INVESTIGATION OF STABLEX® MATERIAL EMPLACED AT WEST THURROCK FACILITY, ENGLAND
DRAFT REPORT

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FOREWORD

The Environmental Protection Agency was created because of increasing public and government concern about the dangers of pollution to the health and the environment. Noxious air, foul water, and spoiled land are tragic testimony to the deterioration of our natural environment. The complexity of the environment and the interplay between its components require a concentrated and integrated attack on the problem.

Research and development is a necessary first step in problem solution and it involves defining the problem, measuring its impact, and searching for solutions. The Municipal Environmental Research Laboratory develops new and improved technology and systems for the prevention, treatment, and management of wastewater and solid and hazardous waste pollutant discharges from municipal and community sources, for the preservation and treatment of public drinking water supplies, and to minimize the adverse economic, social, health, and aesthetic effects of pollution. This publication is one of the products of that research; a most vital communications link between the researcher and the user community.

This study examines the Sealosafe® process used at the West Thurrock Facility of Stablex International Holding Ltd., West Thurrock, England that treats hazardous industrial wastes. Studies such as this advance our understanding of techniques developed for managing (i.e. landfilling) industrial waste with minimum impact on human health and the environment.

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ABSTRACT

In the Spring of 1981, the U.S. Army Engineer Waterways Experiment Station (WES) undertook a field and laboratory study to characterize the treated residue generated at Stablex Limited's facility in Essex County, England. In particular, thirteen cores of the solidified Sealosafe® treated waste were collected from the Aveley Clay Pit and Thurrock Chalk Quarry disposal areas at Stablex Limited's West Thurrock site in England to determine if, under routine waste management conditions, these wastes would degrade with time and leach significant concentrations of toxic heavy metals and cyanide and contaminate the surrounding environment. In addition, samples of surface water, ground water, of uncured Sealosafe® treated waste, and of subwaste rock and soil were also collected at the site to demonstrate the effectiveness of the treatment process used at the West Thurrock facility.

This report describes the methods used in collecting these samples as well as the procedures used, including quality control, and results obtained in testing and analyzing them. The primary testing procedure employed with the cured and uncured treated waste was EPA's extraction procedure (EP). Finally, the report presents a discussion on the analytical results and our conclusions.

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The project was conducted under the general supervision of Dr. John Harrison, Chief, Environmental Laboratory, Mr. Andrew J. Green, Chief, Environmental Engineering Division, and Mr. Norman R. Francingues, Chief, Water Supply and Waste Treatment Group. Director of the WES during the course of this study was COL Tilford C. Creel, CE. Technical Director was F. R. Brown.

SECTION 1

INTRODUCTION

Background

Under the Resource Conservation and Recovery Act, the U. S. Environmental Protection Agency (EPA) is responsible for a nationwide program to identify wastes which, if mismanaged, pose a substantial hazard to human health or the environment and to establish minimum standards for the management of such hazardous wastes. In accord with this mandate, EPA has published regulations identifying the characteristics of hazardous wastes and listing specific hazardous wastes, and established management standards for such wastes. In addition, EPA has established criteria by which generators or other persons may demonstrate that a waste does not pose a hazard and thus should not be regulated as a hazardous waste.

Several processes for treating inorganic type wastes involve chemically treating the wastes with a variety of additives to render the wastes' inorganic constituents relatively immobile in the environment. Among the processes thought to be successful in achieving a low mobility of inorganic constituents are the solidification/stabilization, or fixation processes. This project was aimed at determining if, under routine waste management conditions, these processes yield relatively non-leachable products that will not degrade with time and, thus, will not contaminate the surrounding environment (i.e., ground water or surface water).

The Stablex Corporation (a U. S. Company) is in the process of establishing several commercial hazardous waste treatment facilities in the United States that will use the Sealosafe® solidification/stabilization process. Stablex and Stablex Limited, a licensee of the Sealosafe® process, allowed the EPA to undertake a field and laboratory investigation to characterize the wastes which have been treated using the Sealosafe process at Stablex Limited's facility in Essex County, England. The EPA requested that the Waterways Experiment Station (WES) undertake an investigation of treated waste at the West Thurrock facility and collect additional data at the site that might demonstrate the effectiveness of the treatment process.

It should be noted that the treatment system employed by Stablex Corporation's recently opened facility in Blainsville, Quebec and the treatment system proposed to be used in their U.S.-based facilities, although similar, are different than that used at Stablex Limited's facility in West Thurrock, England. For example, Stablex has indicated that the cyanide destruction process incorporated at their Blainsville, Quebec facility and to be used at their proposed U.S.-based facilities is more effective than that used by

Stablex Limited. In addition, the placement of the treatment residue in the final disposal area is also managed differently at Thurrock than at Blainsville, Quebec or as proposed to be managed at Stablex Corporation's proposed U.S.-based facilities. In particular, at Stablex Blainsville facility and at their proposed U.S.-based facilities, the Sealosafe treated residue will be poured into heated molds to assist the curing process, at least in the winter time, whereas in England the treated residue is simply poured out of the truck and flows down a hill. Therefore, the results obtained from the sampling visit must be viewed in this light. Furthermore, since Stablex Limited's facility in West Thurrock is not subject to any U.S.-based standards and guidelines, the results from this report should not be interpreted to mean that Stablex Limited is not in compliance with the appropriate regulatory authorities.

Objectives

Over the past three years, EPA has received several exclusion petitions from the Stablex Corporation to exclude (or delist) temporarily the treatment residue to be generated from Stablex's proposed facilities in Groveland, Michigan and Hooksett, New Hampshire. In order to support their petitions, Stablex submitted leachate test data on U.S. (stock solutions) and English stabilized wastes; total constituent analyses of the Stablex material; ground water and surface water run-off monitoring data from their facility in West Thurrock, England; and confidential information identifying stock solution constituents, and mixing ratios of the various stabilizing agents used in the treatment process. Based on this information, EPA granted conditional temporary exclusions for the Sealosafe® treated waste to be generated at Stablex Corporation's proposed facilities in Groveland, Michigan, and Hooksett, New Hampshire. Stablex also offered EPA the opportunity to undertake a field and laboratory study to characterize the wastes which have been treated using the Sealosafe® process at Stablex Limited's facility in West Thurrock, England. One of the objectives of this study was to determine whether the data submitted as part of Stablex Corporation's petitions could be verified in a full scale facility operating in field conditions. In addition, this study was also conducted to provide data for the on-going EPA research program on "stabilized wastes." More specifically, laboratory analyses of the samples collected were undertaken to:

- Determine if the toxic heavy metals in the Sealosafe® treated waste as placed in the disposal area have been sufficiently immobilized.
- Determine if the older, weathered Sealosafe® treated waste leached higher concentrations of toxic heavy metals compared to the newer material emplaced in the disposal area.
- Determine if appreciable variation, with respect to metal extractability, occurred during long-term commercial operation of the Sealosafe® process.
- Determine if samples of the fresh (uncured) Sealosafe® treated waste met the levels established as part of the Stablex delisting decision.

