N00174.AR.000114
NSWC INDIAN HEAD
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Placement and Treatability Study Report for Removal of Mercury-Contaminated Soil

for

Site 8 - Nitroglycerin Plant Office Indian Head Division Naval Surface Warfare Center

Indian Head, Maryland

Northern Division
Naval Facilities Engineering Command

Contract Number N62472-90-D-1298
Contract Task Order 0099

August 1993

Halliburton NUS
CORPORATION

R-06-93-6

PLACEMENT AND TREATABILITY STUDY REPORT FOR REMOVAL OF MERCURY-CONTAMINATED SOIL AT SITE 8 - NITROGLYCERIN PLANT OFFICE INDIAN HEAD DIVISION, NAVAL SURFACE WARFARE CENTER INDIAN HEAD, MARYLAND

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Chesapeake Division
Environmental Branch Code 18
Naval Facilities Engineering Command
Washington Navy Yard, Building 212
Washington, D.C. 20374-2121

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CONTRACT NUMBER N62472-90-D-1298
CONTRACT TASK ORDER 0099

AUGUST 1993

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1.0 INTRODUCTION

A Placement and Treatability Study (Study) was preformed under Contract Task Order (CTO) 0099, under the Comprehensive Long-Term Environmental Action Navy (CLEAN), Contract Number N62472-90-D-1298. Under CTO No. 0099, Halliburton NUS is providing engineering and design services, and will provide construction phase services for removal of mercury contaminated sediment/soil at Site 8 - Nitroglycerin Plant Office (Site 8) at the Indian Head Division, Naval Surface Control Center (NSWC) in Indian Head, Maryland. The Placement and Treatability Study was conducted by Halliburton NUS Corporation (Halliburton NUS) under Subtask 1.2 of CTO 0099. The Study was performed to develop, evaluate and select specific chemical stabilization formulas (mixtures) and placement procedures to place mercury-contaminated sediment/soil from Site 8 on NSWC property. This Placement and Treatability Study Report presents the results of that study. The information presented in this report will be used in subsequent design work under CTO 0099.

1.1 BACKGROUND INFORMATION

Site 8 - Nitroglycerin Plant Office (Site 8) is a Navy Installation Restoration Program (IRP) site at the Indian Head Division, Naval Surface Warfare Center (NSWC) in Indian Head, Maryland. Halliburton NUS recently performed environmental investigative work at Site 8 under CTO 0064.

As part of that investigative work under CTO 0064, Halliburton NUS performed a Site Characterization Study (SC Study). During the SC Study, more than 200 sediment/soil samples were collected and analyzed for total mercury, and the nature and extent of mercury contamination was defined. TCLP metal analysis were also performed on three sediment/soil samples that were determined to have relatively high concentrations of total mercury. Mercury was not detected in the TCLP leachate analysis at concentrations above the regulatory hazardous waste level (200 ug/L); therefore, the sediment/soil was determined to be classified as nonhazardous.

Under CTO 0064 the analytical information obtained during the SC Study was used to perform an Engineering Evaluation/Cost Analysis (EE/CA). The subsequent EE/CA Report (Halliburton NUS, January 1993) recommended an interim removal action to address mercury contamination in the Upper Section of Stream area of Site 8. The selected interim removal action consisted of excavation and removal of mercury contaminated sediment/soil from the Upper Section of Stream, stabilizing it as necessary, and placing it in an earthen berm or other earthen embankment structure within the NSWC.

1.2 STUDY PURPOSE

The purpose of the Placement and Treatability Study was to evaluate the leachability of mercury in the sediment/soil, develop a stabilization formula as necessary and appropriate for the sediment/soil, and evaluate and select sediment/soil placement procedures. The Study was performed to specifically address the mercury contaminated sediment/soil that will be excavated from the Upper Section of Stream from Site 8 as part of an interim removal action. The result of the Study are presented in this report and will be the basis for CTO 0099 design work.

1.3 STUDY APPROACH

The Study was performed in accordance with the Placement and Treatability Study work plan that was prepared by Halliburton NUS and submitted to the Navy on April 30, 1993. The Study consisted of both a Treatability Study Task and a Placement Study Task. The initial work under both tasks was a Document Review/Literature Search and the collection of sediment/soil samples. However, the subsequent work varied dramatically between the treatability and placement tasks.

After the Initial Document review, the next work performed under the Treatability Study Task was to review the previously analytical work performed at Site 8. Previous analytical work performed on the sediment/soil from the Upper Section of Stream indicated that mercury did not leach from the sediment/soil at concentrations above the level necessary to classify the material as a hazardous waste. Therefore the material would be classified as nonhazardous. The first analytical work of the Treatability Study task was to evaluate the nonhazardous classification. If it was determined that sediment/soil is not classified as a hazardous waste chemical treatment (chemical stabilization) would not be necessary or appropriate.

After the Initial Document Review, alternative placement procedures were identified and evaluated during the Placement Study task to safely place the sediment/soil at the NSWC.

1.4 REPORT ORGANIZATION

The Placement and Treatability Study Report consists of the following sections:

- Section 1.0 - Introduction
- Section 2.0 - Study Approach and Initial Work
- Section 3.0 - Treatability Study Task

- Section 4.0 - Placement Study Task
- Section 5.0 - Conclusions and Recommendations

Section 1.0 presents an introduction and background information. Section 2.0 provides an overview of the overall Study and the Initial Work performed during the Placement and Treatability Study. This Initial Work includes the Document Review, and sample collection. Section 3.0 discusses the Treatability Study Task. Section 4.0 provides information on the Placement Study Task. Section 5.0 presents the Conclusions and Recommendations that will be the basis for subsequent design.

2.0 STUDY APPROACH AND INITIAL STUDY WORK

As previously described, the study consisted of two separate tasks--treatability and placement. Initial work on both tasks consisted of review of documents and sample collection. Task-specific work was then performed. Because the Placement Study Task could not be completed until the stabilization method was known and the placement area was identified, the Treatability Study Task was performed first.

2.1 DOCUMENT REVIEW

Halliburton NUS reviewed the following types of reports as part of the document review for the study: (1) previous NSWC reports regarding Site 8; (2) reports and guidance documents on chemical stabilization of metals; and (3) waste containment and encapsulation reports.

The previous reports on Site 8 include the Draft Mercury Speciation Study Report (E.C. Jordan, July 1990) and the Engineering Evaluation/Cost Analysis (EE/CA) Report (Halliburton NUS, January 1993). These reports were reviewed by the project team to examine relevant information obtained during previous investigations at Site 8.

Reports and Guidance Documents on chemical stabilization of metals were reviewed to identify procedures that have been utilized at similar projects and to evaluate their applicability to this project. Halliburton NUS scientists and engineers with expertise and experience with stabilization of mercury from were also consulted on the subject of stabilization and mercury contamination sources on chemical stabilization of metals consulted include:

- Chemical Fixation and Solidification of Hazardous Wastes, Jesse R. Conner, 1990.
- Standard Handbook of Environmental Engineering, Robert A. Corbit, 1989.
- Solidification and Stabilization of Wastes Using Portland Cement, Portland Cement Association, 1991.

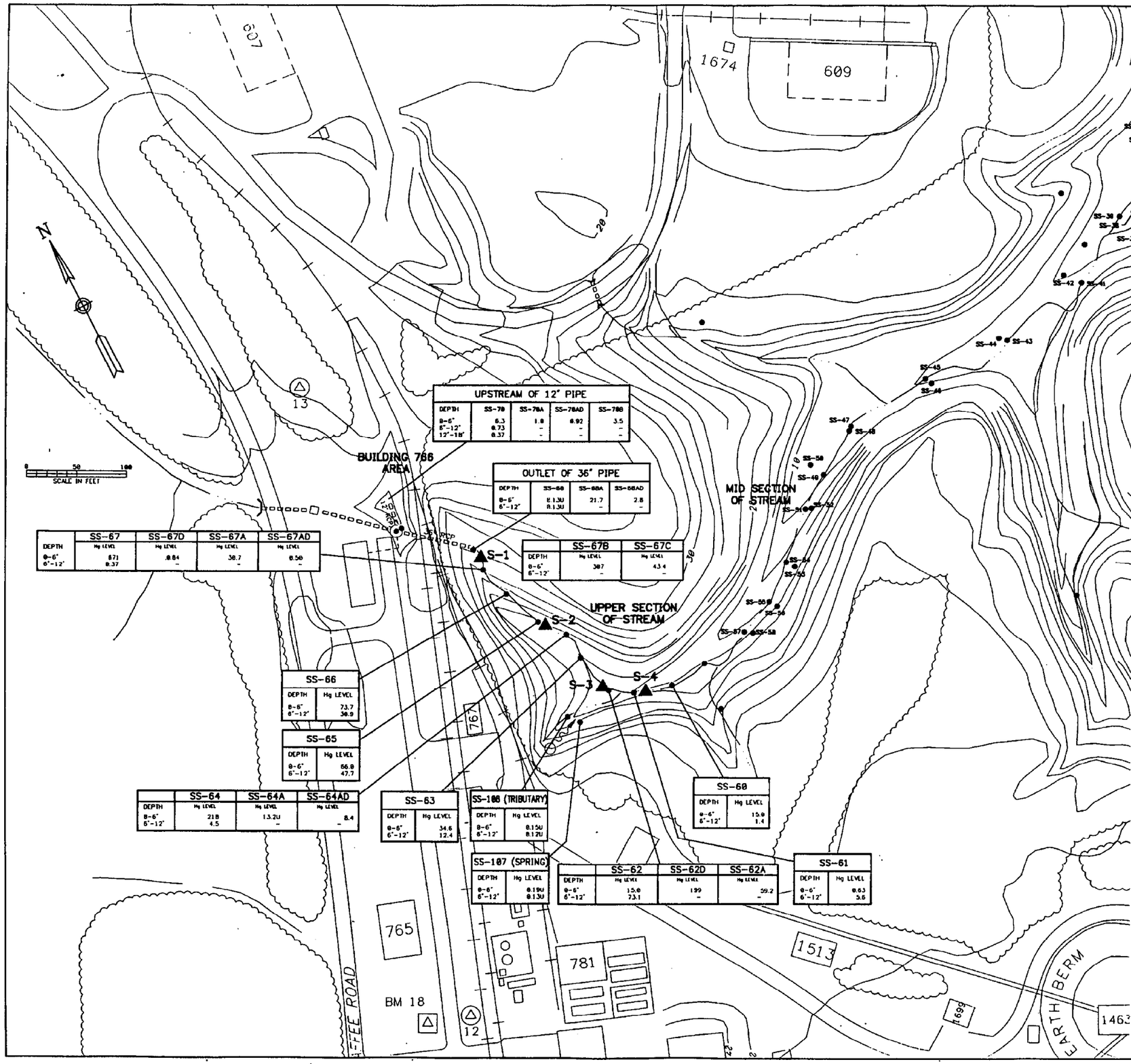
The documents reviewed addressed stabilizing mercury to prevent and/or minimize its leaching potential. Mercury in sediment/soil presents a greater risk to human health and the environment when it leaches into the environment. The TCLP (Toxicity Characteristic Leaching Procedure) test measures mercury leachability. TCLP test procedures and stabilization concepts were reviewed to identify current chemical stabilization standards. Published research and stabilization documents provided guidance on alternative methods of

stabilizing mercury-contaminated soil so that it does not leach at concentrations that would classify the material as a hazardous waste.

