0	p-Nitrotoluene	200	U
121-82-4	RDX	880000	
479-45-8	Tetryl	200	U

GPL Laboratories

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SEMIVOLATILE ORGANICS ANALYSES DATA SHEET

EPA SAMPLE NO. 168

22279

Lab Name : GPL Laboratories | Contract:

Lab Code : GPL | Case No.: | SAS No. | SDG No. 103164

Matrix : SOLID | Lab Sample Id: 103164-007-01-1/1

Sample wt/vol: 2 (g/ml): g | Lab File ID: LCA6893

Level : (Low/Med) LOW | Date Received: Mar. 17, 2001

% Moisture: 0 Decanted: (Y/N) N | Date Extracted: Mar. 20, 2001

Concentrated Extract Volume: 20000 | Date Analyzed: Mar. 28, 2001

Injection Volume: ~~2.0-/00~~ 3/28/01 (µL) | Dilution Factor: 1.0

GPC Cleanup (Y/N): N Ph: N/A | Extraction : (Type) EXT_SW8330

CONCENTRATION UNIT
(ug/Kg ug/kg

CAS NO.	COMPOUND		Q
99-35-4	1,3,5-Trinitrobenzene	77000	
99-65-0	1,3-Dinitrobenzene	1400	
118-96-7	2,4,6-Trinitrotoluene	65000	
121-14-2	2,4-Dinitrotoluene	3500	
606-20-2	2,6-Dinitrotoluene; 2,6-DNT	100	U
35572-78-2	2-Amino-4,6-Dinitrotoluene	4400	
19406-51-0	4-Amino-2,6-Dinitrotoluene	10000	
2691-41-0	HMX	510000	
99-08-1	m-Nitrotoluene	200	U
98-95-3	Nitrobenzene	100	U
88-72-2	o-Nitrotoluene	200	U
99-99-0	p-Nitrotoluene	200	U
121-82-4	RDX	980000	
479-45-8	Tetryl	200	U

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ID

SEMIVOLATILE ORGANICS ANALYSES DATA SHEET

EPA SAMPLE NO.
22280

Lab Name : GPL Laboratories Contract:

Lab Code : GPL Case No.: SAS No. SDG No. 103164

Matrix : SOLID Lab Sample Id: 103164-008-01-1/1

Sample wt/vol: 2 (g/ml): g Lab File ID: LCA6895

Level : (Low/Med) LOW Date Received: Mar. 17, 2001

% Moisture: 0 Decanted: (Y/N) N Date Extracted: Mar. 20, 2001

Concentrated Extract Volume: 20000 Date Analyzed: Mar. 28, 2001

Injection Volume: ~~2.0~~ 100 3/26/01 (µ L) Dilution Factor: 1.0

GPC Cleanup (Y/N): N Ph: N/A Extraction : (Type) EXT_SW8330

CONCENTRATION UNIT
(ug/Kg ug/kg

CAS NO.	COMPOUND		Q
99-35-4	1,3,5-Trinitrobenzene	3900	
99-65-0	1,3-Dinitrobenzene	590	
118-96-7	2,4,6-Trinitrotoluene	7000	
121-14-2	2,4-Dinitrotoluene	970	
606-20-2	2,6-Dinitrotoluene, 2,6-DNT	100	U
35572-78-2	2-Amino-4,6-Dinitrotoluene	3800	
19406-51-0	4-Amino-2,6-Dinitrotoluene	4100	
2691-41-0	HMX	450000	
99-08-1	m-Nitrotoluene	200	U
98-95-3	Nitrobenzene	100	U
88-72-2	o-Nitrotoluene	200	U
99-99-0	p-Nitrotoluene	200	U
121-82-4	RDX	930000	
479-45-8	Tetryl	200	U

GPL Laboratories

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SEMIVOLATILE ORGANICS ANALYSES DATA SHEET

EPA SAMPLE NO. 22281 170

Lab Name : GPL Laboratories Contract:

Lab Code : GPL Case No.: SAS No. SDG No. 103164

Matrix : SOLID Lab Sample Id: 103164-009-01-1/1

Sample wt/vol: 2 (g/ml): g Lab File ID: LCA6897

Level : (Low/Med) LOW Date Received: Mar. 17, 2001

% Moisture: 0 Decanted: (Y/N) N Date Extracted: Mar. 20, 2001

Concentrated Extract Volume: 20000 Date Analyzed: Mar. 28, 2001

Injection Volume: ~~2.0~~ /oo 3/28/01 (µ L) Dilution Factor: 1.0

GPC Cleanup (Y/N): N Ph: N/A Extraction : (Type) EXT_SW8330

CONCENTRATION UNIT
(ug/Kg ug/kg

CAS NO.	COMPOUND		Q
99-35-4	1,3,5-Trinitrobenzene	8300	
99-65-0	1,3-Dinitrobenzene	750	
118-96-7	2,4,6-Trinitrotoluene	290000	
121-14-2	2,4-Dinitrotoluene	790	
606-20-2	2,6-Dinitrotoluene, 2,6-DNT	100	U
35572-78-2	2-Amino-4,6-Dinitrotoluene	3200	
19406-51-0	4-Amino-2,6-Dinitrotoluene	4900	
2691-41-0	HMX	560000	
99-08-1	m-Nitrotoluene	200	U
98-95-3	Nitrobenzene	100	U
88-72-2	o-Nitrotoluene	200	U
99-99-0	p-Nitrotoluene	200	U
121-82-4	RDX	960000	
479-45-8	Tetryl	200	U

GPL Laboratories

ID

SEMIVOLATILE ORGANICS ANALYSES DATA SHEET

EPA SAMPLE NO.
22282

Lab Name : GPL Laboratories Contract:

Lab Code : GPL Case No.: SAS No. SDG No. 103164

Matrix : SOLID Lab Sample Id: 103164-010-01-1/1

Sample wt/vol: 2 (g/ml): g Lab File ID: LCA6899

Level : (Low/Med) LOW Date Received: Mar. 17, 2001

% Moisture: 0 Decanted: (Y/N) N Date Extracted: Mar. 20, 2001

Concentrated Extract Volume: 20000 Date Analyzed: Mar. 28, 2001

Injection Volume: ~~2.0~~ /cc 3/28/01 (µ L) Dilution Factor: 1.0

GPC Cleanup (Y/N): N Ph: N/A Extraction : (Type) EXT_SW8330

CONCENTRATION UNIT
(ug/Kg ug/kg

CAS NO.	COMPOUND		Q
99-35-4	1,3,5-Trinitrobenzene	6000	
99-65-0	1,3-Dinitrobenzene	750	
118-96-7	2,4,6-Trinitrotoluene	15000	
121-14-2	2,4-Dinitrotoluene	660	
606-20-2	2,6-Dinitrotoluene, 2,6-DNT	100	U
35572-78-2	2-Amino-4,6-Dinitrotoluene	2700	
19406-51-0	4-Amino-2,6-Dinitrotoluene	3200	
2691-41-0	HMX	420000	
99-08-1	m-Nitrotoluene	200	U
98-95-3	Nitrobenzene	100	U
88-72-2	o-Nitrotoluene	200	U
99-99-0	p-Nitrotoluene	200	U
121-82-4	RDX	870000	
479-45-8	Tetryl	200	U

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22357
GPL ID: 103240-001-01-1/1
Matrix: Soil
Date Collected: 03/23/01
Date Received: 03/26/01

Prep Method: EXT_SW8330
Prep Date: 03/27/01
Prep Time: 05:00

Analytical Method: SW8330
Date Analyzed: 04/11/01
Time Analyzed 23:37

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	22100	100	ug/kg		1
1,3-Dinitrobenzene	1330	100	ug/kg		1
2,4,6-Trinitrotoluene	14000	100	ug/kg		1
2,4-Dinitrotoluene	425	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1420	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2380	100	ug/kg		1
HMX	513000	200	ug/kg		1
Nitrobenzene	337	100	ug/kg		1
RDX	957000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22358
GPL ID: 103240-002-01-1/1
Matrix: Soil
Date Collected: 03/23/01
Date Received: 03/26/01

Prep Method: EXT_SW8330
Prep Date: 03/27/01
Prep Time: 05:00

Analytical Method: SW8330
Date Analyzed: 04/12/01
Time Analyzed 01:31

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	32300	100	ug/kg		1
1,3-Dinitrobenzene	2220	100	ug/kg		1
2,4,6-Trinitrotoluene	49100	100	ug/kg		1
2,4-Dinitrotoluene	587	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	2310	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	4410	100	ug/kg		1
HMX	424000	200	ug/kg		1
Nitrobenzene	162	100	ug/kg		1
RDX	496000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22359
GPL ID: 103240-003-01-1/1
Matrix: Soil
Date Collected: 03/23/01
Date Received: 03/26/01

Prep Method: EXT_SW8330
Prep Date: 03/27/01
Prep Time: 05:00

Analytical Method: SW8330
Date Analyzed: 04/12/01
Time Analyzed 02:28

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	6010	100	ug/kg		1
1,3-Dinitrobenzene	414	100	ug/kg		1
2,4,6-Trinitrotoluene	13600	100	ug/kg		1
2,4-Dinitrotoluene	243	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1400	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	1710	100	ug/kg		1
HMX	373000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	216000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22360
GPL ID: 103240-004-01-1/1
Matrix: Soil
Date Collected: 03/23/01
Date Received: 03/26/01

Prep Method: EXT_SW8330
Prep Date: 03/27/01
Prep Time: 05:00

Analytical Method: SW8330
Date Analyzed: 04/12/01
Time Analyzed 03:25

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	16200	100	ug/kg		1
1,3-Dinitrobenzene	622	100	ug/kg		1
2,4,6-Trinitrotoluene	15700	100	ug/kg		1
2,4-Dinitrotoluene	1010	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1290	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2100	100	ug/kg		1
HMX	453000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	286000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22361
GPL ID: 103240-005-01-1/1
Matrix: Soil
Date Collected: 03/23/01
Date Received: 03/26/01

Prep Method: EXT_SW8330
Prep Date: 03/27/01
Prep Time: 05:00

Analytical Method: SW8330
Date Analyzed: 04/12/01
Time Analyzed 04:22

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	27100	100	ug/kg		1
1,3-Dinitrobenzene	645	100	ug/kg		1
2,4,6-Trinitrotoluene	260000	100	ug/kg		1
2,4-Dinitrotoluene	1070	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	2110	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	5270	100	ug/kg		1
HMX	442000	200	ug/kg		1
Nitrobenzene	62.7	100	ug/kg	J	1
RDX	695000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22362
GPL ID: 103240-006-01-I/1
Matrix: Soil
Date Collected: 03/23/01
Date Received: 03/26/01

Prep Method: EXT_SW8330
Prep Date: 03/27/01
Prep Time: 05:00

Analytical Method: SW8330
Date Analyzed: 04/12/01
Time Analyzed 05:19

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	3960	100	ug/kg		1
1,3-Dinitrobenzene	300	100	ug/kg		1
2,4,6-Trinitrotoluene	11300	100	ug/kg		1
2,4-Dinitrotoluene	215	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	2190	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2510	100	ug/kg		1
HMX	445000	200	ug/kg		1
Nitrobenzene	61.7	100	ug/kg	J	1
RDX	479000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

178

Client ID 22363
GPL ID: 103240-007-01-1/1
Matrix: Soil
Date Collected: 03/23/01
Date Received: 03/26/01

Prep Method: EXT_SW8330
Prep Date: 03/27/01
Prep Time: 05:00

Analytical Method: SW8330
Date Analyzed: 04/12/01
Time Analyzed 07:13

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	22900	100	ug/kg		1
1,3-Dinitrobenzene	1270	100	ug/kg		1
2,4,6-Trinitrotoluene	39900	100	ug/kg		1
2,4-Dinitrotoluene	2320	100	ug/kg		1
2,6-Dinitrotoluene	3240	100	ug/kg		1
2-Amino-4,6-Dinitrotoluene	2300	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	3440	100	ug/kg		1
HMX	434000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	629000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22364
GPL ID: 103240-008-01-1/1
Matrix: Soil
Date Collected: 03/23/01
Date Received: 03/26/01