Ground water, surface water, and subwaste clay and chalk samples from the site were also analyzed to determine if elevated concentrations of the potential toxicants could be detected. This would be evidence that the toxic constituents were escaping from the treated waste.

Sealosafe® Process

The wastes as they enter the West Thurrock treatment plant are segregated by waste type, ground, where necessary, and blended to produce a neutral relatively homogeneous waste mixture. Some wastes (i.e., arsenic, chromium, and cyanides) are pretreated to convert them to a less toxic form. The conditioned wastes are then treated using the Stablex Corporation's proprietary solidification process, called the Sealosafe® process. The Sealosafe® process itself involves the addition of a calcium containing cement powder to the waste that is dissolved or suspended in water. A setting (or polymerization) reaction takes place within 24 to 72 hours that gives the resulting material better containment properties.

The first commercial facility using the process was constructed near Brownhills, northwest of Birmingham, England in 1974. A second facility at Brownhills with larger treatment capacity came on line in March, 1978. The third facility was put in operation at Thurrock (20 miles east of London) (Schofield, 1979). The plant at Thurrock and the adjacent disposal areas were the facilities visited and sampled during this investigation.

Thurrock Plant Operations

The Thurrock Plant (Fig. 1) has a capacity for treating 400,000 metric tons of waste per year. The wastes arrive at the plant through a reception area that includes three large concrete storage basins (total capacity 25,000 metric tons) equipped with slow speed stirrers and compressed-air agitation. Drummed liquid wastes are tested and mixed with tank-discharged wastes. The facility normally receives only inorganic wastes for processing and wastes with low organic content. The wastes include liquid and solid waste and may vary due to changing productivity and activities of client industries. A large mixer/grinder reduces solids to a particle size that allows all the materials to be handled as a suspension.

A general description of the wastes received during the period July to December 1980 (by waste type) is provided in Table 1. A summary for the same period by type of waste producer is given in Table 2.

Some waste require chemical pretreatment. Arsenic, chromium, and cyanide wastes are converted to chemical forms suitable for mixing with the setting agents. In some cases, it is necessary to pretreat the waste to prevent certain waste components from interfering with the polymerization reaction.

The polymerization (or setting) reaction is produced by adding proprietary reactants on a weight-controlled basis. Polymerization takes place at normal temperatures and pressure. It is reported that no gases are produced and no liquid is discharged during the process (Schofield, 1979).

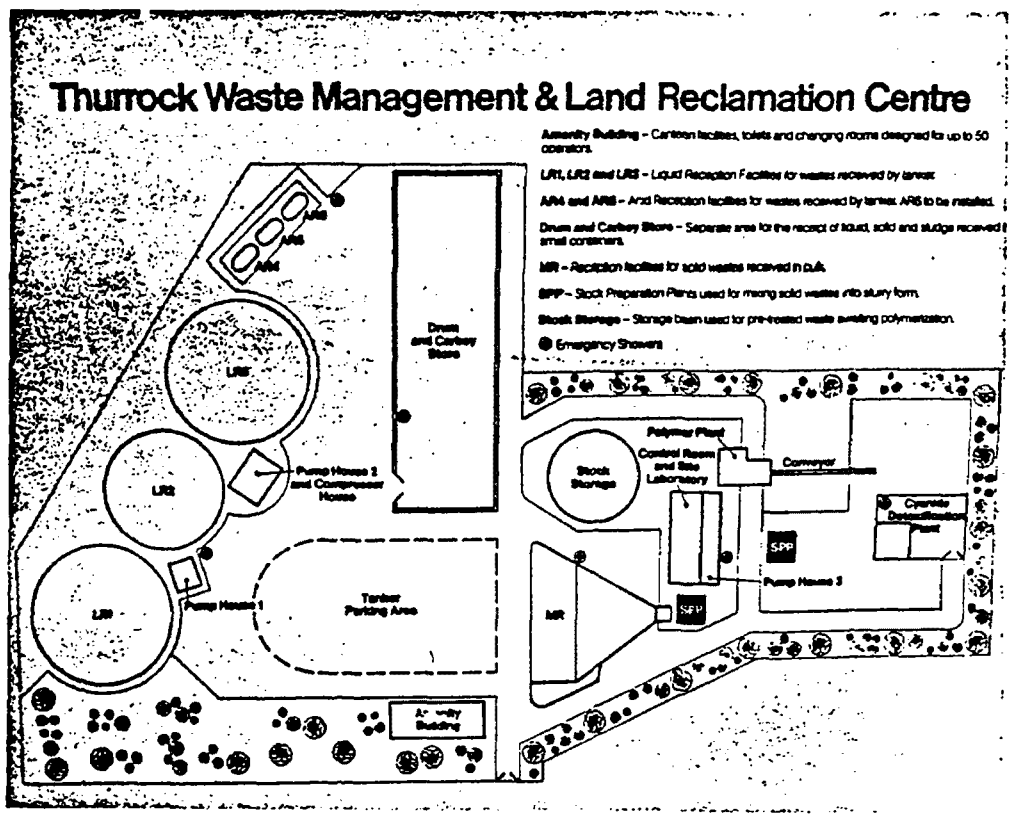

Figure 1. Diagram of the Stablex Facility at Thurrock, England.

TABLE 1. SUMMARY OF WASTE INPUT AT THE THURROCK PLANT DURING THE PERIOD JULY TO DECEMBER, 1980 BY TYPE OF WASTE*

Type of Waste	Percent of Waste Received
Sulphuric acid	4.7
Hydrochloric acid	4.6
Chromic acid	0.6
Mixed acids/other acids	6.6
Aluminum chloride solution	16.2
Ferric chloride solution	0.9
Solid/liquid cyanides	2.7
Caustic solutions	30.5
Neutral sludges	10.4
Lime sludge	14.0
Other sludges	0.8
Filter cakes	1.1
Paint stripper washings	1.7
Ferrous sulphate	1.0
Others	3.1

* Furnished by Stablex-Reutter, Inc., March 12, 1982. Stablex-Reutter is an affiliate of Stablex Corp.

TABLE 2. SUMMARY OF WASTE INPUT AT THE THURROCK PLANT DURING THE PERIOD JULY TO DECEMBER, 1980 BY TYPE OF WASTE PRODUCER*

Type of Waste Producer	Percent of Waste Received
Plating shops	31.4
Chemical manufacturers	17.6
Metal and chemical refiners	31.8
Cosmetic producers	16.3
Power stations/oil refiners	1.0
Aircraft manufacturers	1.9

* Furnished by Stablex-Reutter, Inc., March 12, 1982. Stablex-Reutter is an affiliate of Stablex Corp.