Waste containment and encapsulation documents were reviewed to assess waste placement techniques. These included Navy specifications and guidance documents used in previous earthen berm construction projects at the NSWC. Technical Vendor Manuals were reviewed for information on impermeable and/or low-permeability liners such as clays, geotextile, and bentonite composites. Company information reviewed included National Seal Company, Mirafi, Tenex, and Fluid Systems, Inc. In addition waste management and civil engineering applications were reviewed to acquire information and ideas on effective procedures for construction of earthen structures. The document prepared by ABB Environmental Services, Inc. for CHESDIV (March 1992) "Plans and Specifications Remedial Action" on berm construction was also reviewed.

2.2 SAMPLE COLLECTION

Halliburton NUS collected four 5-gallon buckets of sediment/soil from the Upper Section of Stream at Site 8. The approximate sampling locations are shown on Figure 2-1. The samples were collected from areas where mercury was detected at relatively high concentrations during CTO 0064 sampling and analysis. The buckets were homogenized, and two samples from each bucket were analyzed for total mercury and a sieve analysis was performed on one sample from each bucket.



UPSTREAM OF 12" PIPE				
DEPTH	SS-70	SS-70A	SS-70AD	SS-70B
0-6"	6.3	1.0	0.92	3.5
6"-12"	0.73	-	-	-
12"-18"	0.37	-	-	-

OUTLET OF 36" PIPE			
DEPTH	SS-68	SS-68A	SS-68AD
0-6"	0.13U	21.7	2.8
6"-12"	0.13U	-	-

	SS-67	SS-67D	SS-67A	SS-67AD
DEPTH	Hg LEVEL	Hg LEVEL	Hg LEVEL	Hg LEVEL
0-6"	871	.084	38.7	0.50
6"-12"	0.37	-	-	-

	SS-67B	SS-67C
DEPTH	Hg LEVEL	Hg LEVEL
0-6"	387	43.4
6"-12"	-	-

SS-66	
DEPTH	Hg LEVEL
0-6"	73.7
6"-12"	30.9

SS-65	
DEPTH	Hg LEVEL
0-6"	66.0
6"-12"	47.7

	SS-64	SS-64A	SS-64AD
DEPTH	Hg LEVEL	Hg LEVEL	Hg LEVEL
0-6"	218	13.2U	8.4
6"-12"	4.5	-	-

SS-63	
DEPTH	Hg LEVEL
0-6"	34.6
6"-12"	12.4

SS-106 (TRIBUTARY)	
DEPTH	Hg LEVEL
0-6"	0.15U
6"-12"	0.12U

SS-60	
DEPTH	Hg LEVEL
0-6"	15.0
6"-12"	1.4

SS-107 (SPRING)	
DEPTH	Hg LEVEL
0-6"	0.19U
6"-12"	0.13U

	SS-62	SS-62D	SS-62A
DEPTH	Hg LEVEL	Hg LEVEL	Hg LEVEL
0-6"	15.0	199	59.2
6"-12"	73.1	-	-

SS-61	
DEPTH	Hg LEVEL
0-6"	0.63
6"-12"	5.6

LEGEND

- UNDERGROUND PIPE
- RAILROAD
- BUILDING AND NUMBER
- EARTH COVERED BUILDING AND NUMBER
- MANHOLE
- INLET
- CONTOUR
- NSWC TRAVERSE MONUMENT
- NSWC BENCHMARK
- FENCE
- TREELINE
- SEDIMENT/SOIL SAMPLING LOCATION
- S-1 SEDIMENT/SOIL SAMPLING LOCATION FOR PLACEMENT AND TREATABILITY STUDY
- SPRING

NOTES

1. TOPOGRAPHY DIGITIZED FROM 1"= 100' INDIAN HEAD DIVISION, NSWC TOPOGRAPHIC MAPS OF AREAS 9, 10, AND 14 (DRAWING Nos. 963610, 963611, AND 963615) UNDATED.
2. COORDINATE SYSTEM SHOWN ON THIS MAP WAS DIGITIZED FROM "NOS TRAVERSE" DRAWING (DRAWING No. 15.785). TRAVERSE POINTS 11, 12, AND 83 WERE OBSERVED IN THE FIELD.
3. CENTERLINE OF STREAM AND OTHER KEY FEATURES (PIPES, MANHOLES, ETC.) BASED ON FIELD SURVEY PERFORMED BY GREENHORNE & O'MARA, INC. IN SEPTEMBER 1992.
4. FIVE BACKGROUND SEDIMENT/SOIL SAMPLES WERE COLLECTED AT SITE 8. THREE SAMPLES WERE COLLECTED UPSTREAM OF SITE 8 IN MATTAWOMAN CREEK. THE REMAINING TWO SAMPLES WERE COLLECTED FROM A STREAM CHANNEL LOCATED AT THE NORTHWESTERN CORNER OF THE BASE, APPROXIMATELY ONE MILE FROM SITE 8.
5. ALL MERCURY CONCENTRATIONS ARE SHOWN IN mg/kg. DUPLICATE SAMPLES ARE IDENTIFIED WITH A "D" SUFFIX.
6. DATA VALIDATION QUALIFIERS ARE AS FOLLOWS:

   - - NO SAMPLE TAKEN

   U - VALUE IS NONDETECT AS REPORTED BY THE LABORATORY.

   K(m) - POSITIVE RESULTS ARE ESTIMATED AND BIASED HIGH DUE TO HIGH MATRIX SPIKE RECOVERY.

   J(m) - VALUE IS ESTIMATED DUE TO MATRIX SPIKE NONCOMPLIANCES. BIAS CANNOT BE DETERMINED.

   UJ(m) - NONDETECT IS ESTIMATED DUE TO MATRIX SPIKE NONCOMPLIANCE. BIAS CANNOT BE DETERMINED.

   UJ(d) - NONDETECTED IS ESTIMATED DUE TO LABORATORY DUPLICATE IMPRECISION. BIAS CANNOT BE DETERMINED.

   J(d) - VALUE IS ESTIMATED DUE TO LABORATORY DUPLICATE IMPRECISION. BIAS CANNOT BE DETERMINED.

HALLIBURTON NUS Environmental Engineers

DSGN. DP
SURV.
SUBMITTED BY
CH. ENG.
VERIFIED
NORMCH.
PM
OFFICER IN CHARGE
SERVICE

REV. DESCRIPTION PREP BY DATE APPR'D

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, DC
CHESAPEAKE DIVISION
WASHINGTON NAVY YARD

INDIAN HEAD DIVISION, NAVAL SURFACE WARFARE CENTER
SITE B – NITROGLYCERIN PLANT OFFICE
PLACEMENT AND TREATABILITY STUDY SAMPLING LOCATIONS

SEAL AREA

ISSUED: APRIL 21, 1993

SAT 10 DATE

CODE IDENT NO
SCALE AS NOTED
SPEC NO 04-97-PMPJ
CONTRN CONTR NO N62472-90-D-1298
NAVFAC DRAWING NO

SHEET 1 OF 1
SIZE D
NO. SH. NO

FIGURE 2-1

3.0 TREATABILITY STUDY TASK

The Treatability Study Task was to consist of the following three steps:

- Initial Analysis and Characterization
- Phase I Mixing and Testing
- Phase II Mixing and Testing

The purpose of the first step, "Initial Analysis and Characterization" was to verify the previous analytical work performed and identify the properties of the existing sediment/soil. The purpose of "Phase I Mixing and Testing" was to evaluate various chemical additives to chemically stabilize mercury in the contaminated sediment/soils. The purpose of "Phase II Mixing and Testing" was to further evaluate and optimize the additives which showed beneficial results in Phase I.

According to RCRA Hazardous Waste Classification Rules and Regulations 40 CFR 261, if the results of TCLP testing indicate that mercury in sediment/soils do not leach at concentrations greater than 200 ug/L, the sediment/soils are not classified as "hazardous wastes" and no chemical stabilization is required. If no stabilization is required, the mercury contained in the sediment/soil will be controlled by placement rather than stabilization techniques. TCLP analysis was performed during the first step (Initial Analysis and Characterization) of the treatability study. However, because of schedule constraints, Phase I Mixing and Testing was performed before all results from the initial analysis and characterization were available.

3.1 INITIAL ANALYSIS AND CHARACTERIZATION

As previously described, during CTO 0064 three TCLP mercury analysis were performed on mercury contaminated sediment/soil, no TCLP mercury was detected in those samples. The analytical results are presented in Table 3-1.

The first step of the Treatability Study Task under CTO 0099 was initial analysis and characterization. Two sediment/soil samples from each 5-gallon bucket collected from Site 8 were analyzed for mercury. The results of the total mercury analysis are presented in Table 3-1. As shown on that table, the total mercury concentrations raised from 0.45 to 94.3 mg/kg. Four samples with relatively high mercury concentrations (2.16, 10.4, 11.4 and 94.30 mg/kg) were then analyzed for TCLP mercury. As shown on Table 3-1, mercury was not detected in the TCLP leachate.

TABLE 3-1

RESULTS OF TOTAL AND TCLP MERCURY ANALYSIS
INDIAN HEAD DIVISION, NAVAL SURFACE WARFARE CENTER
INDIAN HEAD, MARYLAND

Project Phase	Sample Date	Sample Number	Total Hg (mg/kg)	TCLP Hg (ug/L)
CTO No. 0064	August 1992	SS-62-0006	15.0	20.0 U
		SS-64-0006	218.0	20.0 U
		SS-113-0006	13.20	29.6R (q)
CTO No. 0099	April 1993	S-1-1A1	7.90	NA
		S-1-1A2	10.40	20.0 U
		S-2-1A1	94.30	20.0 U
		S-2-1A2	2.16	20.0 U
		S-3-1A1	8.00	NA
		S-3-1A2	11.40	20.0 U
		S-4-1A1	0.74	NA
		S-4-1A2	0.45	NA

U - Value is a nondetect as reported by the laboratory
R(q) - Result is a rejected value. Result is considered to be a false positive based on questionable quantitation.
NA - Not analyzed

All laboratory results were validated. Validation memos for all TCLP analysis (CTO 0064 and 0099 and all CTO 0099 analysis) are presented in Appendix A.

To further characterize and classify the sediment/soil, a pH analysis and a grain size analysis was performed on a sample from each 5-gallon bucket collected. The results of these analysis are provided in Appendix B.