Prep Method: EXT_SW8330
Prep Date: 03/27/01
Prep Time: 05:00

Analytical Method: SW8330
Date Analyzed: 04/12/01
Time Analyzed 08:10

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	6650	100	ug/kg		1
1,3-Dinitrobenzene	695	100	ug/kg		1
2,4,6-Trinitrotoluene	417000	100	ug/kg		1
2,4-Dinitrotoluene	818	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	3990	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	7970	100	ug/kg		1
HMX	515000	200	ug/kg		1
Nitrobenzene	104	100	ug/kg		1
RDX	976000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

180

Client ID 22365
GPL ID: 103240-009-01-1/1
Matrix: Soil
Date Collected: 03/23/01
Date Received: 03/26/01

Prep Method: EXT_SW8330
Prep Date: 03/27/01
Prep Time: 05:00

Analytical Method: SW8330
Date Analyzed: 04/12/01
Time Analyzed 09:07

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	3410	100	ug/kg		1
1,3-Dinitrobenzene	264	100	ug/kg		1
2,4,6-Trinitrotoluene	46300	100	ug/kg		1
2,4-Dinitrotoluene	212	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1690	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2120	100	ug/kg		1
HMX	420000	200	ug/kg		1
Nitrobenzene	67.5	100	ug/kg	J	1
RDX	631000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22366
GPL ID: 103240-010-01-1/1
Matrix: Soil
Date Collected: 03/23/01
Date Received: 03/26/01

Prep Method: EXT_SW8330
Prep Date: 03/27/01
Prep Time: 05:00

Analytical Method: SW8330
Date Analyzed: 04/12/01
Time Analyzed 10:04

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	14700	100	ug/kg		1
1,3-Dinitrobenzene	1500	100	ug/kg		1
2,4,6-Trinitrotoluene	24500	100	ug/kg		1
2,4-Dinitrotoluene	1000	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	6590	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	7530	100	ug/kg		1
HMX	464000	200	ug/kg		1
Nitrobenzene	491	100	ug/kg		1
RDX	753000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22569
GPL ID: 104112-001-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/17/01
Prep Time: 11:06

Analytical Method: SW8330
Date Analyzed: 04/20/01
Time Analyzed 21:10

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	54600	100	ug/kg		1
1,3-Dinitrobenzene	2270	100	ug/kg		1
2,4,6-Trinitrotoluene	12000	100	ug/kg		1
2,4-Dinitrotoluene	939	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1990	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2220	100	ug/kg		1
HMX	454000	200	ug/kg		1
Nitrobenzene	196	100	ug/kg		1
RDX	899000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	2900	200	ug/kg		1

Summary of Analytical Results

Client ID 22570
GPL ID: 104112-002-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/17/01
Prep Time: 11:06

Analytical Method: SW8330
Date Analyzed: 04/20/01
Time Analyzed 22:07

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	26500	100	ug/kg		1
1,3-Dinitrobenzene	1630	100	ug/kg		1
2,4,6-Trinitrotoluene	55500	100	ug/kg		1
2,4-Dinitrotoluene	777	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	2480	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2740	100	ug/kg		1
HMX	508000	200	ug/kg		1
Nitrobenzene	238	100	ug/kg		1
RDX	922000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	8440	200	ug/kg		1
p-Nitrotoluene	1690	200	ug/kg		1

Summary of Analytical Results

184

Client ID 22571
GPL ID: 104112-003-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/17/01
Prep Time: 11:06

Analytical Method: SW8330
Date Analyzed: 04/20/01
Time Analyzed 23:05

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	33800	100	ug/kg		1
1,3-Dinitrobenzene	1170	100	ug/kg		1
2,4,6-Trinitrotoluene	30700	100	ug/kg		1
2,4-Dinitrotoluene	1230	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	2060	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2410	100	ug/kg		1
HMX	556000	200	ug/kg		1
Nitrobenzene	250	100	ug/kg		1
RDX	914000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	3600	200	ug/kg		1
p-Nitrotoluene	1910	200	ug/kg		1

Summary of Analytical Results

Client ID 22572
GPL ID: 104112-004-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/17/01
Prep Time: 11:06

Analytical Method: SW8330
Date Analyzed: 04/21/01
Time Analyzed 00:02

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	3060	100	ug/kg		1
1,3-Dinitrobenzene	BQL	100	ug/kg	U	1
2,4,6-Trinitrotoluene	14600	100	ug/kg		1
2,4-Dinitrotoluene	600	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1760	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	1530	100	ug/kg		1
HMX	51800	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	34500	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22573
GPL ID: 104112-005-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/17/01
Prep Time: 11:06

Analytical Method: SW8330
Date Analyzed: 04/21/01
Time Analyzed 01:56

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	685	100	ug/kg		1
1,3-Dinitrobenzene	BQL	100	ug/kg	U	1
2,4,6-Trinitrotoluene	4590	100	ug/kg		1
2,4-Dinitrotoluene	76.9	100	ug/kg	J	1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	781	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	679	100	ug/kg		1
HMX	200000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	446000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	496	200	ug/kg		1
o-Nitrotoluene	602	200	ug/kg		1
p-Nitrotoluene	1720	200	ug/kg		1

Summary of Analytical Results

Client ID 22574
GPL ID: 104112-006-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/17/01
Prep Time: 11:06

Analytical Method: SW8330
Date Analyzed: 04/21/01
Time Analyzed 02:53

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	632	100	ug/kg		1
1,3-Dinitrobenzene	BQL	100	ug/kg	U	1
2,4,6-Trinitrotoluene	23600	100	ug/kg		1
2,4-Dinitrotoluene	BQL	100	ug/kg	U	1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1680	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	1180	100	ug/kg		1
HMX	65700	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	129000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	398	200	ug/kg		1
o-Nitrotoluene	1300	200	ug/kg		1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22575
GPL ID: 104112-007-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/17/01
Prep Time: 11:06

Analytical Method: SW8330
Date Analyzed: 04/21/01
Time Analyzed 03:50

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	8720	100	ug/kg		1
1,3-Dinitrobenzene	776	100	ug/kg		1
2,4,6-Trinitrotoluene	11100	100	ug/kg		1
2,4-Dinitrotoluene	872	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1820	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	4020	100	ug/kg		1
HMX	64000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	19400	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22576
GPL ID: 104112-008-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/17/01
Prep Time: 11:06

Analytical Method: SW8330
Date Analyzed: 04/21/01
Time Analyzed 04:47

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	1640	100	ug/kg		1
1,3-Dinitrobenzene	374	100	ug/kg		1
2,4,6-Trinitrotoluene	5390	100	ug/kg		1
2,4-Dinitrotoluene	69.4	100	ug/kg	J	1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	638	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	702	100	ug/kg		1
HMX	32900	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	300000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	696	200	ug/kg		1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22577
GPL ID: 104112-009-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/17/01
Prep Time: 11:06

Analytical Method: SW8330
Date Analyzed: 04/21/01
Time Analyzed 05:44

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	7350	100	ug/kg		1
1,3-Dinitrobenzene	536	100	ug/kg		1
2,4,6-Trinitrotoluene	3370	100	ug/kg		1
2,4-Dinitrotoluene	BQL	100	ug/kg	U	1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1170	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	1190	100	ug/kg		1
HMX	74700	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	12200	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	462	200	ug/kg		1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22578
GPL ID: 104112-010-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/17/01
Prep Time: 11:06

Analytical Method: SW8330
Date Analyzed: 04/21/01
Time Analyzed 07:38

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	10500	100	ug/kg		1
1,3-Dinitrobenzene	634	100	ug/kg		1
2,4,6-Trinitrotoluene	24700	100	ug/kg		1
2,4-Dinitrotoluene	571	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	2550	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2720	100	ug/kg		1
HMX	98500	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	14900	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

.GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22579
GPL ID: 104112-011-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/17/01
Prep Time: 11:06

Analytical Method: SW8330
Date Analyzed: 04/21/01
Time Analyzed 08:35

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	1640	100	ug/kg		1
1,3-Dinitrobenzene	361	100	ug/kg		1
2,4,6-Trinitrotoluene	4580	100	ug/kg		1
2,4-Dinitrotoluene	64.1	100	ug/kg	J	1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	974	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	841	100	ug/kg		1
HMX	45800	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	8110	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	494	200	ug/kg		1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22580
GPL ID: 104112-012-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/17/01
Prep Time: 11:06

Analytical Method: SW8330
Date Analyzed: 04/21/01
Time Analyzed 09:32

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	18300	100	ug/kg		1
1,3-Dinitrobenzene	841	100	ug/kg		1
2,4,6-Trinitrotoluene	16200	100	ug/kg		1
2,4-Dinitrotoluene	BQL	100	ug/kg	U	1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	5640	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	3840	100	ug/kg		1
HMX	117000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	25600	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22581
GPL ID: 104112-013-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/17/01
Prep Time: 11:06

Analytical Method: SW8330
Date Analyzed: 04/21/01
Time Analyzed 10:29

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	15700	100	ug/kg		1
1,3-Dinitrobenzene	651	100	ug/kg		1
2,4,6-Trinitrotoluene	28700	100	ug/kg		1
2,4-Dinitrotoluene	973	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1990	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2660	100	ug/kg		1
HMX	61100	200	ug/kg		1
Nitrobenzene	81.0	100	ug/kg	J	1
RDX	47100	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22582
GPL ID: 104112-014-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/17/01
Prep Time: 11:06

Analytical Method: SW8330
Date Analyzed: 04/21/01
Time Analyzed 11:26

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	6330	100	ug/kg		1
1,3-Dinitrobenzene	535	100	ug/kg		1
2,4,6-Trinitrotoluene	7430	100	ug/kg		1
2,4-Dinitrotoluene	460	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1520	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2040	100	ug/kg		1
HMX	62100	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	15600	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

196

Client ID 22583
GPL ID: 104112-015-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/17/01
Prep Time: 11:06

Analytical Method: SW8330
Date Analyzed: 04/21/01
Time Analyzed 13:20

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	13800	100	ug/kg		1
1,3-Dinitrobenzene	468	100	ug/kg		1
2,4,6-Trinitrotoluene	11900	100	ug/kg		1
2,4-Dinitrotoluene	817	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1330	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2500	100	ug/kg		1
HMX	108000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	64500	200	ug/kg		1
Tetryl	1950	200	ug/kg		1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	937	200	ug/kg		1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22584
GPL ID: 104134-001-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:39

Analytical Method: SW8330
Date Analyzed: 04/21/01
Time Analyzed 15:14

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	7610	100	ug/kg		1
1,3-Dinitrobenzene	486	100	ug/kg		1
2,4,6-Trinitrotoluene	20100	100	ug/kg		1
2,4-Dinitrotoluene	68.8	100	ug/kg	J	1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1100	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	1200	100	ug/kg		1
HMX	74900	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	13900	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	819	200	ug/kg		1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID: 22585
GPL ID: 104134-002-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:39

Analytical Method: SW8330
Date Analyzed: 04/21/01
Time Analyzed 16:11

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	20500	100	ug/kg		1
1,3-Dinitrobenzene	571	100	ug/kg		1
2,4,6-Trinitrotoluene	860000	100	ug/kg		1
2,4-Dinitrotoluene	1130	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	4310	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	10200	100	ug/kg		1
HMX	229000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	1000000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22586
GPL ID: 104134-003-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:39

Analytical Method: SW8330
Date Analyzed: 04/21/01
Time Analyzed 17:08

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	6420	100	ug/kg		1
1,3-Dinitrobenzene	350	100	ug/kg		1
2,4,6-Trinitrotoluene	27300	100	ug/kg		1
2,4-Dinitrotoluene	1070	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	3810	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	4520	100	ug/kg		1
HMX	113000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	26200	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 122587
GPL ID: 104134-004-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:39

Analytical Method: SW8330
Date Analyzed: 04/21/01
Time Analyzed 19:02

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	17700	100	ug/kg		1
1,3-Dinitrobenzene	708	100	ug/kg		1
2,4,6-Trinitrotoluene	11300	100	ug/kg		1
2,4-Dinitrotoluene	358	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1190	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	1890	100	ug/kg		1
HMX	112000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	33700	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 122588
GPL ID: 104134-005-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:39

Analytical Method: SW8330
Date Analyzed: 04/21/01
Time Analyzed 19:59

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	5340	100	ug/kg		1
1,3-Dinitrobenzene	543	100	ug/kg		1
2,4,6-Trinitrotoluene	103000	100	ug/kg		1
2,4-Dinitrotoluene	259	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1220	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	1960	100	ug/kg		1
HMX	179000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	614000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

302

Client ID 122589
GPL ID: 104134-006-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:39