The polymer in slurry form is transported to the disposal site in open-topped hopper trucks. The trucks are opened to allow the slurry to pour out (Fig. 2) and then elevated to dump the bottom materials. The discharged material then flows down a hill into the emplacement area. The operating disposal area in March-April, 1982 was a former clay pit (Aveley Clay Pit) approximately 5 km northwest of the plant (Fig. 3). Core samples taken from this site and an area used for trial placement of the Stablex material in a chalk quarry (Thurrock Chalk Quarry, Fig. 3) provided the material used in this study.

Sample Collection and Analysis

This study was conducted by WES under the direction of the Municipal Environmental Research Laboratory and the Office of Solid Waste, U.S. Environmental Protection Agency (EPA). In particular, the selection of all sampling points and the collection of all samples was conducted by EPA or WES and their subcontractor (Pollution Prevention (Consultants) Ltd); also, the storage area that was used to store the samples at Stablex Limited's facility in West Thurrock, England prior to shipment was controlled entirely by the WES field supervisor. In addition, although splits of all samples were provided to both Stablex and Stablex Limited, all analyses reported in this report were conducted by WES's analytical group and EPA's Environmental Monitoring and Support Laboratory (EMSL) in Las Vegas. The analytical laboratories carried out this evaluation using a carefully developed quality control program to assure accuracy, reliability, and comparability of results -- namely, replicate runs on single specimens, spiked samples, standards, and splits of samples between laboratories were used to evaluate the quality and reliability of the testing and analysis.

Finally, the discussion of the data included in the report and conclusions reached are those made by WES and do not necessarily reflect the views of Stablex or Stablex Limited. It should also be noted that the discussion of the data in this report simply compares the levels reported in the various samples (i.e., ground water, surface water, or leachate results) with levels established by EPA (i.e., Water Quality Criteria or Drinking Water Standards) or levels set by EPA as part of the Stablex delisting decision.

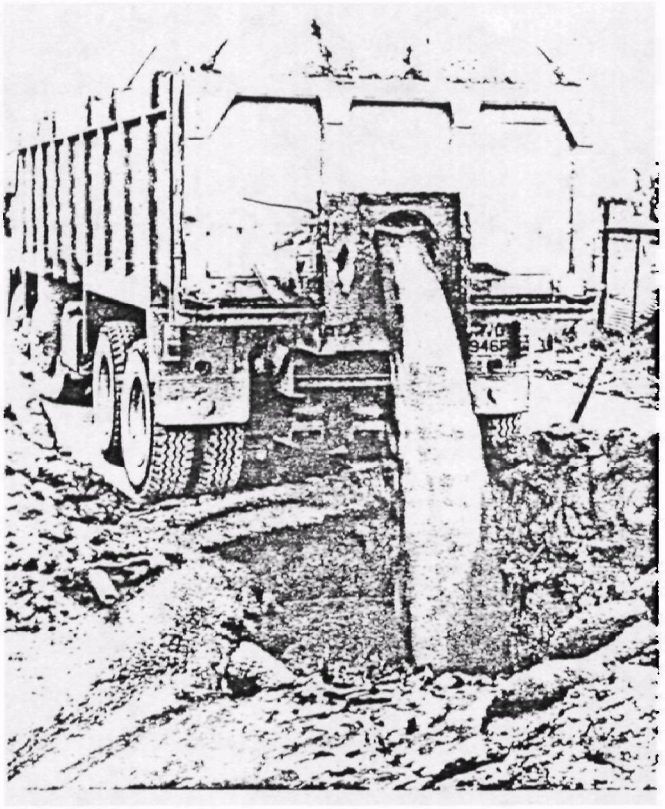

Fig. 2. Open-topped hopper truck releasing treated waste at the Aveley Clay Pit Site.