3.2 PHASE I MIXING AND TESTING

Before the results of the initial TCLP mercury analysis were available, Phase I mixing and testing was performed to begin assessing what types of additives (reagents) would be necessary to chemically stabilize mercury in the contaminated sediment/soil. During Phase I, six different additives and eight separate mixtures were evaluated. Using actual sediment/soil from Site 8 (the four 5-gallon samples used in the initial sampling), Halliburton NUS prepared eight different mixes to assess alternative mix formulas. As requested by the NSWC, Halliburton NUS investigated the development of modified soil (as opposed to a monolith) for incorporation into a structural fill. The stabilization reagents used were: lime; fly ash; sodium sulfide; aluminum sulfate; ferrous sulfate; and Portland cement. Proprietary reagents were not investigated. The various mixtures that were tested are as follows:

- **Mix Number 1: Lime Mix (Low Dosage)**

  Hydrated lime was added at 0.37 percent by weight to a sample of the sediment/soils of Bucket S-1. This raised the pH from 6 to 10. The lime appeared to absorb a lot of the free liquid making the liquid mold easier. Two samples were submitted for total mercury analysis.

- **Mix Number 2: Lime Mix (High Dosage)**

  Hydrated lime was added at 1.44 percent by weight to a sample of the sediment/soils of Bucket S-2. This raised the pH from 6 to 10. This sample was much more soupy and no change was observed. One sample was submitted for total mercury analysis.

- **Mix Number 3: Sodium Sulfide Mix (High Dosage)**

  Sodium sulfide was added at 5.38 percent by weight to a sample of the sediment/soils from Bucket S-2. This changed the pH from 6 to 11. The sample turned to a very dark, almost

black-green and foamed up very aggressively. Because of the reaction, no samples were submitted for analysis.

- **Mix Number 4: Sodium Sulfide Mix (Low Dosage)**

Sodium sulfide was added at 0.38 percent by weight to a sample of the sediment/soils of Bucket S-2. The pH went from 6 to 9. The additive provided a color change and no visible gas formed. A sample and a duplicate were submitted for total mercury analysis.

- **Mix Number 5: Fly Ash Mix**

Fly ash was added at 7.68 percent by weight to a sample of the sediment/soils of Bucket S-3. The pH went from 6 to 8. Concerns were brought up on the leaching of the fly ash with this relatively low pH. The mixture did not seem to set or harden. The samples were submitted for total mercury analysis.

- **Mix Number 6: Aluminum Sulfate Mix**

Aluminum sulfate mix was added at 0.40 percent by weight to a sample of the sediment/soils of Bucket S-1. The additive did not seem to have any noticeable effect on the sample. Two samples were submitted for total mercury analysis.

- **Mix Number 7: Portland Cement Mix**

Portland cement was added at 6.8 percent by weight to a sample of the sediment/soils of Bucket S-2. The pH changed from 6 to 12. One sample and a duplicate were submitted for total mercury analysis.

- **Mix Number 8: Ferrous Sulfate Mix**

Ferrous sulfate was add at 0.26 percent by weight to a sample of the sediment/soils of Bucket S-1. There was no pH change and no physical changes observed. One sample was submitted for total mercury analysis.

Results of total mercury analysis on the Phase I mixtures are provided in Table 3-2. Since the initial Treatability Study Task results indicated that chemical stabilization was not necessary, no TCLP analysis was performed on the mixes. However, some general observations can be made regarding the total mercury analysis presented on Table 3-2. The most obvious observation is mercury contamination in the sediment/soil from the Upper Section of Stream is not evenly distributed. The sample and duplicate of S-2 (before additives) vary by a factor of 4.5. Some samples and duplicates alter the addition of additives also vary by a factor of 3.3. These large differences between samples and their duplicates is consistent with previous results and tends to confirm the conclusion in the SC Study--that elemental mercury is probably present in the Upper Section of Stream. However, it is possible that other forms of mercury are also present.

3.3 PHASE II MIXING AND TESTING

It was proposed that the mixtures which improved the physical and/or chemical properties of the sediment/soil in Phase I be evaluated further in Phase II to refine and optimize the mixture. However, because initial analytical results indicated that mercury in the sediment/soil did not leach in its current state at detectable levels, chemical stabilization was not necessary. Therefore, Phase II mixing and testing was therefore not performed.

3.4 TREATABILITY STUDY TASK SUMMARY

The results of the initial analysis performed on the sediment/soils during CTO 0099 confirmed the findings of the work performed under CTO 0064. Analytical results from both CTO 0064 and CTO 0099 indicate that Site 8 mercury contaminated sediment/soils do not leach mercury in excess of the RCRA characteristic hazardous waste level of 200 ug/L. As a result, the sediment/soils are not classified as a hazardous waste and do not require chemical stabilization. In addition, the mercury concentrations were nondetect at 20 ug/L, indicating that mercury levels were at least one order of magnitude (10 times) less than the hazardous waste classification.

The analytical results for the total mercury analysis showed poor duplicate precision for both the initial analysis and mixture analysis. This is most likely due to the inability to effectively homogenize samples contaminated with mercury. This matter is discussed further in the validation memos contained in Appendix A.

TABLE 3-2

RESULTS OF MIXTURE TOTAL MERCURY ANALYSIS
INDIAN HEAD DIVISION, NAVAL SURFACE WARFARE CENTER
INDIAN HEAD, MARYLAND

Additive	Bucket No.	Initial Total Mercury - without Additive (mg/kg)	Final Total Mercury - with Additive (mg/kg)
Mix No. 1 Lime (low dosage)	S-1	7.90	32.7
Duplicate	S-1	10.40	84.9
Mix No. 2 Lime (high dosage)	S-2	94.3	10.6
Duplicate	S-2	21.6	NA
Mix No. 4 Sodium Sulfide	S-2	94.3	17.4
Duplicate	S-2	21.6	19.7
Mix No. 5 Flyash	S-3	8.0	8.69
Duplicate	S-3	11.4	8.73
Mix No. 6 Aluminum Sulfide	S-1	7.90	37.4
Duplicate	S-1	10.40	11.3
Mix No. 7 Portland Cement	S-2	94.3	7.68
Duplicate	S-2	21.6	11.0
Mix No. 8 Ferrous Sulfate	S-1	7.90	21.2
Duplicate	S-1	10.40	NA

4.0 PLACEMENT STUDY TASK

The results of the Treatability Study Task indicate that chemical stabilization of the mercury in the sediment/soil is not necessary; mercury does not leach from the sediment/soil (based on TCLP analysis). Therefore the sediment/soil can be placed in an earthen structure (such as a berm or magazine soil cover) without chemical stabilization. However, physical barriers can be constructed to contain and/or encapsulate the contaminated soil. As a result, the Placement Study Task was performed to

- Select a site for placement of the contaminated sediment/soil.
- Identify a containment concept.
- Develop an appropriate cap and/or liner design.
- Establish design standards.

4.1 SITE SELECTION

The first step of the site selection process was to establish site selection criteria. After they were established, the criteria were used to evaluate and select a placement site.

4.1.1 Site Selection Criteria

The following site selection criteria were established:

- **On NSWC Property**. The placement site must be located on NSWC property to allow the Navy to control and monitor the site.

- **Upgradient Topography**. The placement site must be located on upgradient topography (away from streams and outside the 100-year floodplain) so that it will not be subject to flooding and erosion. An upgradient location will minimize the potential for the mercury to migrate.

- **Controlled Area**. The placement site must be located in a controlled area where future excavation and disturbances will be minimal and controlled. The sediment/soil should be placed in an area that is not proposed to be developed; it should be placed in a location that will not be developed in the foreseeable future.

- **Volume Capacity**. The site must have capacity for the approximately 400 cubic yards of mercury-contaminated sediment/soil from Site 8. In addition, there should be additional capacity for the liner and/or encapsulation system. A triangular wedge 12 feet high, 24 feet wide, and 90 feet long has a volume of 480 cubic yards.

4.1.2 Site Selection Process

After field review of several alternative sites by Navy and Halliburton NUS personnel, the Navy selected the soil cover of Magazine No. 606 as the site on which to place the contaminated sediment/soil. It is located on NSWC property approximately 1,000 feet from Site 8. Magazine No. 606 is located on upgradient topography within a controlled area. Also there is sufficient volume within the soil cover to place the contaminated sediment/soil.

After review of the topography at Magazine No. 606, the soil cover on the back side of the magazine was determined to be the optimal location for placement of the contaminated sediment/soil. The general placement concept was to excavate sufficient volume from the existing soil cover, place contaminated sediment/soil within the excavation utilizing appropriate containment techniques and then cover it with an earthen/vegetated cap.

4.2 CONTAINMENT CONCEPTS

The area in which the sediment/soil will be placed must be designed with measures to contain the mercury contaminated sediment/soil. The primary purpose of the containment measures will be to minimize human and environmental contact with the contaminated sediment/soils, and potential precipitation infiltration and subsequent leachate.

The contaminated sediment/soil would be contained by utilizing impermeable or low-permeability layers. Alternative containment concepts were identified and evaluated in order to select optimal placement concept for Magazine No. 606. As shown on Figure 4-1, the following four containment concepts were identified and evaluated:

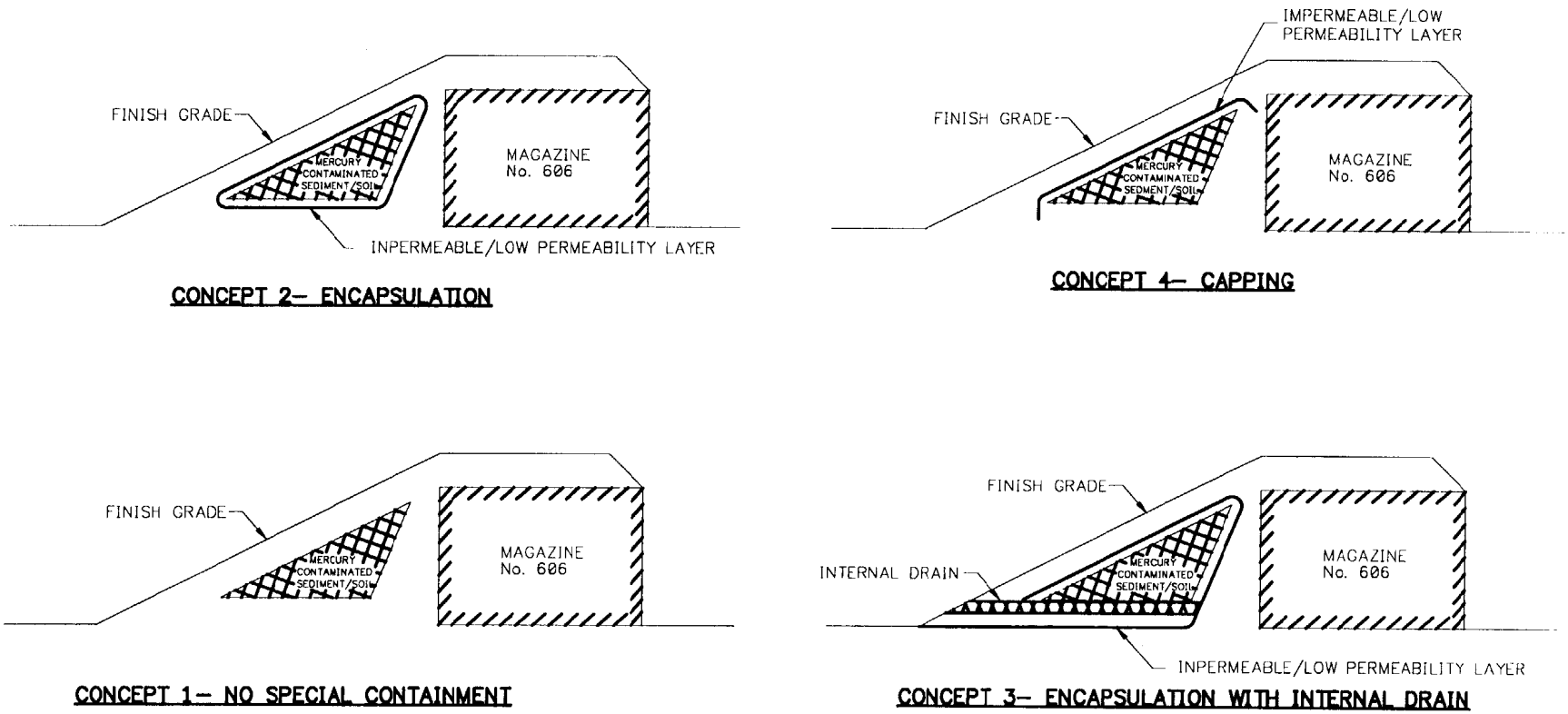


FIGURE 4–1
CONTAINMENT CONCEPTS

ACAD: 6190\93081201.DWG 08/17/93 TD

- **Concept 1 - No Special Containment** - Containment will consist of simply placing the mercury-contaminated sediment/soil within the soil cover of Magazine No. 606.

- **Concept 2 - Encapsulation** - The encapsulation concept will consist of completely encapsulating the mercury-contaminated sediment/soil within the soil cover within an impermeable or low-permeability layer. This concept will minimize infiltration into the mercury-contaminated sediment/soil and contain leachate generated from within the material.

- **Concept 3 - Encapsulation with an Internal Drain** - This concept will be identical to Concept 2 with the addition of an internal drain. This concept will minimize infiltration into the mercury-contaminated soil and provide a mechanism (internal drain) to collect leachate generated in the material.

- **Concept 4 - Capping** - This concept will consist of constructing an impermeable/ low-permeability layer directly above the contaminated sediment/soil. This concept will minimize infiltration into and through the contaminated soil.

The four containment concepts were then evaluated in terms of effectiveness, implementability, and costs. A summary of that evaluation is presented on Table 4-1. As shown in that table, Concept 1 - No Special Containment will be relatively easy to implement and is the lowest cost alternative. However, it will provide no additional control regarding containment of the soil. Concept 2 - Encapsulation will be very effective in containing the mercury in the contaminated sediment/soil; it can be implemented with some difficulty. However, it is a relatively expensive alternative, and there may be a problem with controlling internally generated leachate. Concept 3 - Encapsulation with an Internal Drain addresses the major problem associated with Concept 2 via providing an internal drain. However, the internal drainage system may require a leachate collection and treatment system. Concept 4 - Capping combines the relatively low cost and implementability of Concept 1 with the effectiveness of Concepts 2 and 3. Capping will minimize infiltration into the contaminated sediment/soil; it can be implemented relatively easily and is a low cost alternative. Based on the previously summarized evaluation, Concept 4 was selected as the optional cost-effective containment concept for placement of the sediment/soil at Magazine No. 606.

TABLE 4-1

EVALUATION OF CONTAINMENT CONCEPTS
INDIAN HEAD DIVISION, NAVAL SURFACE WARFARE CENTER
INDIAN HEAD, MARYLAND

Concept	Relative Effectiveness	Relative Implementability	Relative Cost	Comments
Concept 1 - No Special Containment	Low	High	Low	No additional control will be provided.
Concept 2 - Encapsulation	High	Medium	High	Potential problem with internally generated leachate.
Concept 3 - Encapsulation with an Internal Drain	High	Medium	High	Leachate collection and treatment will require continuous operation and maintenance.
Concept 4 - Capping	High	High	Low	Capping will reduce infiltration and subsequent leachate generation.

4.3 CAP DESIGN

The purpose of the cap above the mercury contaminated sediment/soil within the soil cover of Magazine No. 606 will be to:

- Prevent direct human and environmental exposure to the material.
- Prevent wind and water erosion of the material.
- Minimize potential mercury plant uptake.

The cap will include some type of impermeable/low permability layer (liner) and some additional material to protect and buffer the liner. There are two types of liners - synthetic and soil. Synthetic liners are typically made out of polyethylene, high density polyethylene (HDPE), or similar material and are relatively impermeable. Soil liners typically consist of compacted clay or bentonite and have fairly low permeabilities compared to other soils. Both types of liners were analyzed as possible capping alternatives. The synthetic liners are more complicated to install, and more expensive than soil liners. However, a properly installed synthetic liner is virtually impermeable to water. However, soil liners may withstand more settlement and do not create a potential failure surface on side slopes like synthetic liners.

Based on review of the alternatives, a soil liner (compacted clay layer) was selected for this project. The soil liner will consist of a minimum of 12 inches of compacted clay and must have an in-place permeability of less than 10^{-5} cm/sec.

The low permeability soil layer will be placed directly on the contaminated sediment/soil. However, in order to achieve the objectives of the cap and to provide a buffer for the liner, an additional 2 feet (minimum) of soil will be placed on the low permeability soil layer. In addition, 6 inches of topsoil will be placed above the buffer soil layer and vegetation with grasses that have root systems that do not grow deeper than 12 inches. The grasses will be moved regularly. This type of cap and maintenance procedure will prevent direct human and environmental exposure, prevent erosion, and minimize potential plant uptake.

4.4 DESIGN STANDARDS

The contaminated sediment/soil will be placed in the soil cover of Magazine No. 606 in accordance with the following standards.

- The soil will be compacted to 95 percent of standard proctor. The sediment/soil may have to dry (or be dried) in order to properly place and compact it.

- The maximum slope (steepest) of the soil cover will be two horizontal to one vertical (2H:1V).

- Contaminated sediment/soil will be kept a minimum of 5 feet from the back concrete wall of Magazine No. 606.

5.0 SUMMARY AND CONCLUSIONS

The purpose of this Placement and Treatability Study was to identify, evaluate, and select procedures to securely place mercury contaminated sediment/soil on NSWC property. During the Treatability Study Task, treatment via chemical stabilization of the contaminated sediment/soil was evaluated. This treatment typically involves chemically stabilizing the material so that it does not leach at concentrations above the TCLP hazardous waste standard (200 ug/L) for mercury. However, as described in Section 3.0 of this report, results of the TCLP mercury analysis indicated that the mercury contaminated Site 8 sediment/soils do not leach mercury at concentrations in excess of 200 ug/L. In fact, no mercury was detected in the TCLP leachate (detection limit was 20 ug/L). Based on that analysis, the sediment/soil is not classified as a hazardous waste. Therefore, chemical stabilization of the sediment/soils is not necessary and the material can be placed on the NSWC property. During the Placement Study Task, a site in which to place the contaminated sediment/soil was selected and placement procedures were developed.

Based on the results of this Placement and Treatability Study, the mercury-contaminated sediment/soil from Site 8 will be placed in the soil cover of Magazine No. 606 without additional chemical stabilization. The contaminated sediment/soil will be capped with a layer of low-permeability soil. Specific placement details will be developed during the design phase of the project.

APPENDIX A

VALIDATION MEMOS AND RESULTS OF CHEMICAL ANALYSIS

Brown & Root Environmental INTERNAL CORRESPONDENCE

C-49-6-3-189

TO: TONY KLIMEK **DATE:** JUNE 22, 1993

FROM: RICKY C. DEPAUL RCD **COPIES:** D.A. SCHEIB

SUBJECT: INORGANIC DATA VALIDATION - MERCURY (COLD VAPOR)
CTO 99, NSWC INDIAN HEAD, INDIAN HEAD, MARYLAND
SDG S1-IA1

SAMPLES:

8/Soils/

S1-IA1	S1-IA2	S2-IA1	S2-IA2
S3-IA1	S3-IA2	S4-IA1	S4-IA2

Overview

The sample set for the CTO 99 Indian Head site, SDG S1-IA2, consists of eight (8) soil samples. These samples were analyzed for total mercury. No field duplicates or field quality control blanks were included for analysis in this analytical data set.

The samples were collected by Brown & Root Environmental on 04/29/93 and analyzed by GP Environmental Laboratories under Naval Energy and Environmental Support Activity (NEESA) Level C Quality Assurance/Quality Control (QA/QC) criteria. All analyses were conducted using Contract Laboratory Program Statement of Work (SOW) 3/90 analytical and reporting protocols.

Summary

Mercury was successfully analyzed in all samples. The findings offered in this report are based upon a general review of all available data including data completeness, holding times, calibration data, laboratory method blank results, laboratory control sample results, matrix spike and laboratory duplicate results, and compound quantitation.

Areas of concern with respect to data quality are listed below.

Minor Problems

The laboratory duplicate Relative Percent Difference (%RPD) for mercury (66.7%) failed to meet the 35% quality control limit for soils. Only positive sample results were reported for this analyte and these results are qualified as estimated, [coded J(d)]. The direction of bias cannot be determined.

Notes

The Contract Required Detection Limit (CRDL) Standard analysis recovery for mercury was not evaluated as only low concentration samples were analyzed in this data set, and in accordance with EPA Region III, data evaluation for CRDL Standard analyses applies to high concentration samples only.

The soil matrix spike recovery failed to meet the upper quality control limit. However, the initial sample result exceeded 4X the amount spiked, thus, no actions were necessary.

Discussions with GP Environmental laboratory supervisory personnel concerning total mercury analyses in soil matrices indicated peculiar anomalies with the sample matrix. This is thought to be attributable to the inherent lack of homogeneity of the mercury present in the sample matrix as noted in the laboratory's case narrative comments. The heterogeneous nature of these samples seems to be causing analytical difficulty in terms of reproducibility of results.

The discussion of the potential presence of matrix affects is included in this memorandum for informational purposes only.

No other problems were noted.

Executive Summary

Laboratory Performance: Laboratory duplicate imprecision was noted for mercury in the soil matrix.

Other Factors Affecting Data Quality: Some sample results may be affected by matrix interferences as noted in the laboratory's case comments.