Analytical Method: SW8330
Date Analyzed: 04/21/01
Time Analyzed 20:56

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	27700	100	ug/kg		1
1,3-Dinitrobenzene	551	100	ug/kg		1
2,4,6-Trinitrotoluene	35200	100	ug/kg		1
2,4-Dinitrotoluene	635	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	2090	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	3970	100	ug/kg		1
HMX	91200	200	ug/kg		1
Nitrobenzene	89.5	100	ug/kg	J	1
RDX	32400	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 122590
GPL ID: 104134-007-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:39

Analytical Method: SW8330
Date Analyzed: 04/21/01
Time Analyzed 21:53

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	11800	100	ug/kg		1
1,3-Dinitrobenzene	877	100	ug/kg		1
2,4,6-Trinitrotoluene	8210	100	ug/kg		1
2,4-Dinitrotoluene	435	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1210	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	1990	100	ug/kg		1
HMX	272000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	87800	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

204

Client ID 122591
GPL ID: 104134-008-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:39

Analytical Method: SW8330
Date Analyzed: 04/21/01
Time Analyzed 22:50

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	1470	100	ug/kg		1
1,3-Dinitrobenzene	589	100	ug/kg		1
2,4,6-Trinitrotoluene	3900	100	ug/kg		1
2,4-Dinitrotoluene	246	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	998	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	988	100	ug/kg		1
HMX	149000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	49400	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 122592
GPL ID: 104134-009-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:39

Analytical Method: SW8330
Date Analyzed: 04/22/01
Time Analyzed 00:44

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	899	100	ug/kg		1
1,3-Dinitrobenzene	651	100	ug/kg		1
2,4,6-Trinitrotoluene	8050	100	ug/kg		1
2,4-Dinitrotoluene	96.4	100	ug/kg	J	1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	713	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	899	100	ug/kg		1
HMX	145000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	33100	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

206

Client ID 122593
GPL ID: 104134-010-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:39

Analytical Method: SW8330
Date Analyzed: 04/22/01
Time Analyzed 01:42

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	12800	100	ug/kg		1
1,3-Dinitrobenzene	579	100	ug/kg		1
2,4,6-Trinitrotoluene	17200	100	ug/kg		1
2,4-Dinitrotoluene	565	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1350	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2100	100	ug/kg		1
HMX	109000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	24500	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 122594
GPL ID: 104134-011-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:39

Analytical Method: SW8330
Date Analyzed: 04/22/01
Time Analyzed 02:39

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	29500	100	ug/kg		1
1,3-Dinitrobenzene	820	100	ug/kg		1
2,4,6-Trinitrotoluene	44400	100	ug/kg		1
2,4-Dinitrotoluene	2140	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	4360	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	6200	100	ug/kg		1
HMX	110000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	89800	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

208

Client ID 122595
GPL ID: 104134-012-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:39

Analytical Method: SW8330
Date Analyzed: 04/22/01
Time Analyzed 03:36

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	2410	100	ug/kg		1
1,3-Dinitrobenzene	309	100	ug/kg		1
2,4,6-Trinitrotoluene	11500	100	ug/kg		1
2,4-Dinitrotoluene	279	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1150	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	1120	100	ug/kg		1
HMX	98000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	61000	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 122596
GPL ID: 104134-013-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:39

Analytical Method: SW8330
Date Analyzed: 04/22/01
Time Analyzed 04:33

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	1810	100	ug/kg		1
1,3-Dinitrobenzene	295	100	ug/kg		1
2,4,6-Trinitrotoluene	9750	100	ug/kg		1
2,4-Dinitrotoluene	214	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1820	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	1640	100	ug/kg		1
HMX	91600	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	51400	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

210

Client ID 122597
GPL ID: 104134-014-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:39

Analytical Method: SW8330
Date Analyzed: 04/22/01
Time Analyzed 06:27

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	45400	100	ug/kg		1
1,3-Dinitrobenzene	597	100	ug/kg		1
2,4,6-Trinitrotoluene	17500	100	ug/kg		1
2,4-Dinitrotoluene	1950	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	2710	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2910	100	ug/kg		1
HMX	135000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	99400	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	968	200	ug/kg		1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 122598
GPL ID: 104134-015-01-1/1
Matrix: Soil
Date Collected: 04/12/01
Date Received: 04/16/01

Prep Method: EXT_SW8330
Prep Date: 04/19/01
Prep Time: 04:39

Analytical Method: SW8330
Date Analyzed: 04/22/01
Time Analyzed 07:24

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	9170	100	ug/kg		1
1,3-Dinitrobenzene	259	100	ug/kg		1
2,4,6-Trinitrotoluene	6320	100	ug/kg		1
2,4-Dinitrotoluene	290	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1620	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	1690	100	ug/kg		1
HMX	95000	200	ug/kg		1
Nitrobenzene	BQL	100	ug/kg	U	1
RDX	8350	200	ug/kg		1
Tetryl	BQL	200	ug/kg	U	1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

212

Client ID 22716
GPL ID: 104232-001-01-1/1
Matrix: Soil
Date Collected: 04/27/01
Date Received: 05/01/01

Prep Method: EXT_SW8330
Prep Date: 05/02/01
Prep Time: 11:20

Analytical Method: SW8330
Date Analyzed: 05/05/01
Time Analyzed 16:23

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	21500	100	ug/kg		1
1,3-Dinitrobenzene	890	100	ug/kg		1
2,4,6-Trinitrotoluene	156000	100	ug/kg		1
2,4-Dinitrotoluene	880	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1200	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	3350	100	ug/kg		1
HMX	489000	200	ug/kg		1
Nitrobenzene	252	100	ug/kg		1
RDX	924000	200	ug/kg		1
Tetryl	4250	200	ug/kg		1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

Client ID 22717
GPL ID: 104232-002-01-1/1
Matrix: Soil
Date Collected: 04/27/01
Date Received: 05/01/01

Prep Method: EXT_SW8330
Prep Date: 05/02/01
Prep Time: 11:20

Analytical Method: SW8330
Date Analyzed: 05/05/01
Time Analyzed 17:49

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	13700	100	ug/kg		1
1,3-Dinitrobenzene	372	100	ug/kg		1
2,4,6-Trinitrotoluene	8740	100	ug/kg		1
2,4-Dinitrotoluene	488	100	ug/kg		1
2,6-Dinitrotoluene	BQL	100	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1820	100	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2320	100	ug/kg		1
HMX	33200	200	ug/kg		1
Nitrobenzene	81.5	100	ug/kg	J	1
RDX	14200	200	ug/kg		1
Tetryl	2510	200	ug/kg		1
m-Nitrotoluene	BQL	200	ug/kg	U	1
o-Nitrotoluene	BQL	200	ug/kg	U	1
p-Nitrotoluene	BQL	200	ug/kg	U	1

Summary of Analytical Results

1093-1 CONTROL

214

Client ID 22668
GPL ID: 104179-001-01-1/1
Matrix: Soil
Date Collected: 04/20/01
Date Received: 04/23/01

Prep Method: EXT_SW8330
Prep Date: 04/26/01
Prep Time: 09:42

Analytical Method: SW8330
Date Analyzed: 05/01/01
Time Analyzed 18:07

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	180	0.26	ug/kg		1
1,3-Dinitrobenzene	0.957	0.26	ug/kg		1
2,4,6-Trinitrotoluene	346	0.26	ug/kg		1
2,4-Dinitrotoluene	2.20	0.26	ug/kg		1
2,6-Dinitrotoluene	BQL	0.26	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	19.7	0.26	ug/kg		1
4-Amino-2,6-Dinitrotoluene	20.8	0.26	ug/kg		1
HMX	1800	0.519	ug/kg		1
Nitrobenzene	2.80	0.26	ug/kg		1
RDX	4250	0.519	ug/kg		1
Tetryl	BQL	0.519	ug/kg	U	1
m-Nitrotoluene	0.772	0.519	ug/kg		1
o-Nitrotoluene	BQL	0.519	ug/kg	U	1
p-Nitrotoluene	BQL	0.519	ug/kg	U	1

Summary of Analytical Results

1093-1 T1

Client ID 22669
GPL ID: 104179-002-01-1/1
Matrix: Soil
Date Collected: 04/20/01
Date Received: 04/23/01

Prep Method: EXT_SW8330
Prep Date: 04/26/01
Prep Time: 09:42

Analytical Method: SW8330
Date Analyzed: 05/01/01
Time Analyzed 20:02

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	6.79	0.26	ug/kg		1
1,3-Dinitrobenzene	1.96	0.26	ug/kg		1
2,4,6-Trinitrotoluene	275	0.26	ug/kg		1
2,4-Dinitrotoluene	BQL	0.26	ug/kg	U	1
2,6-Dinitrotoluene	BQL	0.26	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	6.89	0.26	ug/kg		1
4-Amino-2,6-Dinitrotoluene	23.1	0.26	ug/kg		1
HMX	803	0.519	ug/kg		1
Nitrobenzene	BQL	0.26	ug/kg	U	1
RDX	168	0.519	ug/kg		1
Tetryl	BQL	0.519	ug/kg	U	1
m-Nitrotoluene	BQL	0.519	ug/kg	U	1
o-Nitrotoluene	BQL	0.519	ug/kg	U	1
p-Nitrotoluene	BQL	0.519	ug/kg	U	1

Summary of Analytical Results

1093-1 T2

216

Client ID 22670
GPL ID: 104179-003-01-1/1
Matrix: Soil
Date Collected: 04/20/01
Date Received: 04/23/01

Prep Method: EXT_SW8330
Prep Date: 04/26/01
Prep Time: 09:42

Analytical Method: SW8330
Date Analyzed: 05/01/01
Time Analyzed 20:59

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	0.221	0.267	ug/kg	J	1
1,3-Dinitrobenzene	1.09	0.267	ug/kg		1
2,4,6-Trinitrotoluene	5.32	0.267	ug/kg		1
2,4-Dinitrotoluene	BQL	0.267	ug/kg	U	1
2,6-Dinitrotoluene	BQL	0.267	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	1.21	0.267	ug/kg		1
4-Amino-2,6-Dinitrotoluene	2.23	0.267	ug/kg		1
HMX	795	0.533	ug/kg		1
Nitrobenzene	BQL	0.267	ug/kg	U	1
RDX	96.8	0.533	ug/kg		1
Tetryl	BQL	0.533	ug/kg	U	1
m-Nitrotoluene	BQL	0.533	ug/kg	U	1
o-Nitrotoluene	BQL	0.533	ug/kg	U	1
p-Nitrotoluene	BQL	0.533	ug/kg	U	1

Summary of Analytical Results

1093-2 control

Client ID 22671
GPL ID: 104179-004-01-1/1
Matrix: Soil
Date Collected: 04/20/01
Date Received: 04/23/01

Prep Method: EXT_SW8330
Prep Date: 04/26/01
Prep Time: 09:42

Analytical Method: SW8330
Date Analyzed: 05/01/01
Time Analyzed 21:56

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	209	0.26	ug/kg		1
1,3-Dinitrobenzene	5.83	0.26	ug/kg		1
2,4,6-Trinitrotoluene	786	0.26	ug/kg		1
2,4-Dinitrotoluene	2.42	0.26	ug/kg		1
2,6-Dinitrotoluene	BQL	0.26	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	12.3	0.26	ug/kg		1
4-Amino-2,6-Dinitrotoluene	17.0	0.26	ug/kg		1
HMX	1630	0.519	ug/kg		1
Nitrobenzene	BQL	0.26	ug/kg	U	1
RDX	4290	0.519	ug/kg		1
Tetryl	BQL	0.519	ug/kg	U	1
m-Nitrotoluene	BQL	0.519	ug/kg	U	1
o-Nitrotoluene	BQL	0.519	ug/kg	U	1
p-Nitrotoluene	BQL	0.519	ug/kg	U	1

Summary of Analytical Results

1093-2 T1

28

Client ID 22672
GPL ID: 104179-005-01-1/1
Matrix: Soil
Date Collected: 04/20/01
Date Received: 04/23/01