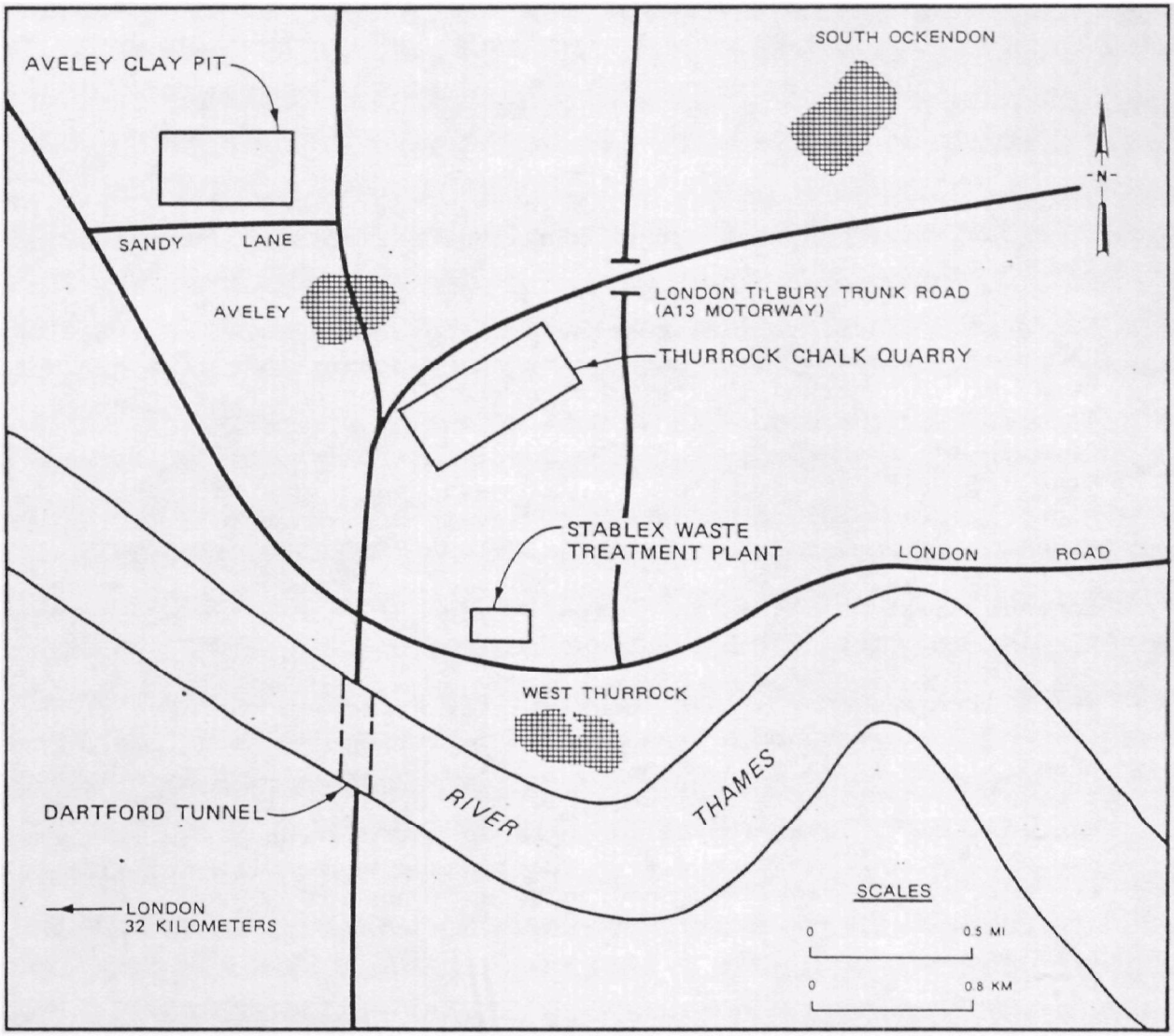

Fig. 3. Sketch map showing the locations of the Stablex Plant and the disposal areas.

SECTION 2

CONCLUSIONS

In evaluating the analytical data on samples collected from Stablex Limited's facility in West Thurrock, England, the following conclusions have been reached:

- Extraction Procedure (EP) testing on 52 ground samples of the solidified Sealosafe treated waste shows that the concentration of all the toxic heavy metals in the EP extract with the exception of selenium were at levels below the level set as part of the Stablex delisting decision (i.e., less than 30 times the National Interim Primary Drinking Water Standards (NIPDWS) for the EP toxic metals and less than 20 ppm for nickel). The Sealosafe® material contained maximum lead, chromium, arsenic, barium, cadmium, and nickel levels of 3320, 1100, 635, 1730, 79.1, and 645 ppm, respectively. Thus, the fact that these high total content levels did not leach significant concentrations demonstrates the binding capacity of the treatment residue.

- Selenium was shown to leach consistently at levels that are higher than the level set as part of the Stablex delisting decision (i.e., greater than .30 mg/l). Although none of the selenium extract levels exceeded the maximum allowable EP levels, 11 of the 52 samples analyzed met or exceeded EPA's level for delisting. No correlation was found between the amount of selenium leached from the treated waste with its bulk selenium content. Furthermore, there apears to be no consistent pattern relating older to newer, or weathered to unweathered treated waste with selenium release.

- Multiple extraction procedure (MEP) testing on five ground samples of the Sealosafe® treated waste indicates that all the toxic heavy metals, except for selenium, leached at levels below the level set as part of the Stablex delisting decision. These tests indicate that the toxic metal contaminants are sufficiently immobilized in the waste matrix. (The MEP was developed to stimulate the leaching effect of long term percolation of acidic rainfall on the waste.) Selenium was the only toxic metal that leached at high levels; it was found in two of the five samples analyzed and further confirms a potential problem of selenium leaching. In both samples (6A and 13B), the highest concentrations were observed in the fifth and sixth extractions.

- Quality control checks on an EPA-approved selenium analytical procedure (hydride generation) suggest that this technique may consistently

underestimate selenium concentrations in EP extractant samples by 40 to 60 percent Thus, more samples with unacceptably high selenium values may have been found had other techniques been employed.

°Sixteen samples of the Sealosafe® treated waste from six cores were also tested in a monolithic (or solid) condition using the Structural Integrity Procedure (SIP). The resulting extracts were then composited for each core. None of the composited extracts showed concentrations of the toxic heavy metals at levels above the level set as part of the Stablex delisting decision; in most cases, the toxic heavy metals were present at or below the limit of detection of the analytical techniques employed in the testing.

°Two samples of the Sealosafe® treated waste slurry was collected in sealed containers at the waste discharge point and tested after approximately 20 days. With the exception of cadmium, the samples leached very low levels of the toxic metals. This generally indicates that the toxic metals are immobilized in the waste slurry. Cadmium, however, leached in both samples at levels above the level set as part of the Stablex delisting decision (i.e., greater than .30 mg/l); the average level seen in duplicate tests on the two samples was 0.709 mg/l.

°Eight samples of the Sealosafe® treated waste were leached with distilled water. In addition, 52 samples of the Sealosafe® treated residue were analyzed for total cyanide and free cyanide (cyanide amenable to chlorination). This data suggests a potential problem with cyanide leaching (although only two of the eight samples leached at levels above the level set in other EPA delisting determinations--namely 2 mg/l) because of the relatively high concentrations of cyanide in the treated waste. Since pozzolonic stabilization processes are not expected to immobilize cyanide, it is important that any cyanide present in the wastes prior to the metal stabilization step be destroyed.

°Analyses of the 52 Sealosafe® treated waste samples revealed a total organic carbon (TOC) content ranging from 3,130 to 14,750 ppm (0.3 to 1.5 percent). These levels did not appear to increase the leachability of the toxic heavy metals from the waste.

°Ground-water samples collected from the eighteen monitoring wells at the Thurrock Chalk Quarry Disposal area generally indicate little, if any, toxic metal contamination was occurring at the site from the treated waste. Cyanide, however, was present in a number of the monitoring wells at levels above the U.S. Public Health Service suggested drinking water standard. Therefore, unless cyanides are destroyed in the pretreatment process, cyanide leaching appears to be a real problem.

°Surface water samples collected at the Aveley Clay Pit generally indicate very low levels of the toxic heavy metals. However, concenntrations of some of the toxic heavy metals in the pond at the base of the disposal area were present at levels as much as an order of magnitude higher than the ponds that are west of the emplacement area. Therefore, there appears to be some potential for contamination from the uncured

Sealosafe® treatment residue. This contamination probably results from drainage of the excess process water not used in the polymerization reaction or from leaching of the uncured material that flows into the pond.

- Analysis of samples of the geologic strata (clay and chalk) directly below the Sealosafe® treated waste shows no consistent pattern that could be related to the leaching of toxic heavy metals from the treated waste. This is considered significant in that it indicates that the inorganic constituents are generally immobilized by the treatment process.

SECTION 3

SAMPLE COLLECTION AND DOCUMENTATION

FIELD METHODS

The sample collection at the Thurrock Site began on March 29, 1982 and was completed on April 8, 1982 (Pollution Prevention, Ltd. 1982). The samples include:

a) four surface water samples collected from a large lagoon and two small ponds at the Aveley Clay Pit disposal area.

b) eighteen groundwater samples from monitoring wells installed by Stablex Corporation at the Thurrock Chalk Quarry Site.

c) two samples of treated waste in slurry form being discharged from a hopper truck at the Aveley Clay Pit disposal area.

d) thirteen cores through treated waste emplaced at the two disposal areas associated with the Thurrock Facility. Eight cores were from the Aveley Clay Pit, the present active disposal site while five cores were collected from the Thurrock Chalk Quarry Disposal Site. The chalk quarry site was an experimental disposal area, where 12,000 metric tons of Sealosafe was disposed of in order to determine the extent of contamination that can be expected in this type of disposal environment. A fourteenth borehole was attempted; but no core (only grab sample material) was recovered.

e) thirteen samples of subwaste geologic materials. At each boring, core collection was continued through the Sealosafe®-treated material into the clay (Aveley Clay Pit site) or chalk site (Thurrock Chalk Quarry) below the waste. There are eight samples of clay from the Aveley Site and five samples of chalk from the Thurrock Site.