MEMO TO: TONY KLIMEK
DATE: JUNE 22, 1993 - PAGE 3

Data for these analyses were reviewed with reference to the "National Functional Guidelines for Inorganic Data Validation" (7/88), as amended for use within EPA Region III, and the NEESA guidelines document "Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program" (NEESA 20.2-047B; June 1988).

The text of this report has been formulated to address only those problem areas affecting data quality. Documentation of compliance for non-problem areas is presented in the attached Appendix C (HNUS/CLEAN Data Validation Worksheets.)

"I attest that the data referenced herein were validated according to the agreed-upon validation criteria as specified in the NEESA Guidelines and the Quality Assurance Project Plan (QAPP)."

Ricky C. DePaul
Brown & Root Environmental Corporation

Ricky C. DePaul
Data Reviewer

Debra A. Scheib
Brown & Root Environmental Corporation

Debra A. Scheib
CLEAN Quality Assurance Manager

Attachments:

1. Appendix A - Qualified Analytical Results
2. Appendix B - Results as Reported by the Laboratory
3. Appendix C - HNUS/CLEAN Data Validation Worksheets
4. Appendix D - Support Documentation

Appendix A

QUALIFIED ANALYTICAL RESULTS

CLEAN SDG S1-IA1
INDIAN HEAD, MARYLAND
GP ENVIRONMENTAL SERVICES INC.

TAL SOIL INORGANICS (mg/kg)

CLIENT ID:			S1-IA1		S1-IA2		S2-IA1		S2-IA2		S3-IA1	
LAB ID:			930424301A		930424302A		930424303A		930424304A		930424305A	
ANALYTE	CRDL	IDL										
MERCURY	0.1	0.1	8.20	J(d)	10.40	J(d)	94.40	J(d)	21.60	J(d)	8.00	J(d)

CLEAN SDG S1-IA1
INDIAN HEAD, MARYLAND
GP ENVIRONMENTAL SERVICES INC.

TAL SOIL INORGANICS (mg/kg)

CLIENT ID:			S3-IA2		S4-IA1		S4-IA2	
LAB ID:			930424306A		930424307A		930424308A	
ANALYTE	CRDL	IDL						
MERCURY	0.1	0.1	11.40	J(d)	0.74	J(d)	0.45	J(d)

QUALIFIER KEY:

U - Value is a nondetect as reported by the laboratory.

J(d) - Value is estimated due to laboratory duplicate imprecision. Bias cannot be determined.

HALLIBURTON NUS
Environmental Corporation

INTERNAL CORRESPONDENCE

C-49-10-2-249

TO: TONY KLIMEK **DATE:** OCTOBER 19, 1992

FROM: KAREN M. SMECKER

SUBJECT: INORGANIC DATA VALIDATION - TCLP METALS
CTO #64, INDIAN HEAD
CASE NO. 920975, SDG s62006

SAMPLES: 3/Extracts/

SS62-006 SS64-006 SS113-006

Overview

The sample set for the CO #64 Indian Head site, Case No. 92-0975, SDG s62006, consists of three (3) Toxicity Characteristic Leaching Procedure (TCLP) extracts. These samples were analyzed for TCLP metals. No field quality control blanks or field duplicate pairs were included in this analytical data set.

The samples were collected by HALLIBURTON NUS Environmental Corporation on 08/30/92 and 08/31/92 and analyzed by GP ENVIRONMENTAL under Naval Energy and Environmental Support Activity (NEESA) Level C Quality Assurance/Quality Control (QA/QC) criteria. All analyses were conducted using Contract Laboratory Program (CLP) Statement of Work (SOW) 3/90 analytical and reporting protocols.

Summary

All compounds were successfully analyzed, with the exception of those results qualified as rejected, [R]. The findings offered in this report are based upon a general review of all available data including data completeness, holding times, calibration data, laboratory method blank results, matrix spike recoveries, laboratory control sample results, laboratory duplicate results and analyte quantitation.

Areas of concern with respect to data quality are listed below.

Major Problems

- In the validator's professional opinion, the quantitation of the positive mercury result (29.6 µg/L) reported for sample SS113-006 is questionable. Associated initial and continuing calibration blanks had absorbance values of either 0.007 and 0.008 units. These values corresponded to a nondetected

concentration (< 20 µg/L). The absorbance value shownfor sample SS113-006 in the raw data is 0.008 units. Consequently, the analysis does not indicate the presence of mercury in this sample, and this result has been rejected, [coded R(q)].

Minor Problems

- A negative concentration, whose absolute value was > IDL, was reported for selenium in a laboratory method blank. This occurrence is an indication of poor instrument performance (base-line drifting). Only sample SS113-006 was affected, the selenium nondetect for this sample is qualified as biased low, [coded UL(n)].

Notes

Arsenic was detected as a contaminant in a laboratory method blank. No qualifications were necessary because no positive sample results were reported for this analyte.

A positive result for mercury (25.0 µg/L) was reported in the TCLP method blank associated with sample SS113-006. No action was taken since the he positive mercury result in this sample is qualified as rejected as a result of questionable quantitation.

The Matrix Spike (MS) recovery for mercury (174%) was high (> 125%). No action was taken since the positive mercury result was qualified based on blank contamination.

No other problems were noted.

Executive Summary

Laboratory Performance: Mercury was detected as a contaminant in a TCLP method blank. A negative concentration was reported for selenium in a laboratory method blank. The quantitation of mercury for sample SS113-006 was questionable.

Other Factors Affecting Data Quality: The MS recovery for mercury was high.

Data for these analyses were reviewed with reference to the "National Functional Guidelines for Inorganic Data Validation" (7/88), as amended for use within USEPA Region III, and the NEESA document entitled "Sampling and Chemical Analysis Quality

Assurance Requirements for the Navy Installation Restoration Program" (6/88).

The text of this report has been formulated to address only those problem areas affecting data quality.

"I attest that the data referenced herein were validated according to the agreed-upon validation criteria as specified in the NEESA Guidelines and the Quality Assurance Project Plan (QAPP)."

HALLIBURTON NUS Environmental Corporation

Karen M. Smecker
Data Reviewer

HALLIBURTON NUS Environmental Corporation

Debra A. Scheib
Data Validation Quality Assurance Officer

Attachments:

1. Appendix A - Qualified Analytical Results
2. Appendix B - Results as Reported by the Laboratory
3. Appendix C - Support Documentation

cc: D. Scheib (HNUS, Pittsburgh)

Data Qualifier Key:

U	-	Value is a nondetect as reported by the laboratory.
UL(n)	-	Nondetect is considered to be biased low due to poor instrument performance (i.e. negative laboratory method blank concentrations).
R(q)	-	Result is considered to be a false positive based on questionable quantitation.

APPENDIX A

Qualified Analytical Results

SITE: CTO #64, INDIAN HEAD
CASE NO. 920975, SDG s62006
LABORATORY: GP ENVIRONMENTAL

INORGANIC TCLP EXTRACT ANALYSES (ug/L)

CLIENT ID:			SS62-006	SS64-006	SS113-006
LAB ID:			9209158-01	9209158-02	9209075-01
ANALYTE	CRDL	IDL			
ARSENIC	2	276	276 U	276 U	276 U
BARIUM	40	26.0	837	26.0 U	588
CADMIUM	1	18.0	18.0 U	18.0 U	18.0 U
CHROMIUM	2	25.0	25.0 U	25.0 U	25.0 U
LEAD	0.6	282	282 U	282 U	282 U
MERCURY	0.2	20.0	20.0 U	20.0 U	29.6 R(q)
SELENIUM	1	167	167 U	167 U	167 UL(n)
SILVER	2	45.0	45.0 U	45.0 U	45.0 U

Brown & Root Environmental INTERNAL CORRESPONDENCE

C-49-6-3-190

TO: TONY KLIMEK **DATE:** JUNE 22, 1993

FROM: RICKY C. DEPAUL RCD **COPIES:** D.A. SCHEIB

SUBJECT: INORGANIC DATA VALIDATION - MERCURY (COLD VAPOR)
CTO 99, NSWC INDIAN HEAD, INDIAN HEAD, MARYLAND
SDG M1-S1D

SAMPLES:

12/Soils/

M1-S-1	M1-S1D	M2-S-2	M4-S-2
M4-S2D	M5-S-3	M5-S3D	M6-S-1
M6-S1D	M7-S-2	M7-S2D	M8-S-1

Overview

The sample set for the CTO 99 Indian Head site, SDG M1-S1D, consists of twelve (12) soil samples (including five field duplicate pairs, the duplicate member of which is designated -D). These samples were analyzed for total mercury. No field quality control blanks were included for analysis in this analytical data set.

The samples were collected by Brown & Root Environmental on 5/5/93 and analyzed by GP Environmental Laboratories under Naval Energy and Environmental Support Activity (NEESA) Level C Quality Assurance/Quality Control (QA/QC) criteria. All analyses were conducted using Contract Laboratory Program Statement of Work (SOW) 3/90 analytical and reporting protocols.

Summary

Mercury was successfully analyzed in all samples. The findings offered in this report are based upon a general review of all available data including data completeness, holding times, calibration data, laboratory method blank results, laboratory control sample results, matrix spike and laboratory duplicate results, and analyte quantitation.

Areas of concern with respect to data quality are listed below.

Minor Problems

The laboratory duplicate Relative Percent Difference (%RPD) for mercury (130.9%) failed to meet the 35% quality control limit for soils. Additionally, the Matrix Spike (MS) Percent Recovery (%R) for mercury (35.1%) was below the 75% lower quality control limit, yet > 30%. Only positive results were reported for mercury in the soil samples. These results are considered to be estimated, and are thus qualified, [coded J(d,m)]. The direction of bias cannot be determined for these results.

Notes

In accordance with EPA Region III data validation protocol, no qualifications are made to the sample data based on the evaluation of field duplicate precision. Tables summarizing the field duplicate results can be found in the attached HNUS/CLEAN Data Validation Worksheets (Appendix C).

Discussions with GP Environmental laboratory supervisory personnel concerning total mercury analyses in soil matrices indicated peculiar anomalies with the sample matrix. This is thought to be attributable to the inherent lack of homogeneity of the mercury present in the sample matrix as noted in the laboratory's case narrative comments. The heterogeneous nature of these samples seems to be causing analytical difficulty in terms of reproducibility of results.

The discussion of the potential presence of matrix affects is included in this memorandum for informational purposes only.

No other problems were noted.

Executive Summary

Laboratory Performance: Laboratory duplicate imprecision was noted for mercury in the soil matrix.

Other Factors Affecting Data Quality: Sample results may be affected by matrix interferences as noted in the laboratory's case comments and as evidenced by the matrix spike noncompliance as well as field duplicate imprecision.

Data for these analyses were reviewed with reference to the

"National Functional Guidelines for Inorganic Data Validation" (7/88), as amended for use within EPA Region III, and the NEESA guidelines document "Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program" (NEESA 20.2-047B; June, 1988).