Prep Method: EXT_SW8330
Prep Date: 04/26/01
Prep Time: 09:42

Analytical Method: SW8330
Date Analyzed: 05/01/01
Time Analyzed 22:53

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	BQL	0.26	ug/kg	U	1
1,3-Dinitrobenzene	9.62	0.26	ug/kg		1
2,4,6-Trinitrotoluene	1060	0.26	ug/kg		1
2,4-Dinitrotoluene	2.47	0.26	ug/kg		1
2,6-Dinitrotoluene	BQL	0.26	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	14.5	0.26	ug/kg		1
4-Amino-2,6-Dinitrotoluene	61.1	0.26	ug/kg		1
HMX	666	0.519	ug/kg		1
Nitrobenzene	0.906	0.26	ug/kg		1
RDX	512	0.519	ug/kg		1
Tetryl	BQL	0.519	ug/kg	U	1
m-Nitrotoluene	5.48	0.519	ug/kg		1
o-Nitrotoluene	BQL	0.519	ug/kg	U	1
p-Nitrotoluene	BQL	0.519	ug/kg	U	1

Summary of Analytical Results

Client ID 22673
GPL ID: 104179-006-01-1/1
Matrix: Soil
Date Collected: 04/20/01
Date Received: 04/23/01

Prep Method: EXT_SW8330
Prep Date: 04/26/01
Prep Time: 09:42

Analytical Method: SW8330
Date Analyzed: 05/01/01
Time Analyzed 23:50

1093-2 T2

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	0.558	0.26	ug/kg		1
1,3-Dinitrobenzene	0.698	0.26	ug/kg		1
2,4,6-Trinitrotoluene	120	0.26	ug/kg		1
2,4-Dinitrotoluene	BQL	0.26	ug/kg	U	1
2,6-Dinitrotoluene	BQL	0.26	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	4.72	0.26	ug/kg		1
4-Amino-2,6-Dinitrotoluene	9.36	0.26	ug/kg		1
HMX	751	0.519	ug/kg		1
Nitrobenzene	BQL	0.26	ug/kg	U	1
RDX	1410	0.519	ug/kg		1
Tetryl	BQL	0.519	ug/kg	U	1
m-Nitrotoluene	BQL	0.519	ug/kg	U	1
o-Nitrotoluene	BQL	0.519	ug/kg	U	1
p-Nitrotoluene	BQL	0.519	ug/kg	U	1

Summary of Analytical Results

1093-3 T=0 cycles

270

Client ID 22674
GPL ID: 104179-007-01-1/1
Matrix: Soil
Date Collected: 04/20/01
Date Received: 04/23/01

Prep Method: EXT_SW8330
Prep Date: 04/26/01
Prep Time: 09:42

Analytical Method: SW8330
Date Analyzed: 05/02/01
Time Analyzed 01:44

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	145	0.26	ug/kg		1
1,3-Dinitrobenzene	0.863	0.26	ug/kg		1
2,4,6-Trinitrotoluene	681	0.26	ug/kg		1
2,4-Dinitrotoluene	BQL	0.26	ug/kg	U	1
2,6-Dinitrotoluene	BQL	0.26	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	7.93	0.26	ug/kg		1
4-Amino-2,6-Dinitrotoluene	4.15	0.26	ug/kg		1
HMX	1010	0.519	ug/kg		1
Nitrobenzene	0.480	0.26	ug/kg		1
RDX	3380	0.519	ug/kg		1
Tetryl	BQL	0.519	ug/kg	U	1
m-Nitrotoluene	BQL	0.519	ug/kg	U	1
o-Nitrotoluene	BQL	0.519	ug/kg	U	1
p-Nitrotoluene	BQL	0.519	ug/kg	U	1

Summary of Analytical Results

1093-3 Cycle 1

Client ID 22675
GPL ID: 104179-008-01-1/1
Matrix: Soil
Date Collected: 04/20/01
Date Received: 04/23/01

Prep Method: EXT_SW8330
Prep Date: 04/26/01
Prep Time: 09:42

Analytical Method: SW8330
Date Analyzed: 05/02/01
Time Analyzed 02:41

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	39.8	0.267	ug/kg		1
1,3-Dinitrobenzene	2.33	0.267	ug/kg		1
2,4,6-Trinitrotoluene	377	0.267	ug/kg		1
2,4-Dinitrotoluene	BQL	0.267	ug/kg	U	1
2,6-Dinitrotoluene	BQL	0.267	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	19.7	0.267	ug/kg		1
4-Amino-2,6-Dinitrotoluene	26.3	0.267	ug/kg		1
HMX	1550	0.533	ug/kg		1
Nitrobenzene	BQL	0.267	ug/kg	U	1
RDX	3470	0.533	ug/kg		1
Tetryl	BQL	0.533	ug/kg	U	1
m-Nitrotoluene	BQL	0.533	ug/kg	U	1
o-Nitrotoluene	BQL	0.533	ug/kg	U	1
p-Nitrotoluene	BQL	0.533	ug/kg	U	1

Summary of Analytical Results

1093-3 cycle 2

222

nt ID 22676
GPL ID: 104179-009-01-1/1
Matrix: Soil
Date Collected: 04/20/01
Date Received: 04/23/01

Prep Method: EXT_SW8330
Prep Date: 04/26/01
Prep Time: 09:42

Analytical Method: SW8330
Date Analyzed: 05/02/01
Time Analyzed 03:38

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	21.1	0.267	ug/kg		1
1,3-Dinitrobenzene	5.38	0.267	ug/kg		1
2,4,6-Trinitrotoluene	1150	0.267	ug/kg		1
2,4-Dinitrotoluene	BQL	0.267	ug/kg	U	1
2,6-Dinitrotoluene	BQL	0.267	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	19.1	0.267	ug/kg		1
4-Amino-2,6-Dinitrotoluene	34.3	0.267	ug/kg		1
HMX	1630	0.533	ug/kg		1
Nitrobenzene	BQL	0.267	ug/kg	U	1
RDX	3000	0.533	ug/kg		1
Tetryl	BQL	0.533	ug/kg	U	1
m-Nitrotoluene	0.307	0.533	ug/kg	J	1
o-Nitrotoluene	BQL	0.533	ug/kg	U	1
p-Nitrotoluene	BQL	0.533	ug/kg	U	1

Summary of Analytical Results

1093-3 cycle 4.

Client ID 22677
GPL ID: 104179-010-01-1/1
Matrix: Soil
Date Collected: 04/20/01
Date Received: 04/23/01

Prep Method: EXT_SW8330
Prep Date: 04/26/01
Prep Time: 09:42

Analytical Method: SW8330
Date Analyzed: 05/02/01
Time Analyzed 04:35

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	2.46	0.267	ug/kg		1
1,3-Dinitrobenzene	4.04	0.267	ug/kg		1
2,4,6-Trinitrotoluene	742	0.267	ug/kg		1
2,4-Dinitrotoluene	BQL	0.267	ug/kg	U	1
2,6-Dinitrotoluene	BQL	0.267	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	24.9	0.267	ug/kg		1
4-Amino-2,6-Dinitrotoluene	82.7	0.267	ug/kg		1
HMX	1720	0.533	ug/kg		1
Nitrobenzene	BQL	0.267	ug/kg	U	1
RDX	589	0.533	ug/kg		1
Tetryl	BQL	0.533	ug/kg	U	1
m-Nitrotoluene	BQL	0.533	ug/kg	U	1
o-Nitrotoluene	BQL	0.533	ug/kg	U	1
p-Nitrotoluene	BQL	0.533	ug/kg	U	1

Summary of Analytical Results

1093-3 cycle 6

224

Client ID 22678
GPL ID: 104179-011-01-1/1
Matrix: Soil
Date Collected: 04/20/01
Date Received: 04/23/01

Prep Method: EXT_SW8330
Prep Date: 04/26/01
Prep Time: 09:42

Analytical Method: SW8330
Date Analyzed: 05/02/01
Time Analyzed 05:32

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
1,3,5-Trinitrobenzene	2.28	0.286	ug/kg		1
1,3-Dinitrobenzene	3.72	0.286	ug/kg		1
2,4,6-Trinitrotoluene	1.06	0.286	ug/kg		1
2,4-Dinitrotoluene	BQL	0.286	ug/kg	U	1
2,6-Dinitrotoluene	BQL	0.286	ug/kg	U	1
2-Amino-4,6-Dinitrotoluene	0.484	0.286	ug/kg		1
4-Amino-2,6-Dinitrotoluene	3.55	0.286	ug/kg		1
HMX	784	0.571	ug/kg		1
Nitrobenzene	BQL	0.286	ug/kg	U	1
RDX	134	0.571	ug/kg		1
Tetryl	BQL	0.571	ug/kg	U	1
m-Nitrotoluene	BQL	0.571	ug/kg	U	1
o-Nitrotoluene	BQL	0.571	ug/kg	U	1
p-Nitrotoluene	BQL	0.571	ug/kg	U	1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22674
GPL ID: 104179-007-01-1/1
Matrix: Water
Date Collected: 04/20/01
Date Received: 04/23/01

Prep Method:
Prep Date:
Prep Time:

Analytical Method: SW6010B-SL
Date Analyzed: 05/21/01
Time Analyzed 21:54

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
Iron	BQL	1500	ug/L	U	1
Manganese	BQL	50	ug/L	U	1

Summary of Analytical Results

226

ent ID 22675
GPL ID: 104179-008-01-1/1
Matrix: Water
Date Collected: 04/20/01
Date Received: 04/23/01

Prep Method: SW3010A
Prep Date: 05/03/01
Prep Time: 03:09

Analytical Method: SW6010B_SL
Date Analyzed: 05/21/01
Time Analyzed 22:01

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
Iron	BQL	1500	ug/L	U	1
Manganese	134	50	ug/L		1

Summary of Analytical Results

Client ID 22676
GPL ID: 104179-009-01-1/1
Matrix: Water
Date Collected: 04/20/01
Date Received: 04/23/01

Prep Method: SW3010A
Prep Date: 05/03/01
Prep Time: 03:09

Analytical Method: SW6010B_SL
Date Analyzed: 05/21/01
Time Analyzed 22:08

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
Iron	BQL	1500	ug/L	U	1
Manganese	250	50	ug/L		1

Summary of Analytical Results

228

Client ID 22677
GPL ID: 104179-010-01-1/1
Matrix: Water
Date Collected: 04/20/01
Date Received: 04/23/01

Prep Method: SW3010A
Prep Date: 05/03/01
Prep Time: 03:09

Analytical Method: SW6010B_SL
Date Analyzed: 05/21/01
Time Analyzed 22:14

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
Iron	BQL	1500	ug/L	U	1
Manganese	739	50	ug/L		1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 22678
GPL ID: 104179-011-01-1/1
Matrix: Water
Date Collected: 04/20/01
Date Received: 04/23/01

Prep Method: SW3010A
Prep Date: 05/03/01
Prep Time: 03:09

Analytical Method: SW6010B_SL
Date Analyzed: 05/21/01
Time Analyzed 22:21

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
Iron	BQL	1500	ug/L	U	1
Manganese	673	50	ug/L		1

GPL LABORATORIES, LLLP

Summary of Analytical Results

230

Client ID 23393
GPL ID: 106135-001-01-I/I
Matrix: Water
Date Collected: 06/19/01
Date Received: 06/25/01

Prep Method:
Prep Date:
Prep Time:

Analytical Method: 001
Date Analyzed: 06/26/01
Time Analyzed 14:15

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
TDS, Total Dissolved Solids	182	20	mg/L		2

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 23393
GPL ID: 106135-001-01-1/I
Matrix: Water
Date Collected: 06/19/01
Date Received: 06/25/01

Prep Method:
Prep Date:
Prep Time:

Analytical Method: 003
Date Analyzed: 06/26/01
Time Analyzed 14:15

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
Suspended solids (residue, non-filterable)	314	10	mg/L		1

232

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 23393
GPL ID: 106135-001-02-1/1
Matrix: Water
Date Collected: 06/19/01
Date Received: 06/25/01

Prep Method:
Prep Date:
Prep Time:

Analytical Method: 001
Date Analyzed: 06/26/01
Time Analyzed 16:50

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
Percent Free Liquid	100	0.1	%		1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 23394
GPL ID: 106135-002-01-1/1
Matrix: Water
Date Collected: 06/19/01
Date Received: 06/25/01

Prep Method:
Prep Date:
Prep Time:

Analytical Method: 002
Date Analyzed: 06/26/01
Time Analyzed 14:15

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
TDS, Total Dissolved Solids	274	20	mg/L		2

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GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 23394
GPL ID: 106135-002-01-1/1
Matrix: Water
Date Collected: 06/19/01
Date Received: 06/25/01

Prep Method:
Prep Date:
Prep Time:

Analytical Method: 004
Date Analyzed: 06/26/01
Time Analyzed 14:15

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
Suspended solids (residue, non-filterable)	322	10	mg/L		1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 23394
GPL ID: 106135-002-02-1/1
Matrix: Water
Date Collected: 06/19/01
Date Received: 06/28/01

Prep Method:
Prep Date:
Prep Time:

Analytical Method: 002
Date Analyzed: 06/26/01
Time Analyzed 16:50

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
Percent Free Liquid	100	0.1	%		1

GPL LABORATORIES, LLLP

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Summary of Analytical Results

Client ID 23395
GPL ID: 106135-003-01-1/1
Matrix: Water
Date Collected: 06/19/01
Date Received: 06/25/01

Prep Method:
Prep Date:
Prep Time:

Analytical Method: 003
Date Analyzed: 06/26/01
Time Analyzed 14:15

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
TDS, Total Dissolved Solids	364	20	mg/L		1

GPL LABORATORIES, LLLP

Summary of Analytical Results

Client ID 23395
GPL ID: 106135-009-01-1/1
Matrix: Water
Date Collected: 06/19/01
Date Received: 06/25/01

Prep Method:
Prep Date:
Prep Time:

Analytical Method: 005
Date Analyzed: 06/26/01
Time Analyzed 14:15

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
Suspended solids (residue, non-filterable)	240	10	mg/L		2

GPL LABORATORIES, LLLP

Summary of Analytical Results

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Client ID 23395
GPL ID: 106135-003-02-1/1
Matrix: Water
Date Collected: 06/19/01
Date Received: 06/25/01

Prep Method:
Prep Date:
Prep Time:

Analytical Method: 003
Date Analyzed: 06/26/01
Time Analyzed 16:50

Parameter	Result	Rep Limit	Units	Qualifier	D.F.
Percent Free Liquid	100	0.1	%		1

APPENDIX D

Joliet AAP "Bake-off" Summary
DARAMEND Toxicity Studies Excerpts

Joliet AAP "Bake-off" Summary

Joliet "Bakeoff" Summary

Plexus Scientific was commissioned by the U.S. Army Environmental Center to demonstrate and evaluate five bioremediation technologies that were potentially applicable to explosive contaminated soils. This was accomplished by performing a market study to search for promising biotechnologies that met the following criteria:

- *Qualify as a biological treatment*
- *Have a potential for remediating explosives contaminated soils*
- *Differ from conventional composting or bioslurry technology*
- *Be substantially new or innovative*

Five technologies satisfied those criteria:

Formula-1 developed by Midwest Microbial which consists of aerobic and anaerobic bacteria and microbial nutrients specially formulated for each site. This product was applied as a liquid.

BTS, developed by Bioremediation Technology Services, is a patented humic substance containing microorganisms selected to metabolize TNT, RDX, and HMX.

Chemical-Biological Treatment developed by Institute of Gas Technology, treats contaminated soils biologically, then chemically using hydrogen Peroxide and iron salt (Fenton's reagent)

DARAMEND, developed by WR Grace is a soil specific, solid phase, organic amendment that alters the physical and chemical properties of the waste to enhance biological activity

Fungal Based Remediation, developed by Intech One-Eighty Corporation and licensed to EarthFax Engineering, uses white rot fungi to degrade contaminants in soil by establishing a dominant culture of a nonindigenous species of fungi.

The "Bakeoff" consisted of three components;

1. *Laboratory Demonstration: Each process was a small reactor capable of treating 250-gram soil sample, spiked with TNT and Tetryl for 60 days. The % removal of TNT and tetryl was then measured.*
2. *Pilot demonstration: 20 cubic yards of explosives contaminated soils were treated using each technology. The % removal was again measured*
3. *Full scale cost estimates: based on performances of laboratory and pilot demonstrations and normalizing some variables such as temperatures, treatment criteria and climate cost estimates were calculated. In some instance*

generate full-scale cost estimates. The Table below summarizes the results of the bakeoff.

TNT

	Lab Demo	Pilot Demo	Cost EST	Comments
Midwest Microbial	34%	31%	None	
BTS	69%	0%	None	
IGT	14%	84%	$1578 to 3942 per yd	2nd
WR Grace	87%	97%	$476 to 819 per yd	1st
Intech	89%	61%	None	3rd

Tetryl

	Lab Demo	Pilot Demo	Cost EST	Comments
Midwest Microbial	52%	3%	None	
BTS	29%	64%	$1000 to 2438 per yd	3rd
IGT	56%	75%	$1240 to 3861 per yd	4th
WR Grace	26%	100%	$211 to 444 per yd	1st
Intech	89%	53%	$804 to $1792 per yd	2nd

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OCETA Environmental Technology Profile

DARAMEND™ BIOREMEDIATION TECHNOLOGY

PROCESS/PRODUCT DESCRIPTION:

- biodegradation
- bioremediation
- amendments
- microsites
- heavy hydrocarbons

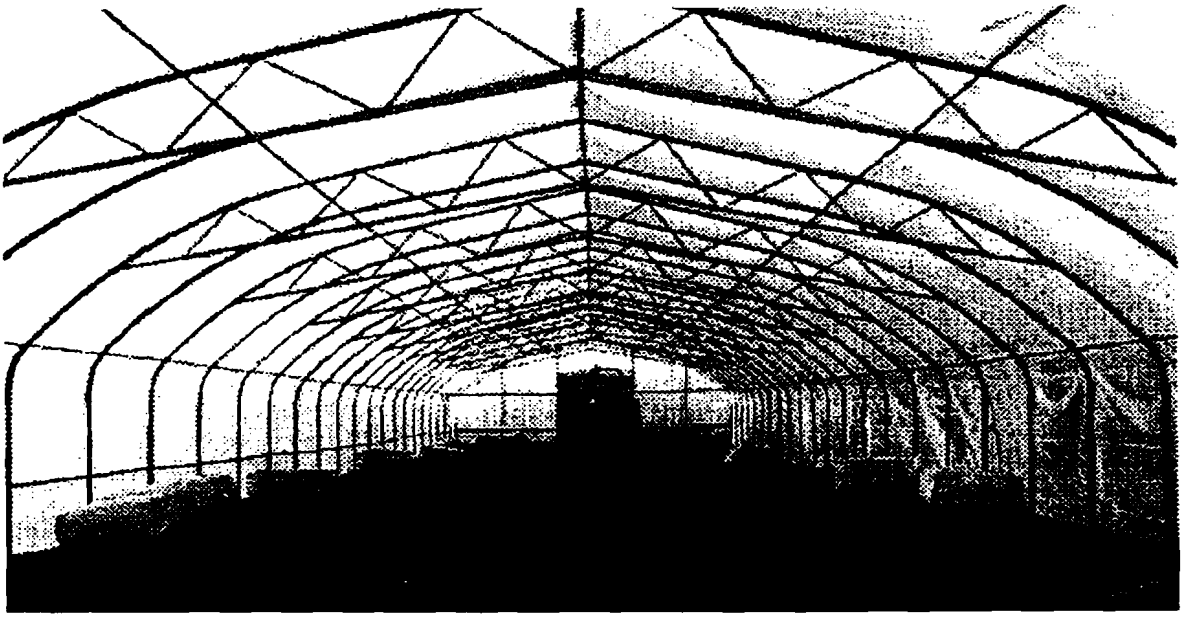

Figure 1: A DARAMEND treatment greenhouse

Bioremediation is a preferred means of remediating contaminated soil and sediment because of its low cost, high degree of public acceptance and the fact that it can provide a final solution by completely decomposing contaminants. **DARAMEND™** is a patented bioremediation technology that utilizes matrix-specific solid-phase organic amendments to beneficially alter the soil or sediment structure, nutrient profile and water-holding capacity. After homogenous distribution through the soil or sediment **DARAMEND** particles become hydrated and function as aquatic microsites where native microorganisms can grow, contact contaminants, and degrade them. This allows the soil or sediment to be bioremediated more rapidly and thoroughly than would otherwise be possible. **DARAMEND** products are matrix-specific solid-phase organic particles that are manufactured from natural botanical materials. Prior to field-scale treatment the technology is optimized in our laboratory at bench-scale. Parameters that are optimized include the size, shape, nutrient content, nutrient-release kinetics, and application rate of **DARAMEND** particles and operation and maintenance conditions such as soil water content and aeration

status.

DARAMEND™ is a registered trademark of W.R.Grace & Co.

PROCESS/PRODUCT APPLICATION:

- high concentrations
- low residuals
- recalcitrant compounds
- soil/sediment

DARAMEND was designed to enable rapid bioremediation of soils or sediments containing high concentrations of creosote, pentachlorophenol (PCP), polycyclic aromatic hydrocarbons (PAHs), heavy oils and petroleum hydrocarbons.

Conventional thinking was that soil with PCP concentrations greater than about 400 mg/kg could not be bioremediated because they were too acutely toxic to allow significant microbial activity. Amendment of such soils with **DARAMEND** products improves the ability of microorganisms to grow and degrade the contaminants to the extent that even soils with very high PCP concentrations (e.g., 2,000 mg/kg) can be rapidly and thoroughly remediated. Typical residual concentrations of 10-50 mg/kg associated with other bioremediation techniques have also been eliminated, leaving final concentrations lower than the required level for most industrial sites (i.e., 5 mg/kg).

Large quantities (>10,000 tonnes) of soil or dewatered sediment can be treated at less than $100/tonne which compares with costs of up to $1,500/tonne for some alternate methods.

Results have shown that after the application of **DARAMEND**, the degradation of contaminants will continue even after active maintenance has stopped.

Since the early 1990's, **DARAMEND** bioremediation has been applied in numerous pilot- scale and in several full scale remediation projects. Up to 3,900 tons of waste have been treated in a single batch. Project sites include the former Domtar wood treating plant at Trenton, Ontario; sediment from Randall Reef in Hamilton Harbour; and several industrial sites in the USA. Results from these projects are provided in Table 1.

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TABLE 1:

Performance data from application of DARAMEND technology to soils and sediments

Site	Year	Pollutants	Initial Conc. (mg/kg)	Final Conc. (mg/kg)	Time	Scale
Domtar Inc. (wood preserving)	1991	CP/PAH	702/1442	4/35	345 days	pilot
Domtar Inc. (wood preserving)	1992	CP/PAH	680/1568	4.4/95.9	291 days	pilot
Domtar Inc. (wood preserving)	1995	CP/PAH	183/1774	3.3/95	308 days	full
Hamilton Harbour (sediment)	1993	PAH	1000	100	300 days	pilot
New Jersey	1996	Phthalates	4350	26	130 days	bench
South Carolina (pesticides)	1996	Toxaphene/DDT	239/90	36/23	211 days	pilot
Bench Scale (pesticides)	1996	Toxaphene	40	2	142 days	bench
Bench Scale (TNT)	1996	TNT	7200	19	125 days	bench

PROCESS/PRODUCT OPERATION:

- microbial biodegradation
- aeration
- laboratory microscosm studies

DARAMEND products are prepared from naturally occurring botanical materials which are processed to achieve soil-specific nutrient profiles and nutrient-release kinetics. These amendments serve as reaction surfaces for contact between microorganisms and the contaminants. Increased microbial activity is accomplished by improving nutrient status, biologically available water, and surfaces for microbial adhesion.

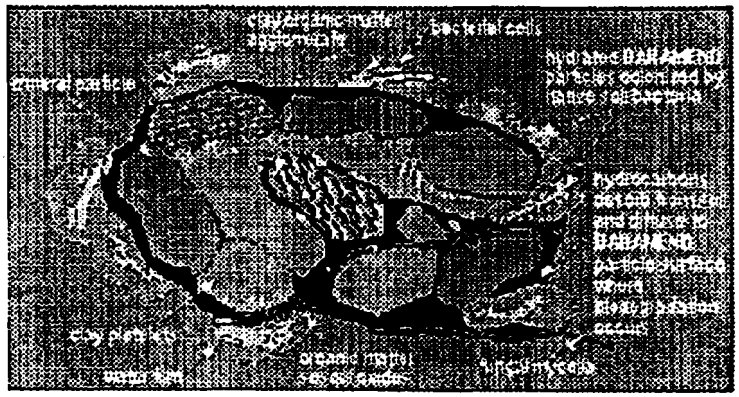

Figure 2: The DARAMEND Product

In an ex-situ treatment, contaminated soil excavated from the site can be kept in climate-controlled greenhouses for year-round remediation (see Fig. 1). The soil is tilled periodically to provide aeration and to redistribute **DARAMEND** particles and water though the soil or sediment. In-situ treatments are also possible; a special tiller is used that provides deep penetration of the soil. In both methods, moisture content is constantly monitored and maintained with irrigation systems.