Surface Water Sampling

Both the Aveley Clay Pit and the Thurrock Chalk Quarry are depressions that receive runoff from the immediately surrounding areas. At the time of the WES visit, there was no surface water at the immediate study area in the Thurrock Chalk Quarry. The Aveley Clay Pit, however, contained a large lagoon and two small ponds. The water, prior to discharge, at Aveley is routinely tested by Stablex International Holding Limited (SIHL) and the Anglian Water Authority. When testing indicates the water is sufficiently low in contaminants as judged by the Anglian Water Authority, the Stablex Corporation pumps

some of the water to a surface water system which drains to the Thames River (estuary).

The location of all sampling points are shown in Figure 4. Sampling point L1 is on a small pond at the base of the disposal area. This pond receives primarily runoff from the emplaced Sealosafe material and some discharge water directly from the polymer dumping or tipping point. Uncured Stablex material frequently flowed into this pond during the study. The other surface water samples (L2, L3, and L4) were collected from other ponds that received primarily surface water runoff. These ponds are separated from the small pond located at the base of the disposal area by a dike or bond. However, during part of the study, a channel existed in the dike to enable free flow from the pond at the base of the waste emplacement area into the large lagoon. Upon each surge of uncured waste into the pond, an approximately equal amount of water was displaced into the large lagoon.

Surface water samples were collected by the WES contractor on April 6, 1982, using a bailer-type sampler. The pH was measured on-site at the time of collection using a battery-powered pH meter. Conductivity was also measured using a portable conductivity cell. The pH and conductivity measurements are presented in Table 3. No temperature measurements were reported. At each sample point, a two-liter sample intended for general chemical analysis was

TABLE 3. CONDUCTIVITY AND pH MEASUREMENTS OF SURFACE WATER SAMPLES COLLECTED AT THE AVELEY CLAY PIT DISPOSAL SITE, APRIL 6, 1982

Sample designation	Electrolytic conductivity (microS/cm)	pH conventional units(s)
L1	20200	9.6
L2	4480	8.0
L3	4500	8.1
L4	1700	7.4

filtered through a 0.45-micron membrane filter and acidified with reagent grade nitric acid to pH 2.0. The acidified sample was transferred to two clean, one-liter glass jugs for shipment to WES. The WES contractor also collected a 2.5-liter unfiltered, unpreserved (unacidified) sample at each of the four sampling points. These samples were originally collected to determine the concentration of hexavalent chromium.

All surface water samples were shipped in sealed, unrefrigerated cases. The samples were received for analysis by the Analytical Laboratory Group, WES, on April 22, 1982 and stored in a locked refrigerator pending sample preparation and analysis.

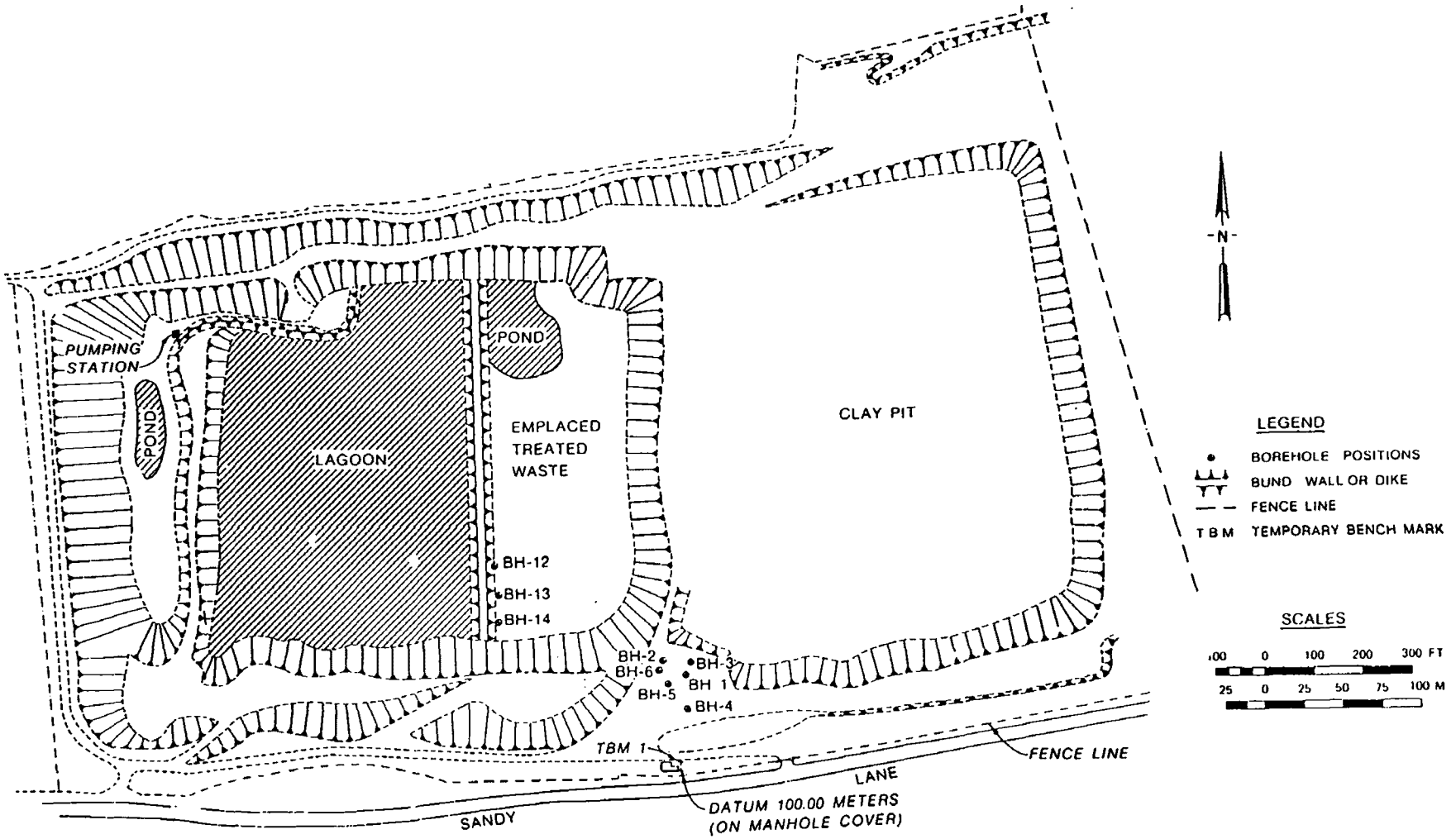

Fig. 4. Sketch map of the Aveley Clay Pit site showing locations of surface water sampling points.