The text of this report has been formulated to address only those problem areas affecting data quality. Documentation of compliance for non-problem areas is presented in the attached Appendix C (HNUS/CLEAN Data Validation Worksheets.)

"I attest that the data referenced herein were validated according to the agreed-upon validation criteria as specified in the NEESA Guidelines and the Quality Assurance Project Plan (QAPP)."

Ricky C. DePaul

Brown & Root Environmental Corporation

Ricky C. DePaul
Data Reviewer

Debra A. Scheib

Brown & Root Environmental Corporation

Debra Scheib
CLEAN Quality Assurance Manager

Attachments:

1. Appendix A - Qualified Analytical Results
2. Appendix B - Results as Reported by the Laboratory
3. Appendix C - HNUS/CLEAN Data Validation Worksheets
4. Appendix D - Support Documentation

Appendix A

QUALIFIED ANALYTICAL RESULTS

CLEAN SDG M1-S1D
INDIAN HEAD, MARYLAND
GP ENVIRONMENTAL SERVICES INC.

TAL SOIL MERCURY (mg/kg)

CLIENT ID:			M1-S-1		M1-S1D		M2-S-2		M4-S-2		M4-S2D	
LAB ID:			930503701A		930503702A		930503703A		930503704A		930503705A	
ANALYTE	CRDL	IDL										
MERCURY	0.1	0.1	7.00	J(d,m)	85.00	J(d,m)	10.60	J(d,m)	17.40	J(d,m)	19.70	J(d,m)

Brown & Root Environmental INTERNAL CORRESPONDENCE

C-49-07-3-179

TO: TONY KLIMEK DATE: JULY 20, 1993

FROM: WILLIAM J. BROTZ COPIES: D.A. SCHEIB

SUBJECT: INORGANIC DATA VALIDATION - MERCURY (COLD VAPOR)
CTO 99, NSWC INDIAN HEAD, INDIAN HEAD, MARYLAND
SDG S1-IA2

SAMPLES:

6/Soils/

S1-IA2	S1-IA2D	S1-IA2S	S2-IA1
S2-IA2	S3-IA2		

Overview

The sample set for the CTO 99 NWSC Indian Head site, SDG M1-S1D, consists of six (6) soil samples (including one field duplicate pair, the duplicate member of which is designated -D). These samples were subjected to Toxicity Characteristic Leaching Procedure (TCLP) extraction, with subsequent analysis for total mercury. Because these samples were obtained for waste characterization purposes only, no field quality control blanks were included for analysis in this analytical data set.

The samples were collected by Brown & Root Environmental on 4/29/93 and analyzed by GP Environmental Laboratories under Naval Energy and Environmental Support Activity (NEESA) Level C Quality Assurance/Quality Control (QA/QC) criteria. The samples were prepared using SW-846 Method 1311 (TCLP extraction) and were subsequently analyzed for total mercury via SW-846, Method 7471.

Summary

TCLP mercury was successfully analyzed in all samples. The findings offered in this report are based upon a general review of all available data including data completeness, holding times, calibration data, laboratory method blank results, laboratory control sample results, matrix spike and laboratory duplicate results, field duplicate precision and analyte quantitation.

No major or minor problems occured which could impact data quality. All sata are accepted without qualification. Items of note are discussed below.

Notes

Tables summarizing the field duplicate results can be found in the attached HNUS/CLEAN Data Validation Worksheets (Appendix C).

Executive Summary

Laboratory Performance: No problems were noted.

Other Factors Affecting Data Quality: None

Data for these analyses were reviewed with reference to method specific quality control criteria and quality control requirements outlined in the "National Functional Guidelines for Inorganic Data Validation" (7/88), as amended for use within EPA Region III, and the NEESA guidelines document "Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program" (NEESA 20.2-047B; June, 1988).

The text of this report has been formulated to address only those problem areas affecting data quality. Documentation of compliance for non-problem areas is presented in the attached Appendix C (HNUS/CLEAN Data Validation Worksheets.)

"I attest that the data referenced herein were validated according to the agreed-upon validation criteria as specified in the NEESA Guidelines and the Quality Assurance Project Plan (QAPP)."

7/21/93

Brown & Root Environmental Corporation

William J. Brotz
Data Reviewer

Brown & Root Environmental Corporation

Debra Scheib
CLEAN Quality Assurance Manager

MEMO TO: TONY KLIMEK
DATE: JULY 20, 1993 - PAGE 3

Attachments:

1. Appendix A - Qualified Analytical Results
2. Appendix B - Results as Reported by the Laboratory
3. Appendix C - HNUS/CLEAN Data Validation Worksheets
4. Appendix D - Support Documentation

Appendix A

QUALIFIED ANALYTICAL RESULTS

GP ENVIRONMENTAL SERVICES INC.

TAL SOIL INORGANICS (mg/kg)

CLIENT ID:			S1-IA2		S1-IA2D		S1-IA2S		S2-IA1		S2-IA2	
LAB ID:			930502501A		930502501A		930502501A		930502502A		930502503A	
ANALYTE	CRDL	IDL										
MERCURY	0.2	0.2	20.0	U	20.0	U	20.0	U	20.0	U	20.0	U

GP ENVIRONMENTAL SERVICES INC.

TAL SOIL INORGANICS (mg/kg)

CLIENT ID:			S3-IA2	
LAB ID:			930502504A	
ANALYTE	CRDL	IDL		
MERCURY	0.2	0.2	20.0	U

APPENDIX B

GRAIN SIZE ANALYSIS

NUS CORPORATION

Laboratory No. P233514

Sheet ____ of ____

Project Name NAVY CLEAN Project No. ____ Tested by DU/JCL date 5-11-93

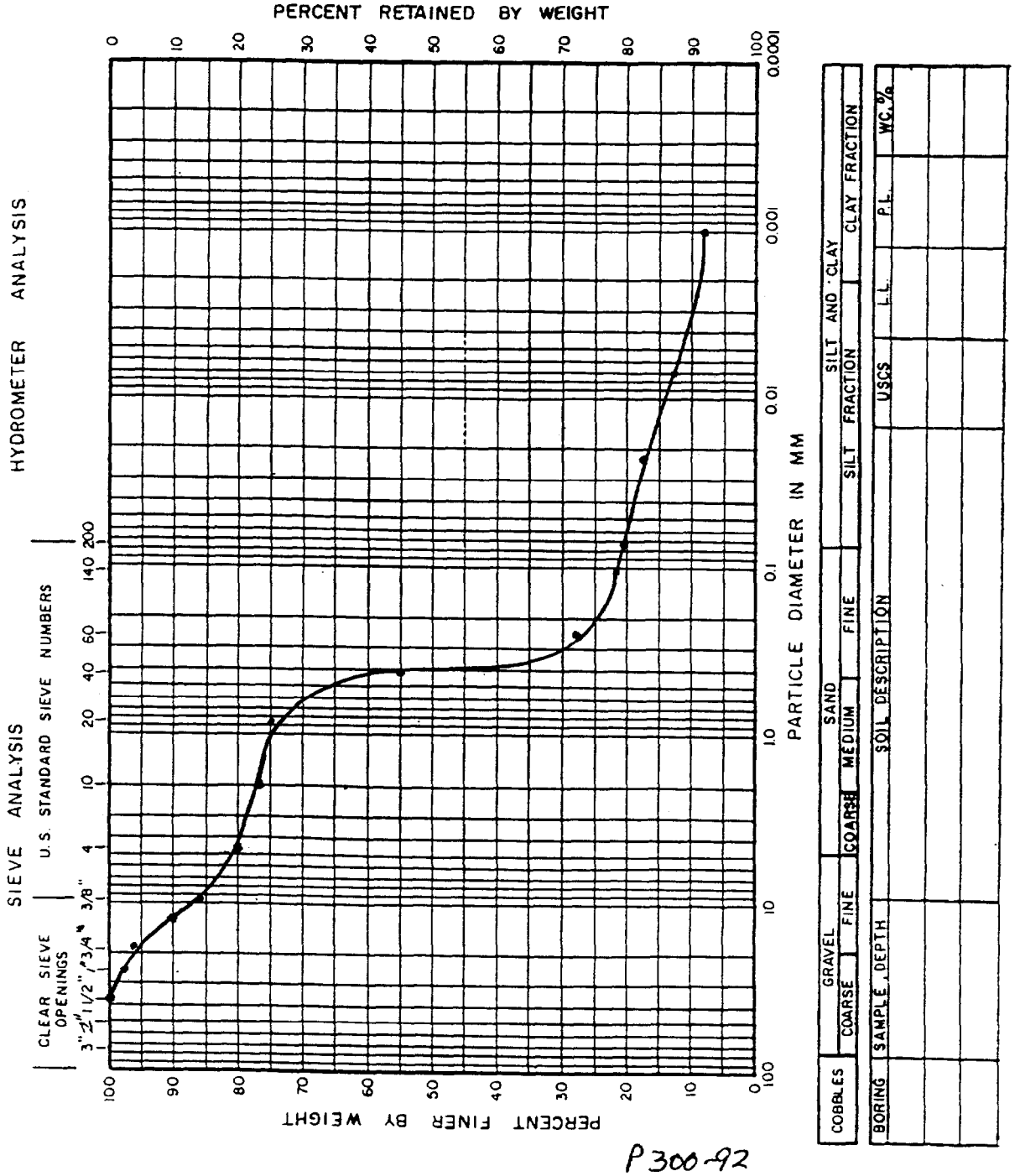
Boring/Test Pit No. [illegible] Sample No. ____ Calculated by DU/JCL date 5-[illegible]