Laboratory microcosm studies are conducted concurrently with field-scale treatment to provide near real-time monitoring of field-scale treatment progress Microcosms are prepared with a variety of

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treatment modifications to in-process fine-tuning of the treatment.

When applied to pesticides, the aerobic **DARAMEND** bioremediation technology is modified to cycle between *anoxic* and *oxic* phases, which, sequentially, reductively dechlorinate the chlorinated organics and then aerobically mineralize the dechlorinated organics. Bench scale trials have been completed; field trials are underway in South Carolina and Ontario. The new reductive dechlorination technology provides an effective approach to treatment of soil containing even very refractory chlorinated compounds such as the pesticides Toxaphene and DDT.

VENDOR INFORMATION:

Grace Bioremediation Technologies - Div. of W.R. Grace & Co. of Canada Ltd.
3451 Erindale Station Rd., P.O. Box 3060, Station A,
Mississauga, Ontario, Canada L5A 3T5
Tel: (905) 272-7480
Fax: (905) 272-7472

DARAMEND bioremediation technology was developed by W.R.Grace of Canada under the sponsorship of the Government of Canada. Grace Bioremediation Technologies has acquired the sole license for worldwide application of the technology. The **DARAMEND** technology is covered by issued, allowed, and pending patents.

The U.S. EPA (SITE Program) and Environment Canada (DESRT Program) have completed independent evaluations of the technology. Reports from these evaluations, both of which verify the technology's effectiveness, are available from the EPA, Environment Canada or Grace.

Grace Bioremediation Technologies can provide bench-scale treatability tests, remedial design, implementation, operation and maintenance services. The technology has also been implemented through collaboration with site owners and environmental engineering/consulting firms.

Profile Print Date: 12/96
Catalogue # 01-010H

Back to Listing

DARAMEND Toxicity Studies Excerpts

Attached is the text about the toxicity level of DARAMEND-treated soil from the AEC report on the "bake-off" done at Joliet AAP:

4.2.5 Toxicity

The results of toxicity testing *(Ceriodaphnia dubia,* Ames Mutagenicity, and MicroTox®) of samples collected on Day 120 are discussed for each test pile. It was the purpose of these tests to gauge the toxicity of the final treatment mixture, because this is a measure of the success of the technology. The toxicity of each of the technology piles was compared to the corresponding control pile to determine if that technology had a significant effect on the toxicity.

Of the results obtained from testing the toxicity of *Ceriodaphnia dubi*a, the reproductive inhibition concentration 25 (IC-25) is presented in the technology sections. The IC-25 describes the concentration that results in a 25 percent decrease in reproduction. It is presented rather than the no-observed-effect concentration (NOEC) because it can vary from 0 to 100, while the NOEC values are limited to the concentrations tested. This is useful for correlating toxicity results with chemical data. Samples with higher values are less likely to cause significant environmental impact, because a higher concentration of these samples are needed to have a toxic effect.

Ames testing was conducted using *Salmonella typhimurium* in order to determine whether or not the treated soil sample had mutagenic properties. No mutagenic properties were observed in any of the samples.

MicroTox® tests were used to examine the toxic effects of the treated soil sample extract on bacteria *(Vibrio fischeri*). Emission concentration 50 (EC-50) is the concentration that causes a light emission 50 percent lower than that of the control after 15 minutes of exposure to soil extract. Negative impacts are associated with a reduction in light output by the bacteria during the exposure periods; thus, a higher value indicates a less toxic sample.

Grace Bioremediation Technologies – DARAMEND Technology

8.2.5 Toxicity

8.2.5.1 TNT Run

As discussed in Section 4.2.5, a sample collected from the GRACE pilot phase TNT pile on Day 120 was subjected to the following toxicity tests: *Ceriodaphnia dubi*a, Ames Mutagenicity, and MicroTox®. This testing produced the following results:

- Reproduction IC-25 was 15.5 percent (i.e., a concentration of 15.5 percent extract decreased reproduction by 25 percent).
- Ames testing showed no mutagenetic properties.

- The EC-50 was greater than 90.0 percent (i.e., a concentration of greater than 90.0 percent was required to cause a 50 percent reduction in light emission).

The results of the *Ceriodaphnia dubia* and MicroTox® tests for the GRACE Day 120 sample from the TNT pile are shown graphically in Figure 8-15, along with the results from the TNT control pile.

As indicated on the figure, for both tests a greater concentration of extract was needed to cause a response in the GRACE-treated TNT soil than in the TNT control pile. Thus, the GRACE sample toxicity was lower than that of the control pile.

8.2.5.2 Tetryl Run

As discussed in Section 4.2.5, a sample collected from the GRACE pilot phase tetryl pile on Day 120 was subjected to the following toxicity tests: *Ceriodaphnia dubia*, Ames Mutagenicity, and MicroTox®. This testing produced the following results:

- The reproduction IC-25 was 16.8 percent (i.e., a concentration of 16.8 percent extract decreased reproduction by 25 percent).
- Ames testing showed no mutagenetic properties.
- The EC-50 was greater than 90.0 percent (i.e., a concentration of greater than 90.0 percent was required to cause a 50 percent reduction in light emission).

The results of the *Ceriodaphnia dubia* and MicroTox® tests for the GRACE Day 120 sample from the tetryl pile are shown graphically in Figure 8-15, along with the results from the tetryl control pile. As shown, for both tests a greater concentration of extract was needed to cause a response in the GRACE-treated tetryl soil than in the tetryl control pile. Thus, the GRACE sample toxicity was lower than that of the control pile.

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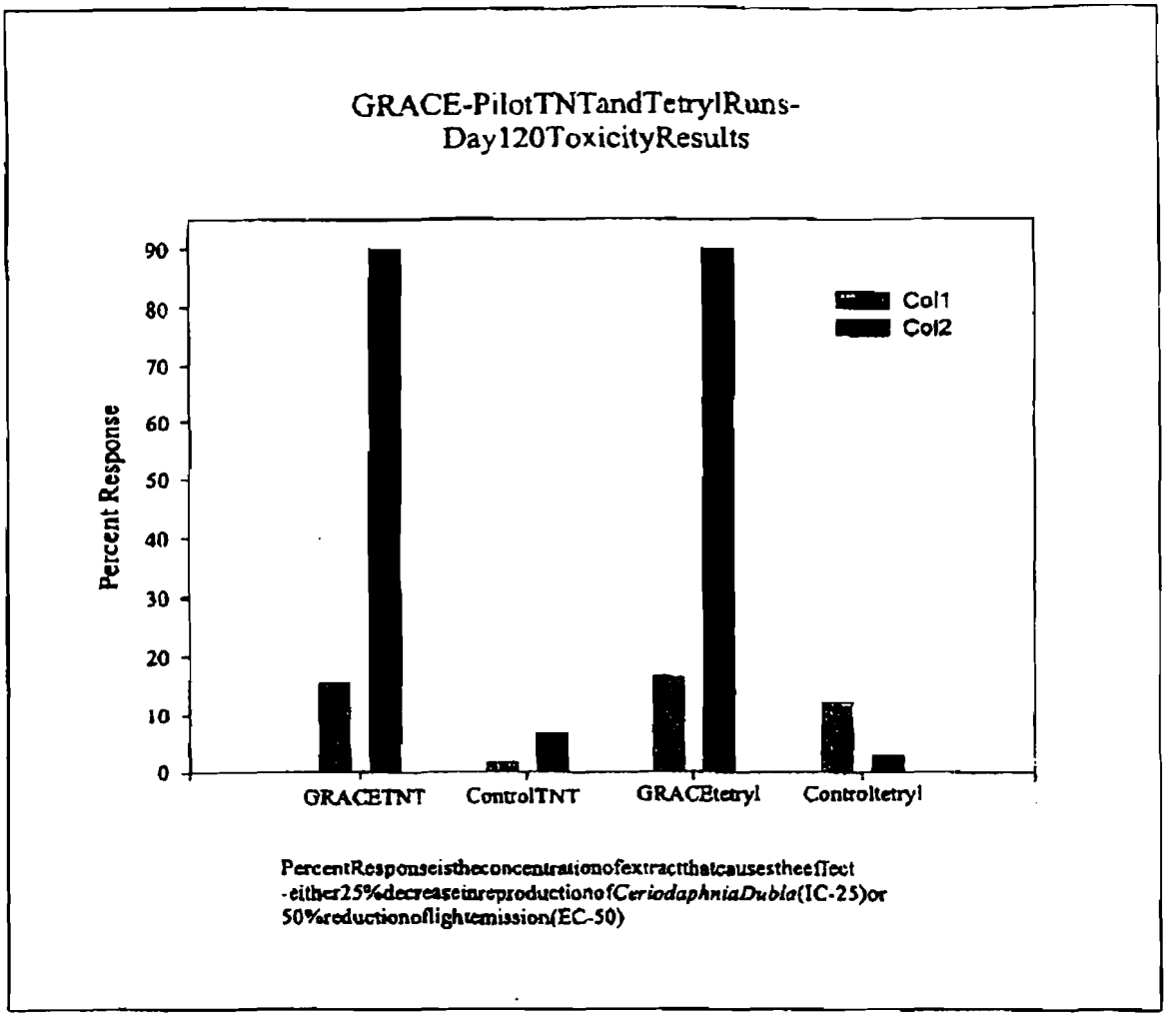

FIGURE8-15:GRACE-PILOTTNTANDTETRYLRUNS-DAY120TOXICITIES

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APPENDIX E

DARAMEND Treatment Studies
Pantex Bench-Scale Treatability Study Data
Yorktown Naval Weapons Station Full-Scale Treatment

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BACKGROUND

DARAMEND® bioremediation was successfully demonstrated at full-scale on soil containing organic explosive compounds at Yorktown Naval Weapons Station (WPNSTA) in Yorktown, Virginia. This demonstration was sponsored by the US Navy, through the Naval Facilities Engineering Service Center (NFESC), the Naval Facilities Engineering Command – Atlantic Division (LANTDIV), and WPNSTA Yorktown. This demonstration represents the first successful full-scale, on-site application of solid-phase bioremediation, other than composting, to soil containing high concentrations of organic explosives.

SITE INFORMATION

Soil was excavated from a former munitions manufacturing facility (Site 6) at WPNSTA Yorktown. Process and wash water from the facility had carried TNT, RDX, HMX, and other organic explosive compounds into an impoundment adjacent to the plant. Soil from the impoundment was excavated and transported to an on-site, 1,200 ton capacity, HDPE-lined, engineered bioremediation cell (EBC) (Figure 1 & Figure 2) which was covered with a steel/transparent polyethylene structure (greenhouse) to prevent entry of precipitation (Figure 3). DARAMEND® treatment of the soil was initiated in August of 1999 and completed early in 2000.

DARAMEND® BIOREMEDIATION

DARAMEND® bioremediation technology was developed by W. R. Grace & Co. for bioremediation of a wide range of recalcitrant organic compounds and, over the past 5 years, has been successfully applied to more than 100,000 tons of soil. The application of DARAMEND® bioremediation to soils and sediments impacted with organic explosives involves the repeated and sequential application of anoxic and oxic conditions, as follows.

1. Generation of strong reducing (anoxic) conditions through the application of 2% (w/w) DARAMEND® 6390 and 0.2% (w/w) powdered iron (Figure 4).
2. Amendments are incorporated using a deep rotary tiller and standard agricultural tractor.
3. Irrigation of the amended soil to increase soil moisture to approximately 80% of the soil water holding capacity.
4. Subsequent generation of oxic (aerobic) conditions through repeated tillage (aeration).
5. Repeat steps 1 to 4 as required.