Ground-water Sampling

No ground-water monitoring wells had been installed at the Aveley Clay Pit site. Thus, all eighteen ground-water samples in this study were collected from monitoring wells located at the Thurrock Chalk Quarry site. Twenty monitoring holes had been installed in 1982 by SIHL personnel in connection with the testing program designed to evaluate the placement of Sealosafe -treated waste in chalk. Twelve thousand metric tons of treated wastes were placed in the test site from October 1981 to December 1981. (Some Stablex treated waste was also placed in a hole dug in the chalk quarry in the summer of 1979). With the exception of an unplanned discharge of treated waste in January 1982, no waste had been placed in the test pit after the December 1981 test disposal period. The ground-water samples were collected on April 6, 1982, by the WES contractor. The locations of the monitoring wells are shown in Figure 5.

Monitoring wells 1, 4, 5, 6, 7, 8, and 10 were constructed using depth samplers as shown in Figure 6. The depth sampler was located 5 m below ground level in borings numbered 1, 5, 6, 7, 8, and 10, and 10 m in boring No. 4. The samples were obtained by displacing the water in the depth sampler with nitrogen. Each sampler was evacuated four times before the sample was collected. The sample volume from the depth sampler was approximately 2.5 liters. The tops of these wells were not inside any protective enclosure, although the access tubes to the samplers were clamped off.

Monitoring holes 3, 11, 12, 13, 14, 15, 16, and 17 were constructed as shown in Figure 7. The samples were taken by lowering a water sampler down the standpipe. The height of the water standing in each holes was recorded before the sample was taken, and the holes were baled dry before the sample was collected. The depths to the water table, the depths to the bottom of the hole, and the height of the standpipes are all recorded in Table 4.

Boreholes 18, 19, and 20 were deep holes, located around the outside of the site, constructed as shown in Figure 7. The samples were obtained by pumping from a depth of approximately 25 m below ground level. The depths to the water table, the depths to the bottom of the hole, and the height of the standpipes are recorded in Table 4. Electrolytic conductivity and pH were measured on site with battery-powered equipment and the results are also presented in Table 4.

The holes constructed as shown in Figure 7 (holes 3, 11, 12, 13, 14, 15, 16, 17, 18, 19, and 20) were not protected by permanent structure or shield, and were not covered. Samples from these holes are, therefore, subject to contamination from rainwater and from material thrown down the casing.

The ground-water samples collected for general chemical characterization were filtered through a 0.45-micron membrane filter and acidified to pH 2.0 with reagent-grade nitric acid. The samples were placed in labelled glass bottles. The WES contractor also collected duplicate samples of unfiltered, unpreserved (unacidified) water for the determination of hexavalent chromium and included these samples in the WES shipment. All ground-water samples were shipped in sealed, unrefrigerated cases. The samples were received for

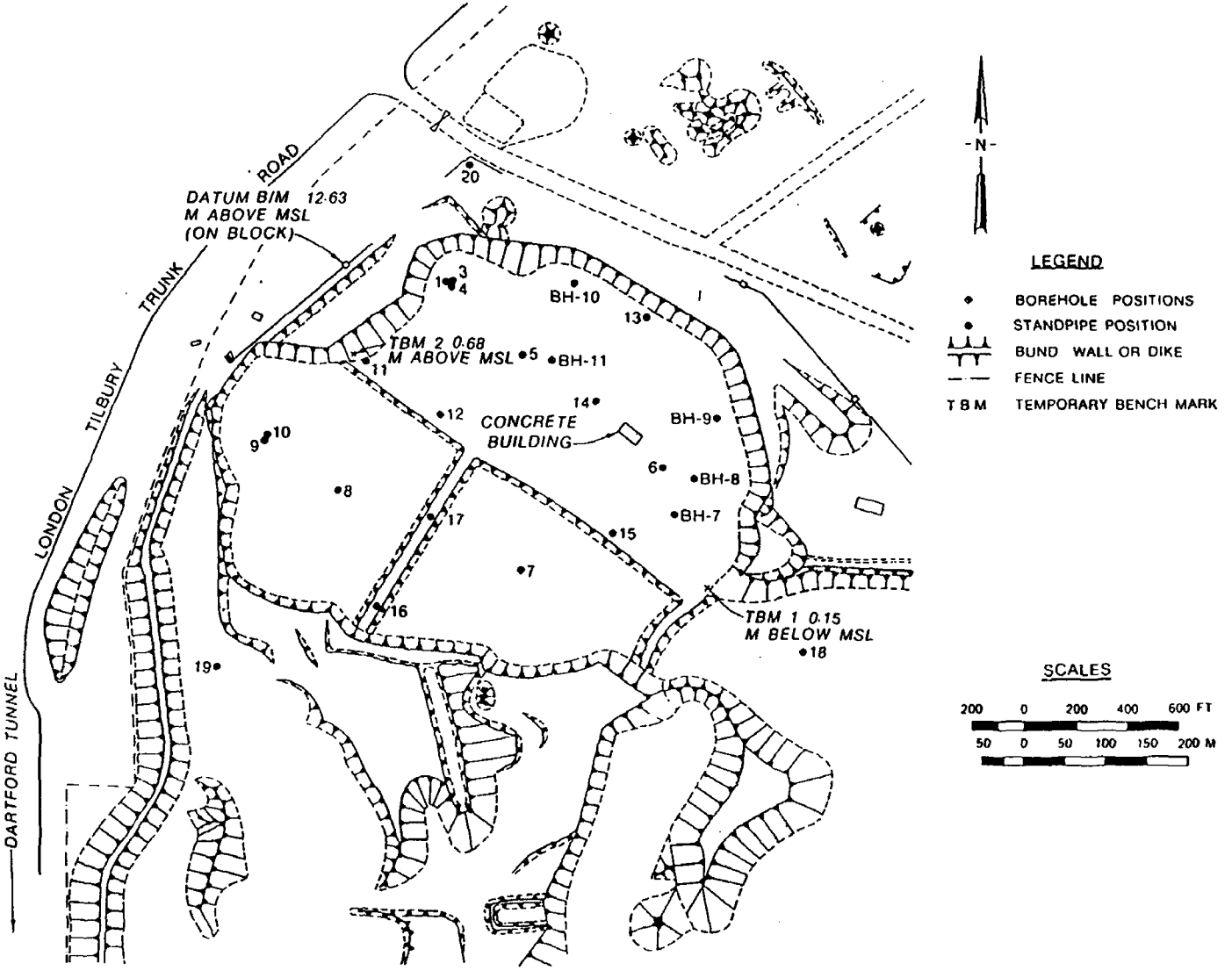

Fig. 5. Sketch map of Thurrock Chalk Quarry site showing locations of monitoring wells.