Sample Depth ____ Sample Type ____ Checked by JCL date 5-17-93

Sample Description ____

Sample Preparation Method ____

GRAIN SIZE ANALYSIS
COHESIVE MATERIAL



P 300-92

89

NUS CORPORATION

Laboratory No. P233515

Sheet ____ of ____

Project Name NAVY CLEAN Project No. ____ Tested by DL/RL date 5-11-93

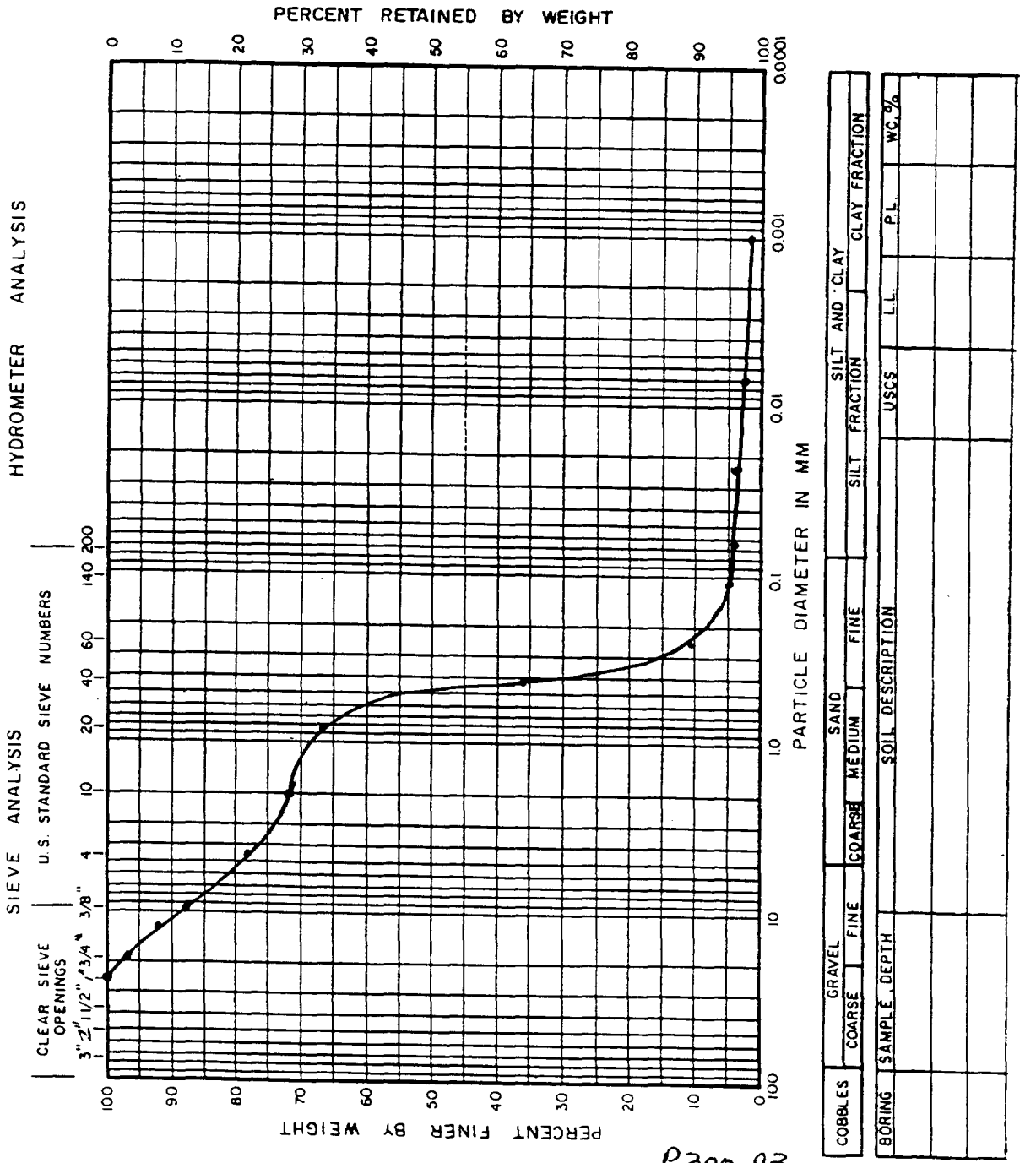
Boring/Test Pit No. ____ Sample No. ____ Calculated by ↓/↓ date 5-17-93

Sample Depth ____ Sample Type ____ Checked by RL date 5-17-93

Sample Description ____

Sample Preparation Method ____

GRAIN SIZE ANALYSIS
COHESIVE MATERIAL



P300-92

90

NUS CORPORATION

Laboratory No. P233516

Sheet ____ of ____

Project Name NAVY CLEAN Project No. ____ Tested by DN/RL date 5-11-93

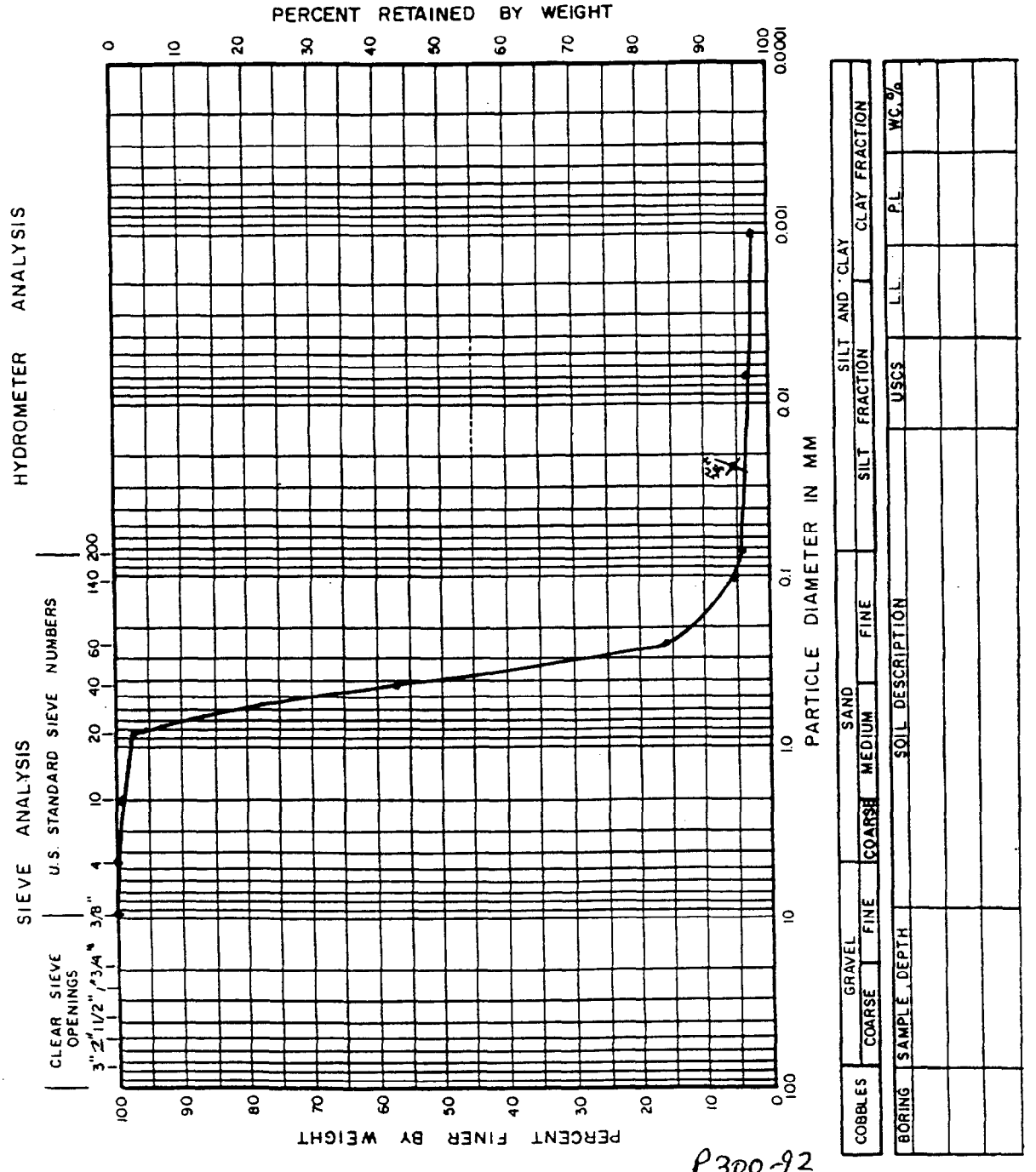
Boring/Test Pit No. ____ Sample No. ____ Calculated by ↓ / ↓ date 5-

Sample Depth ____ Sample Type ____ Checked by JRL date 5-17-93

Sample Description ____

Sample Preparation Method ____

GRAIN SIZE ANALYSIS
COHESIVE MATERIAL



P300-92

91

NUS CORPORATION

Laboratory No. P233517

Sheet ____ of ____

Project Name NAVY CLEAN Project No. ____ Tested by DW/TCL date 5-11-93

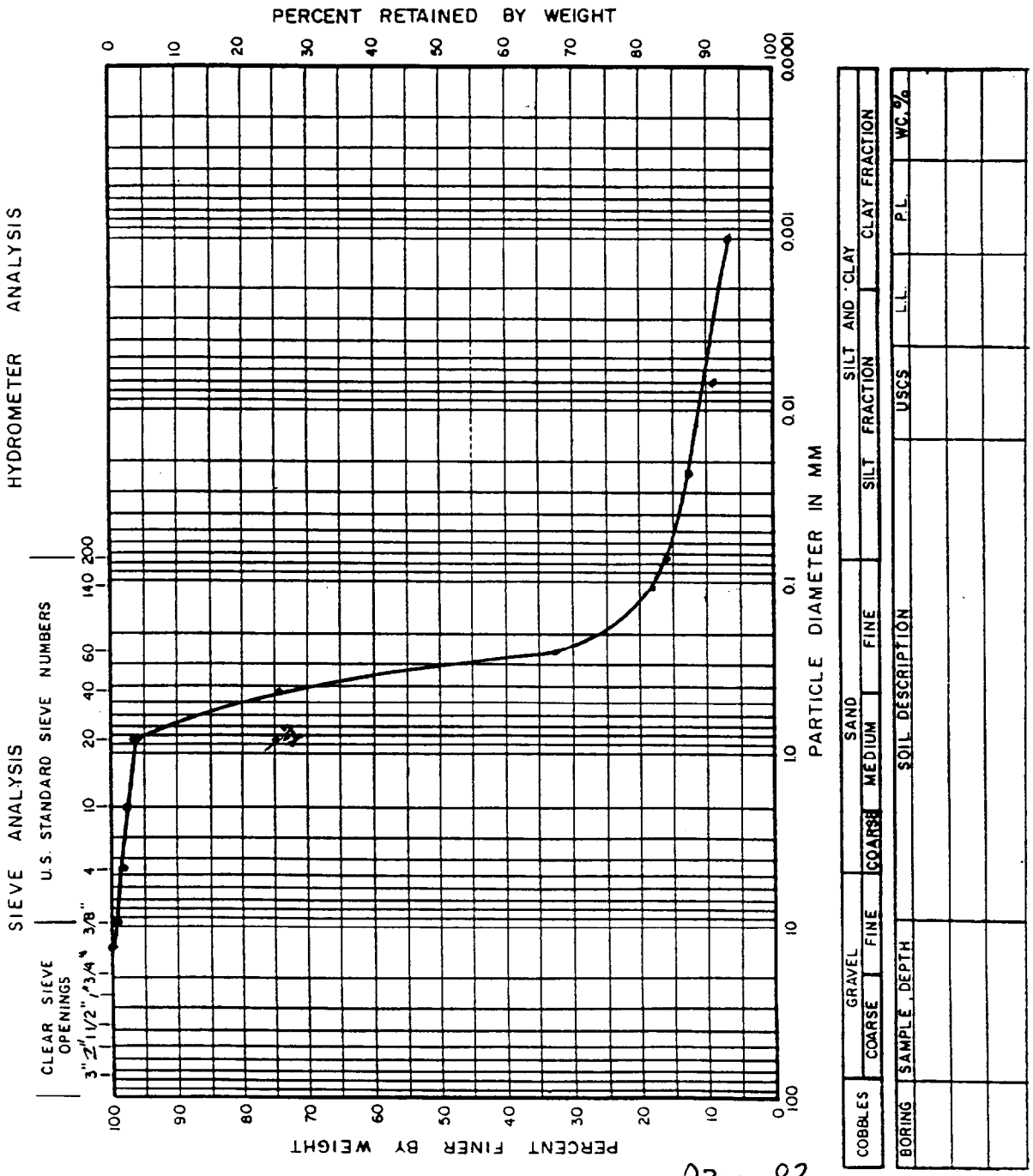
Boring/Test Pit No. ____ Sample No. ____ Calculated by ↓/↓ date 5-17-93