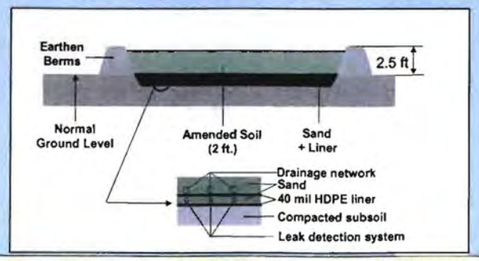

Figure 1. Schematic showing cross sectional detail of engineered bioremediation cell within the greenhouse at WPNSTA Yorktown

Figure 2. Engineered bioremediation cell (under construction) at WPNSTA Yorktown

Figure 3. Engineered bioremediation cell (complete) at WPNSTA Yorktown

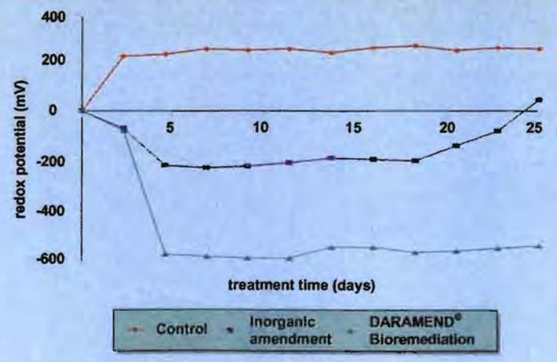

Figure 4. Influence of DARAMEND bioremediation on soil redox potentials during anoxic (reductive) phase of each treatment cycle

RESULTS and DISCUSSION

Analysis of soil samples collected from the EBC prior to initiation of treatment indicated that the soil had a total organic explosive compound concentration of 11,369 mg/kg, with the primary contaminants being TNT and RDX at concentrations of 10,151 mg/kg and 210 mg/kg, respectively. The remedial goals for TNT and RDX were 15 mg/kg and 5 mg/kg, respectively.

The EBC was divided into 10 sampling zones. Soil samples for explosives analysis were prepared by blending five core samples (0 - 2 ft) from each zone. Samples were collected at regular intervals, usually following each treatment cycle. Results indicated that concentrations of all organic explosive compounds were sharply reduced during treatment. The remedial goals were attained following completion of 14 treatment cycles (Table 1). At the conclusion of treatment, the concentration of TNT had been reduced from 10,151 mg/kg to 6.2 mg/kg, representing a removal efficiency of 99.9% (Figure 5). The concentration of RDX was reduced from a mean of 210 mg/kg to 3 mg/kg, for a removal efficiency of 98.6% (Figure 6).

Soil analysis also revealed sharp declines in total explosive compound concentrations and total amino-DNT concentrations (Table 1).

Table 1. Influence of DARAMEND® bioremediation on the concentration of various organic explosive compounds in Site 6 soils at WPNSTA Yorktown

Compound	Concentration (mg/kg)		Removal Efficiency (%)
	Initial	Final	
TNT	10,151	6.2	99.9
RDX	210	3	98.6
HMX	52	nd[1]	>99.5
Amino-DNT	1,001	13	98.7
Total Explosives	11,369	23	99.8

1. nd – below method detection limit of 0.5 mg/kg.

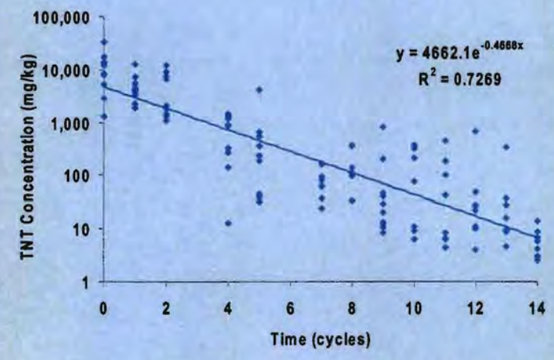

Figure 5. Influence of DARAMEND bioremediation on the concentration of TNT in Site 6 soils at WPNSTA Yorktown

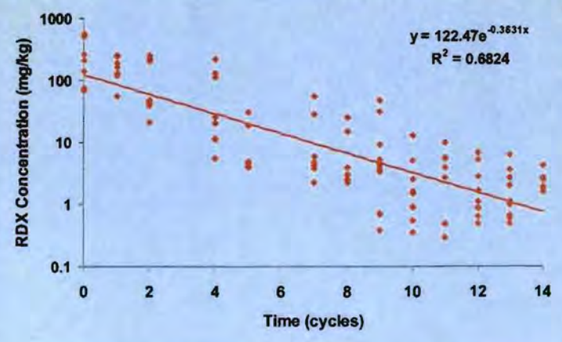

Figure 6. Influence of DARAMEND bioremediation on the concentration of RDX in Site 6 soils at WPNSTA Yorktown

ADVANTAGES OF DARAMEND® BIOREMEDIATION

When compared with other bioremediation technologies DARAMEND® bioremediation offers the following advantages:

1. Little, if any, bulking occurs as relatively small quantities of DARAMEND® amendment are required (i.e., 0.2% – 2% (w/w) per cycle). When treatment is complete soil can generally be re-compacted to its original volume.
2. DARAMEND® bioremediation is flexible in that it can be applied to soil in place (i.e., without excavation) or *ex-situ*, using an EBC or windrows.
3. Highly contaminated soil is amenable to DARAMEND® bioremediation and, in contrast to composting and slurry technologies, soil is treated at full strength without dilution.
4. DARAMEND® bioremediation uses defined amendments that are dry, odor and pathogen free, easily transported and readily available.
5. DARAMEND® bioremediation can be implemented at a lower cost than alternatives.

CONCLUSIONS

DARAMEND® bioremediation was successfully applied to soils excavated from Site 6 at WPNSTA Yorktown. Although slight delays associated with weather (hurricanes Floyd and Gert) extended the time required for treatment, the concentrations of target compounds were reduced to below the remedial goals in all ten sampling zones. A second 1,200 ton batch of soil is currently undergoing treatment at WPNSTA Yorktown and Grace expects treatment of a third batch to be initiated in the third quarter of 2001.

CONTACT INFORMATION:

GRACE Bioremediation Technologies
3465 Semenyk Ct., 2nd Floor
Mississauga, Ontario
Canada L5C 4P9
Ph: (905) 273-5374
Fx: (905) 273-4367

Pantex Bench-Scale Treatability Study Data

Pantex Treatability Study

In early July, 1998 Grace endeavored to conduct a treatability study to evaluate the effectiveness of DARAMEND bioremediation on organic explosive impacted soil from the Pantex Plant in Amarillo, TX.

Two treatability investigations were initiated on 17 July, 1998 to collect data on contaminant removal efficiency for Pantex soil under a variety of DARAMEND treatment protocols. The first study included treatments that are cycled between anoxic and oxic conditions. The second study included treatments that are maintained under anoxic conditions at all times. Treatment variables include the composition and application rates of DARAMEND soil amendments, and application rates of inorganic supplements. Appropriate controls were also included for both studies. In both studies, key operating parameters (soil pH, redox and moisture content) were maintained within desired ranges.

Analytical Results

Analytical results from samples taken following 194 days of treatment indicated that there were significant reductions in the concentrations of organic explosive compounds in response to DARAMEND treatment. In the most effective DARAMEND treatment of the cycled study, concentrations of RDX and total explosives were reduced from the initial values of 21,325 mg/kg and 28,408 mg/kg to 55 mg/kg and 88 mg/kg, respectively. This corresponds to a 99.7% reduction in total explosives.

In the most effective DARAMEND treatment of the purely anoxic study, concentrations of RDX and total explosives have been reduced from the initial values of 21,325 mg/kg and 28,408 mg/kg to 3.3 mg/kg and 13.3 mg/kg, respectively. This corresponds to > 99.9% reduction in total explosives.

No accumulation of products of partial TNT degradation (i.e., aromatic amino compounds) were observed in soil subjected to any of the DARAMEND treatment protocols.

Analytical results also indicated that concentrations of explosive compounds in the control microcosms decreased. The average concentration of total explosive compounds in the control following 194 days of treatment was 16,970 mg/kg and 15,981 mg/kg in the cycled and purely anoxic studies, respectively. Further details are provide in Appendix ?

Table 7. Influence of cycled DARAMEND® treatment (study 1039-1) on total explosive compound concentrations in Pantex soil.

PROTOCOL	Total Explosive Compounds (mg/kg)				
Time	Initial	40 days	88 days	129 days	194 days
Control	28,408	16,787	11,922	7,696	16,844
DARAMEND 1	28,408	12,511	3,575	281	86.5
DARAMEND 4	28,408	13,826	N/A	590	N/A
$LSD_{(0.05)}$		2,262	6,361	4,492	7,772

N/A - not analyzed.
$LSD_{(0.05)}$ = least significant difference at the 95% level of confidence.

Table 8. Influence of cycled DARAMEND® treatment (study 1039-1) on RDX concentrations in Pantex soil.

PROTOCOL	RDX (mg/kg)				
Time	Initial	40 days	88 days	129 days	194 days
Control	21,325	12,867	9,324	5,903	12,948
DARAMEND 1	21,325	11,067	3,082	172	54.8
DARAMEND 4	21,325	12,000	N/A	340	N/A
$LSD_{(0.05)}$		2,116	5,352	4,564	3,307

N/A - not analyzed.
$LSD_{(0.05)}$ = least significant difference at the 95% level of confidence.

Table 9. Influence of cycled DARAMEND® treatment (study 1039-1) on HMX concentrations in Pantex soil.

PROTOCOL	HMX (mg/kg)				
Time	Initial	40 days	88 days	129 days	194 days
Control	2,820	1,510	1,081	677	1,563
DARAMEND 1	2,820	1,317	470	99.6	24.4
DARAMEND 4	2,820	1,563	N/A	245	N/A
$LSD_{(0.05)}$		230	629	512	384

N/A - not analyzed.
$LSD_{(0.05)}$ = least significant difference at the 95% level of confidence.

Table 10. Influence of cycled DARAMEND® treatment (study 1039-1) on 2,4,6-trinitrotoluene (TNT) concentrations in Pantex soil.

PROTOCOL	TNT (mg/kg)				
Time	Initial	40 days	88 days	129 days	194 days
Control	4,263	2,410	1,516	1,116	2,333
DARAMEND 1	4,263	128	BDL	9.73	7.24
DARAMEND 4	4,263	263	N/A	4.62	N/A
$LSD_{(0.05)}$		278	805	546	367

N/A - not analyzed.
BDL- below detection limit of 4.60 mg/kg.
$LSD_{(0.05)}$ = least significant difference at the 95% level of confidence.

Table 3. Influence of anoxic DARAMEND® treatment (study1039-2) on total explosive compound concentrations in Pantex soil.

PROTOCOL	Total Explosive Compounds (mg/kg)			
Time	Initial	40 days	88 days	194 days
Control	28,408	17,767	13,180	15,970
DARAMEND 1	28,408	11,244	960	13.8
DARAMEND 4	28,408	13,286	N/A	N/A
$LSD_{(0.05)}$		2,575	5,044	3,054

N/A - not analyzed.
$LSD_{(0.05)}$ = least significant difference at the 95% level of confidence.

Table 4. Influence of anoxic DARAMEND® treatment (study 1039-2) on RDX concentrations in Pantex soil.

PROTOCOL	RDX (mg/kg)			
Time	Initial	40 days	88 days	194 days
Control	21,325	13,500	10,218	12,321
DARAMEND 1	21,325	9,530	572	3.24
DARAMEND 4	21,325	11,500	N/A	N/A
$LSD_{(0.05)}$		2,210	4,355	3,008

N/A - not analyzed.
$LSD_{(0.05)}$ = least significant difference at the 95% level of confidence.

Table 5. Influence of anoxic DARAMEND® treatment (study 1039-2) on HMX concentrations in Pantex soil.

PROTOCOL	HMX (mg/kg)			
Time	Initial	40 days	88 days	194 days
Control	2,820	1,577	1,163	1,523
DARAMEND 1	2,820	1,400	386	5.92
DARAMEND 4	2,820	1,367	N/A	N/A
$LSD_{(0.05)}$		253	539	349

N/A - not analyzed.
$LSD_{(0.05)}$ = least significant difference at the 95% level of confidence.

Table 6. Influence of anoxic DARAMEND® treatment (study 1039-2) on 2,4,6 - trinitrotoluene (TNT) concentrations in Pantex soil.

PROTOCOL	TNT (mg/kg)			
Time	Initial	40 days	88 days	194 days
Control	4,263	2,690	1,799	2,126
DARAMEND 1	4,263	314	BDL	3.33
DARAMEND 4	4,263	419	N/A	N/A
$LSD_{(0.05)}$		486	667	261

N/A - not analyzed.
BDL – Below detection limit of 4.60,mg/kg
$LSD_{(0.05)}$ = least significant difference at the 95% level of confidence.

Table 12. Influence of cycled DARAMEND® treatment (study 1039-1) on explosive compound concentrations in leachate from Pantex soil following 194 days of treatment.