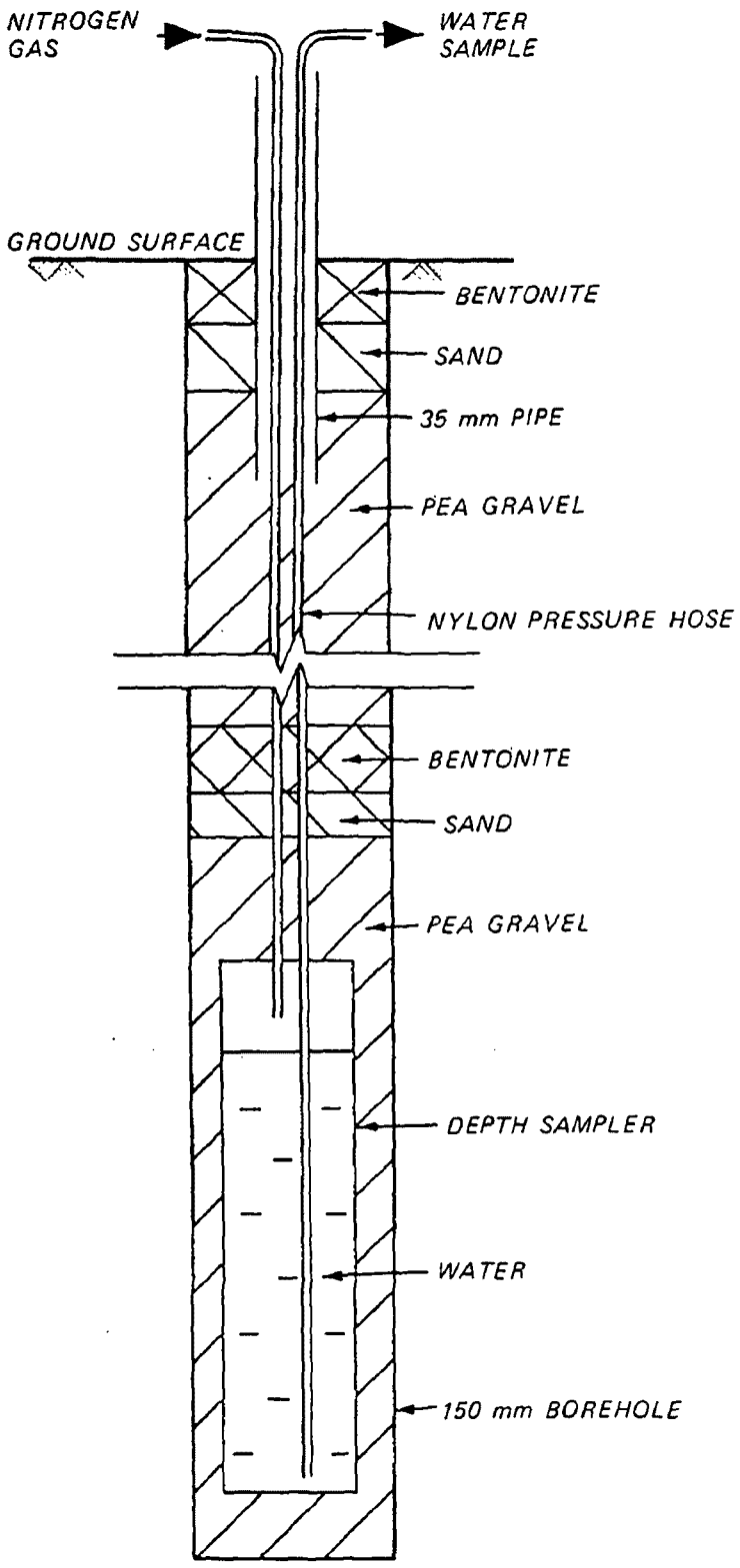

Fig. 6. Details of construction of the depth sampler monitoring wells at the Thurrock Chalk Quarry disposal site.