Sample Depth ____ Sample Type ____ Checked by TCL date 5-17-93

Sample Description ____

Sample Preparation Method ____

GRAIN SIZE ANALYSIS
COHESIVE MATERIAL



P300-92

92

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Environmental Corporation
Environmental Laboratories

5350 Campbells Run Road
Pittsburgh, PA 15205

900 Gemini Avenue
Houston, TX 77058

CC: PF
R. SIMCIK

May 19, 1993
Report No.: 00015116
Section A Page 1

LABORATORY ANALYSIS REPORT

CLIENT NAME: NAVY CLEAN - C/O HALLIBURTON NUS
ADDRESS: 661 ANDERSEN DRIVE
PITTSBURGH, PA 15220-0000
ATTENTION: MR.TONY KLIMEK

NUS CLIENT NO: 1495 0009
WORK ORDER NO: ~~5508~~
VENDOR NO: 6190-010

Carbon Copy:

SAMPLE ID: S-1
NUS SAMPLE NO: P0233514
P.O. NO.: CTO # 64

DATE SAMPLED: UnAvail
DATE RECEIVED: 30-APR-93
APPROVED BY: Chuck Kieda

LN	TEST CODE	DETERMINATION	RESULT	UNIT
1	T45	Grain Size - Sieve & Hydrometer		
		b. 1.5 inch sieve	100.0	% Passed
		c. 1.0 inch sieve	98.0	% Passed
		d. 3/4 inch sieve	96.7	% Passed
		e. 1/2 inch sieve	90.0	% Passed
		f. 3/8 inch sieve	85.9	% Passed
		g. Sieve No. 4	80.0	% Passed
		h. Sieve No. 10	77.1	% Passed
		i. Sieve No. 20	74.9	% Passed
		j. Sieve No. 40	55.0	% Passed
		k. Sieve No. 60	27.8	% Passed
		l. Sieve No. 140	21.9	% Passed
		m. Sieve No. 200	21.1	% Passed
		n. Particle Size .022mm	17.7	% Passed
		o. Particle Size .007mm	13.1	% Passed
		p. Particle Size .001mm	8.5	% Passed
2	I490S	Non-aqueous sample pH in Water	6.9	

COMMENTS:

HALLIBURTON NUS
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May 19, 1993
Report No.: 00015116
Section A Page 2

LABORATORY ANALYSIS REPORT

CLIENT NAME: NAVY CLEAN - C/O HALLIBURTON NUS
ADDRESS: 661 ANDERSEN DRIVE
PITTSBURGH, PA 15220-0000
ATTENTION: MR.TONY KLIMEK

NUS CLIENT NO: 1495 0009
WORK ORDER NO: 5508-
VENDOR NO:

Carbon Copy:

SAMPLE ID: S-2
NUS SAMPLE NO: P0233515
P.O. NO.: CTO # 64

DATE SAMPLED: UnAvail
DATE RECEIVED: 30-APR-93
APPROVED BY: Chuck Kieda

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	T45	Grain Size - Sieve & Hydrometer		
		c. 1.0 inch sieve	100.0	% Passed
		d. 3/4 inch sieve	97.0	% Passed
		e. 1/2 inch sieve	91.8	% Passed
		f. 3/8 inch sieve	88.2	% Passed
		g. Sieve No. 4	78.6	% Passed
		h. Sieve No. 10	72.1	% Passed
		i. Sieve No. 20	66.8	% Passed
		j. Sieve No. 40	35.8	% Passed
		k. Sieve No. 60	10.5	% Passed
		l. Sieve No. 140	4.8	% Passed
		m. Sieve No. 200	3.7	% Passed
		n. Particle Size .023mm	3.6	% Passed
		o. Particle Size .007mm	2.5	% Passed
		p. Particle Size .001mm	1.8	% Passed
2	I490S	Non-aqueous sample pH in Water	8.5	

COMMENTS:

HALLIBURTON NUS
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May 19, 1993
Report No.: 00015116
Section A Page 3

LABORATORY ANALYSIS REPORT

CLIENT NAME: NAVY CLEAN - C/O HALLIBURTON NUS
ADDRESS: 661 ANDERSEN DRIVE
PITTSBURGH, PA 15220-0000
ATTENTION: MR.TONY KLIMEK

NUS CLIENT NO: 1495 0009
WORK ORDER NO: 5508-
VENDOR NO:

Carbon Copy:

SAMPLE ID: S-3
NUS SAMPLE NO: P0233516
P.O. NO.: CTO # 64

DATE SAMPLED: UnAvail
DATE RECEIVED: 30-APR-93
APPROVED BY: Chuck Kieda

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	T45	Grain Size - Sieve & Hydrometer		
		f. 3/8 inch sieve	100.0	% Passed
		g. Sieve No. 4	99.8	% Passed
		h. Sieve No. 10	99.5	% Pas
		i. Sieve No. 20	97.4	% Pas
		j. Sieve No. 40	57.0	% Passed
		k. Sieve No. 60	15.8	% Passed
		l. Sieve No. 140	5.7	% Passed
		m. Sieve No. 200	4.2	% Passed
		n. Particle Size .023mm	5.6 ^	% Passed
		o. Particle Size .007mm	3.5	% Passed
		p. Particle Size .001mm	2.5	% Passed
2	I490S	Non-aqueous sample pH in Water	6.8	

COMMENTS: ^ Excessive foam in hydrometer hindered an accurate reading.

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May 19, 1993
Report No.: 00015116
Section A Page 4

LABORATORY ANALYSIS REPORT

CLIENT NAME: NAVY CLEAN - C/O HALLIBURTON NUS
ADDRESS: 661 ANDERSEN DRIVE
PITTSBURGH, PA 15220-0000
ATTENTION: MR.TONY KLIMEK

NUS CLIENT NO: 1495 0009
WORK ORDER NO: 5508-
VENDOR NO:

Carbon Copy:

SAMPLE ID: S-4
NUS SAMPLE NO: P0233517
P.O. NO.: CTO # 64

DATE SAMPLED: UnAvail
DATE RECEIVED: 30-APR-93
APPROVED BY: Chuck Kieda

LN	TEST CODE	DETERMINATION	RESULT	UNITS
1	T45	Grain Size - Sieve & Hydrometer		
		e. 1/2 inch sieve	100.0	% Passed
		f. 3/8 inch sieve	99.3	% Passed
		g. Sieve No. 4	98.7	% Passed
		h. Sieve No. 10	98.2	% Passed
		i. Sieve No. 20	96.8	% Passed
		j. Sieve No. 40	74.4	% Passed
		k. Sieve No. 60	32.6	% Passed
		l. Sieve No. 140	18.5	% Passed
		m. Sieve No. 200	16.1	% Passed
		n. Particle Size .023mm	12.9	% Passed
		o. Particle Size .007mm	8.9	% Passed
		p. Particle Size .001mm	7.0	% Passed
2	I490S	Non-aqueous sample pH in Water	6.2	

COMMENTS:

CLIENT ORIGINAL

HALLIBURTON NUS
Environmental Corporation
Environmental Laboratories

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May 19, 1993
Report No.: 00015116
Section B Page 1

QUALITY CONTROL REPORT
SUPPLEMENTAL INFORMATION

			SAMPLE PREPARATION			SAMPLE ANALYSIS				
LN	TEST CODE	BATCH	LR-METHOD	DATE/TIME	ANALYST	LR-METHOD	DATE/TIME	ANALYST	ANLS BATCH	INSTRUMENT

SAMPLE ID: S-1 NUS SAMPLE NO: P0233514

1	T45	0	NA			01-D422	11-MAY-93	800	JL	0
2	I490S	17872	NA			19-9045	01-MAY-93	1300	CMW	0

LR Method Literature Reference
01 ASTM-American Society for Testing and Materials, Part 31, 1979.
19 EPA-Test Methods for Evaluating Solid Waste, 3rd ed, Nov. 1986

SAMPLE ID: S-2 NUS SAMPLE NO: P0233515

1	T45	0	NA			01-D422	11-MAY-93	800	JL	0
2	I490S	17872	NA			19-9045	01-MAY-93	1300	CMW	0

LR Method Literature Reference
01 ASTM-American Society for Testing and Materials, Part 31, 1979.
19 EPA-Test Methods for Evaluating Solid Waste, 3rd ed, Nov. 1986

SAMPLE ID: S-3 NUS SAMPLE NO: P0233516

1	T45	0	NA			01-D422	11-MAY-93	800	JL	0
2	I490S	17872	NA			19-9045	01-MAY-93	1300	CMW	0

LR Method Literature Reference
01 ASTM-American Society for Testing and Materials, Part 31, 1979.
19 EPA-Test Methods for Evaluating Solid Waste, 3rd ed, Nov. 1986

SAMPLE ID: S-4 NUS SAMPLE NO: P0233517

1	T45	0	NA			01-D422	11-MAY-93	800	JL	0
2	I490S	17872	NA			19-9045	01-MAY-93	1300	CMW	0

LR Method Literature Reference

HALLIBURTON NUS
Environmental Corporation
Environmental Laboratories

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Pittsburgh, PA 15205

900 Gemini Avenue
Houston, TX 77058

QUALITY CONTROL REPORT
SUPPLEMENTAL INFORMATION

			SAMPLE PREPARATION			SAMPLE ANALYSIS				
LN	TEST CODE	BATCH	LR-METHOD	DATE/TIME	ANALYST	LR-METHOD	DATE/TIME	ANALYST	ANLS BATCH	INSTRUMENT

LR Method Literature Reference

01 ASTM-American Society for Testing and Materials, Part 31, 1979.
19 EPA-Test Methods for Evaluating Solid Waste, 3rd ed, Nov. 1986

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May 19, 1993
Report No.: 00015116
Section F Page 1

QUALITY CONTROL REPORT
DUPLICATE AND MATRIX SPIKE DATA

PREP BATCH: 17872 NUS SAMPLE NO: P0233267

TEST	DETERMINATION	ORIGINAL RESULT	DUPLICATE RESULT	UNITS	RANGE / RPD	UNITS	MS RESULT	MS % RC
I490S	Non-aqueous sample pH in Water	9.7	9.76		0.205			