COMPOUND/PROTOCOL	CONCENTRATION (mg/L)	
PROTOCOL	CONTROL	DARAMEND 1
1,3,5-Trinitrobenzene	3.13	<0.06
1,3-Dinitrobenzene	<1.20	<0.06
2,4,6-Trinitrotoluene	47.3	0.12
2,4-Dinitrotoluene	<2.60	<0.13
2,6-Dinitrotoluene	<1.20	<0.06
2-Amino-4,6-dinitrotoluene	<2.60	<0.13
2-Nitrotoluene	<1.20	<0.06
3-Nitrotoluene	<1.20	<0.06
4-Amino-2,6-dinitrotoluene	<2.60	0.03
4-Nitrotoluene	<2.60	<0.13
HMX	2.87	0.14
Nitrobenzene	<1.20	<0.06
RDX	28.5	1.55
Tetryl	<2.60	<0.13
Total Explosive Compounds	81.8	1.84

N/A - not analyzed.
RDX $LSD_{(0.05)}$ = 18.0 mg/kg
HMX $LSD_{(0.05)}$ = 2.18 mg/kg
TNT $LSD_{(0.05)}$ = 29.5 mg/kg
Total Explosives $LSD_{(0.05)}$ = 49.5 mg/kg

Table 11. Influence of anoxic DARAMEND® treatment (study 1039-2) on explosive compound concentrations in leachate from Pantex soil following 194 days of treatment.

COMPOUND/PROTOCOL	CONCENTRATION (mg/L)	
PROTOCOL	CONTROL	DARAMEND 1
1,3,5-Trinitrobenzene	<1.20	$<1.20 \times 10^{-3}$
1,3-Dinitrobenzene	<1.20	$<1.20 \times 10^{-3}$
2,4,6-Trinitrotoluene	38.4	3.40×10^{-3}
2,4-Dinitrotoluene	<2.60	$<1.20 \times 10^{-3}$
2,6-Dinitrotoluene	<1.20	$<1.20 \times 10^{-3}$
2-Amino-4,6-dinitrotoluene	0.12	7.00×10^{-4}
2-Nitrotoluene	<2.60	$<2.60 \times 10^{-3}$
3-Nitrotoluene	<2.60	$<2.60 \times 10^{-3}$
4-Amino-2,6-dinitrotoluene	<1.20	7.0×10^{-4}
4-Nitrotoluene	<2.60	$<2.60 \times 10^{-3}$
HMX	2.62	$<2.60 \times 10^{-3}$
Nitrobenzene	<1.20	$<1.20 \times 10^{-3}$
RDX	25.3	$<2.60 \times 10^{-3}$
Tetryl	<2.60	$<2.60 \times 10^{-3}$
Total Explosive Compounds	66.3	4.80×10^{-3}

N/A - not analyzed.
Total Explosives $LSD_{(0.05)}$ = 10.4 mg/kg
TNT $LSD_{(0.05)}$ = 7.52 mg/kg

Yorktown Naval Weapons Station Full-Scale Treatment

Results and Discussion from Yorktown Naval Weapons Station

Analysis of soil samples collected from the EBC prior to initiation of treatment indicated that the soil had a total organic explosive compound concentration of 11,369 mg/kg, with the primary contaminants being TNT and RDX at concentrations of 10,151 mg/kg and 210 mg/kg, respectively. The remedial goals for TNT and RDX were 15 mg/kg and 5 mg/kg, respectively.

The EBC was divided into 10 sampling zones. Soil samples for explosives analysis were prepared by blending five core samples (0 - 2 ft) from each zone. Samples were collected at regular intervals, usually following each treatment cycle. Results indicated that concentrations of all organic explosive compounds were sharply reduced during treatment. The remedial goals were attained following completion of 14 treatment cycles (Table 1). At the conclusion of treatment, the concentration of TNT had been reduced from 10,151 mg/kg to 6.2 mg/kg, representing a removal efficiency of 99.9% (Figure 1). The concentration of RDX was reduced from a mean of 210 mg/kg to 3 mg/kg, for a removal efficiency of 98.6% (Figure 2).

Soil analysis also revealed sharp declines in total explosive compound concentrations and total amino-DNT concentrations (Table 1).

Table 1. Influence of DARAMEND® bioremediation on the concentration of various organic explosive compounds in Site 6 soils at WPNSTA Yorktown

Compound	Concentration (mg/kg)		Removal Efficiency (%)
	Initial	Final	
TNT	10,151	6.2	99.9
RDX	210	3	98.6
HMX	52	nd[1]	N/A
Amino-DNT	1,001	13	98.7
Total Explosives	**11,369**	**23**	**99.8**

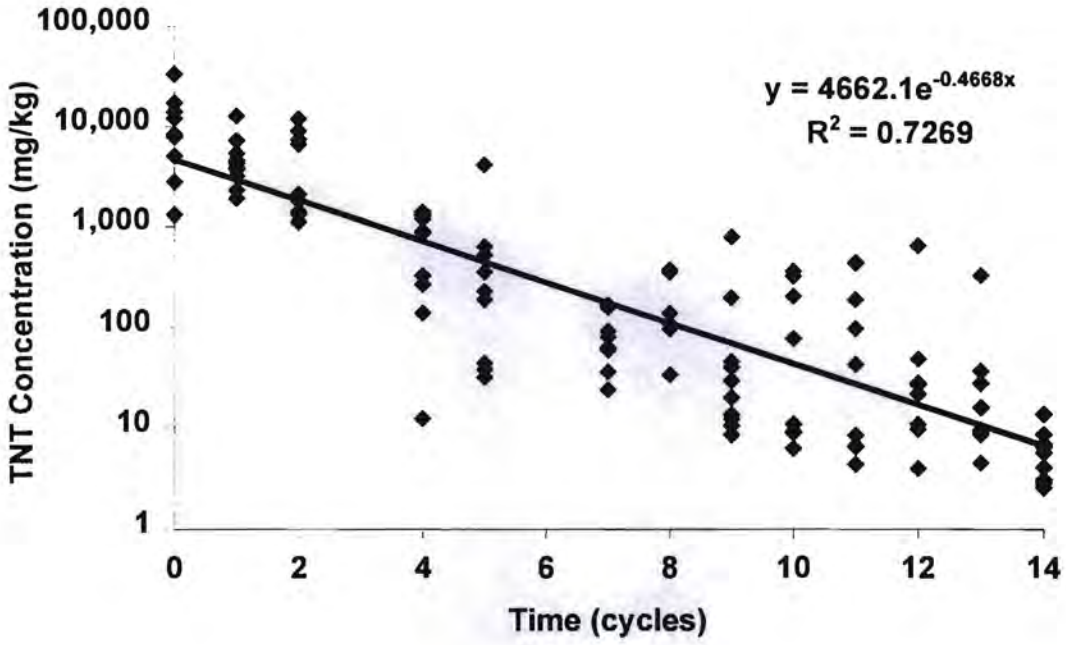

Figure 1. Influence of DARAMEND bioremediation on the concentration of TNT in Site 6 soils at WPNSTA Yorktown.

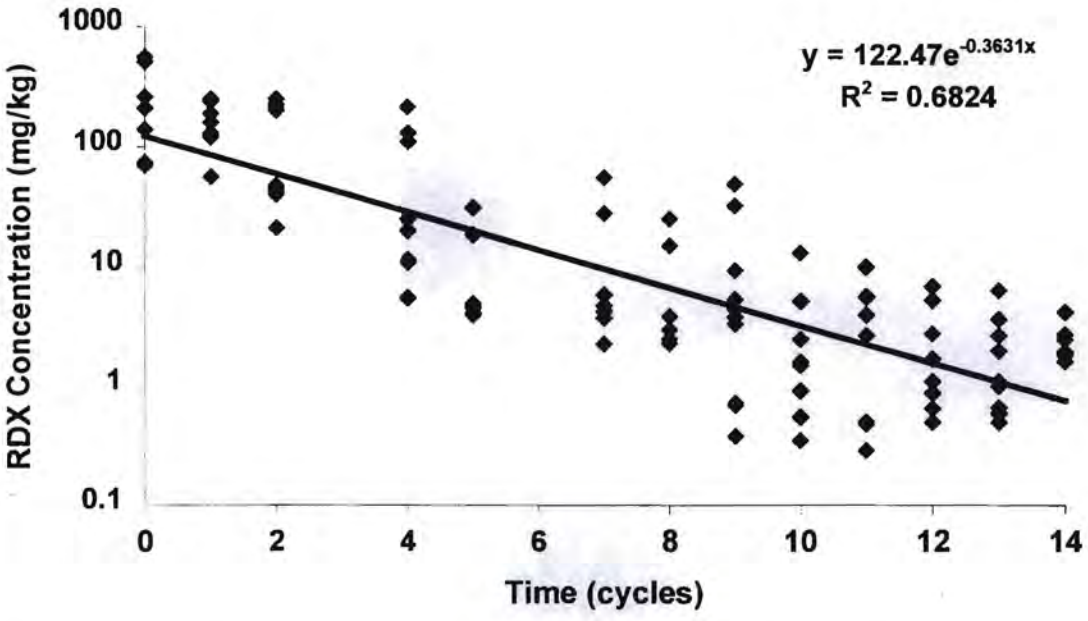

Figure 2. Influence of DARAMEND bioremediation on the concentration of RDX in Site 6 soils at WPNSTA Yorktown.

Parameter	Initials										
	All values reported in ug/kg										
Concentration (ug Grid #	1	2	3	4	5	6	7	8	9	10	Mean
1,3,5-trinitrobenzene											
1,3-dinitrobenzene											
2,4,6-trinitrotoluene	**14,000,000**	**7,900,000**	**12,000,000**	**17,000,000**	19,000	**5,100,000**	**33,000,000**	**1,300,000**	**8,400,000**	**2,800,000**	**10,151,900**
2,4-dinitrotoluene					4,100						
2,6-dinitrotoluene											
2-amino-4,6-dinitrotolue	940,000	500,000	1,100,000	1,400,000	445	590,000	1,200,000	88,000	980,000	230,000	702,845
2-nitrotoluene											
3-nitrotoluene											
4-amino-2,6-dinitrotolue	450,000	270,000	460,000	520,000	390	240,000	570,000	26,000	330,000	120,000	298,639
4-nitrotoluene											
HMX					52,000						
nitrobenzene											
RDX	140,000	**260,000**	**260,000**	210,000	**485**	510,000	**560,000**	12,000	74,000	**70,000**	**209,649**
tetryl											
Total amino-DNTs	1,390,000	770,000	1,560,000	1,920,000	835	830,000	1,770,000	114,000	1,310,000	350,000	1,001,484
Total DNTs	0	0	0	0	4,100	0	0	0	0	0	
Total Explosives	15,530,000	8,930,000	13,820,000	19,130,000	76,420	6,440,000	35,330,000	1,426,000	9,784,000	3,220,000	11,368,642

Notes:
All blank cells represent compounds reported as Non-Detect

Parameter	Cycle 14										
	All values reported in ug/kg										
Concentr Grid #	1	2	3	4	5	6	7	8	9	10	Mean
1,3,5-trinitrobenzene											
1,3-dinitrobenzene											
2,4,6-trinitroto	4,121	6,543	3,098	7,040	2,568	5,726	8,753	2,877	14,400	6,787	6,191
2,4-dinitrotoluene											
2,6-dinitrotoluene											
2-amino-4,6-dini	5,060	28,780	2,674	2,930	1,316	12,490	1,335	2,930	28,580	13,920	10,002
2-nitrotoluene											
3-nitrotoluene											
4-amino-2,6-dinitrotoluene			2,162	3,051	1,203	6,813	1,020	2,152	11,060	6,825	4,286
4-nitrotoluene											
HMX											
nitrobenzene											
RDX	2,761	1,847	8,000	4,285	2,500	1,630	2,500	2,500	2,500	1,966	3,049
tetryl											
Total amino-DNTs	5,060	28,780	4,836	5,981	2,519	19,303	2,355	5,082	39,640	20,745	13,430
Total DNTs	0	0	0	0	0	0	0	0	0	0	
Total Explosives	11,942	37,170	15,934	17,306	7,587	26,659	13,608	10,459	56,540	29,498	22,670

Notes:
Values meeting RG are shown in RED
All blank cells represent compounds reported as Non-Detect

APPENDIX F

DARAMEND Explosives Treatment Preliminary Procedures Manual