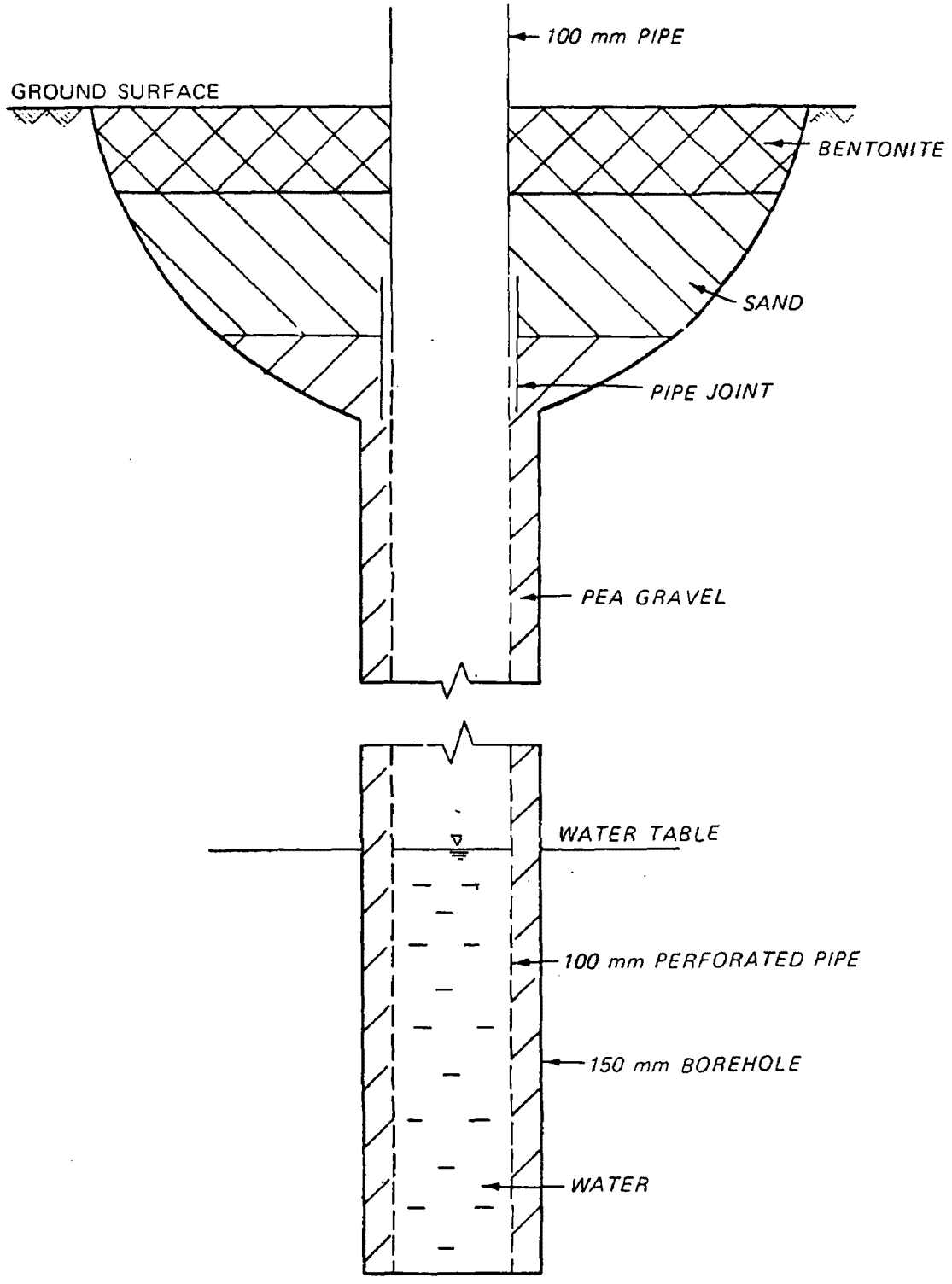

Fig. 7. Details of construction of the standpipe monitoring wells at the Thurrock Chalk Quarry disposal site.

TABLE 4. FIELD DATA ON GROUNDWATER SAMPLES COLLECTED FROM THE THURROCK CHALK QUARRY MONITORING WELL ON APRIL 6, 1982

Sample designation	Type of monitoring well	Method of sample extraction	Depth to water from top of standpipe (m)	Depth to bottom of borehole from top of standpipe (m)	Height of standpipe above ground level (m)	Internal diameter of standpipe (m)	pH	Electrolytic conductivity (μS/cm)
B1	Depth sampler	Depth sample pumped from 5 m	-*	-	-	-	6.4	1,320
B3	Open top standpipe	Dipped from standpipe	6.04	8.53	1.47	0.15	6.5	1,140
B4	Depth sampler	Depth sample pumped from 10 m	-	-	-	-	6.4	1,900
B5	Depth sampler	Depth sample pumped from 5 m	-	-	-	-	6.8	1,490
B6	Depth sampler	Depth sample pumped from 5 m	-	-	-	-	6.4	1,620
B7	Depth sampler	Depth sample pumped from 5 m	-	-	-	-	6.5	4,000
B8	Depth sampler	Depth sample pumped from 5 m	-	-	-	-	6.3	2,200
B9	Insufficient volume to allow a sample to be taken							
B10	Depth sampler	Depth sample pumped from 5 m	-	-	-	-	6.9	2,340
B11	Open top standpipe	Dipped from standpipe	4.39	7.20	1.43	0.1	7.1	2,580
B12	Open top standpipe	Dipped from standpipe	3.74	6.44	0.66	0.1	6.3	2,360
B13	Open top standpipe	Dipped from standpipe	5.60	7.02	0.64	0.1	7.0	9,300
B14	Open top standpipe	Dipped from standpipe	5.55	7.93	1.36	0.1	7.0	2,610
B15	Open top standpipe	Dipped from standpipe	3.36	5.93	0.58	0.1	6.4	2,500
B16	Open top standpipe	Dipped from standpipe	3.19	5.80	0.47	0.1	6.9	1,910
B17	Open top standpipe	Dipped from standpipe	4.22	6.18	1.36	0.1	7.1	2,040
B18	Open top standpipe	Deep BH pumped via standpipe from 25 m	0.94	23.07	0.1	0.15	7.0	1,550
B19	Open top standpipe	Deep BH pumped via standpipe from 25 m	10.72	36.2	1.2	0.15	6.9	3,406
B20	Open top standpipe	Deep BH pumped via standpipe from 25 m	14.88	35.25	0 (at ground level)	0.15	7.2	3,000

* Depth of water, depth to bottom, and related measurements cannot be made on "depth sampler" wells.

analysis by the Analytical Laboratory Group at WES, on April 22, 1982, and stored in a locked refrigerator pending sample preparation and analysis.

Sealosafe®-Treated Waste Slurry Sampling

Sampling of the uncured, Sealosafe®-treated waste slurry was scheduled late in the field study to assure that the material would arrive at WES for testing without becoming fully set. Two one-liter volume samples of the Sealosafe® slurry were collected on April 8, 1982, from the hopper trucks discharging into the Aveley Clay Pit disposal site. The first sample (Stablex® slurry No. 1) was collected at 9:30 a.m. The second sample (Stablex® slurry No. 2) came from a second truck that discharged (and was sampled) at 10:45 a.m. The samples came from the same run of material at the plant and both had a brownish-grey appearance and both were pourable at the time of collection. The samples were sealed in plastic jars and shipped in sealed, unrefrigerated cases. The samples were received by the Analytical Laboratory Group at WES, on April 22, 1983, and stored in a locked refrigerator. The samples were inspected on arrival at WES and at that time had retained the brownish-grey color; but had reached a putty-like consistency and could no longer be poured when mixed and split to obtain a sample for EP testing. No free liquid was present in the containers.

The treatment facility can change formulation in response to waste type and other conditions. Such a change in formulation may have occurred on April 7, just prior to sample collection. The slurry color had been grey from the initiation of the site visit, but became noticeably brownish on April 7. The slurry collected is a typical Stablex material; but was not identical to the material being poured earlier in the week.

Sealosafe®-Treated Waste and Soil Sampling

The original sampling plan (Attachment A) called for randomly spaced drill holes over all areas where the treated waste had been placed. However, some of the waste areas were under water and in other places the waste was too soft to bear the weight of the drill rig. For example, the lack of trafficability made it impossible to core the center or eastern side of the emplaced wastes at the Aveley Clay Pit. The final selection of the sampling points, therefore was a compromise between randomly placed holes and locations that were accessible.

Eight holes were cored and samples were recovered at the Aveley Clay Pit site (Boring numbers BH1 through 6, 12 and 13 in Figure 8). A ninth hole, designated BH14 was attemped at the Aveley Clay Pit but the core could not be recovered due to the very soft nature of the Sealosafe®-treated wastes. A sample of loose material from the surface was collected at this sampling point; but no testing was done on this sample.

Borings 1 through 6 were drilled into the older treated waste at this site. Borings 12 and 13 were drilled into more recently deposited material. The surface of the newly deposited material would not support the weight of the drilling rig thus it was necessary to place the drill rig on the bund or dike and drill by extending the drill arm out over the waste. Water was encountered in all the drill holes at the Aveley Clay Pit site.

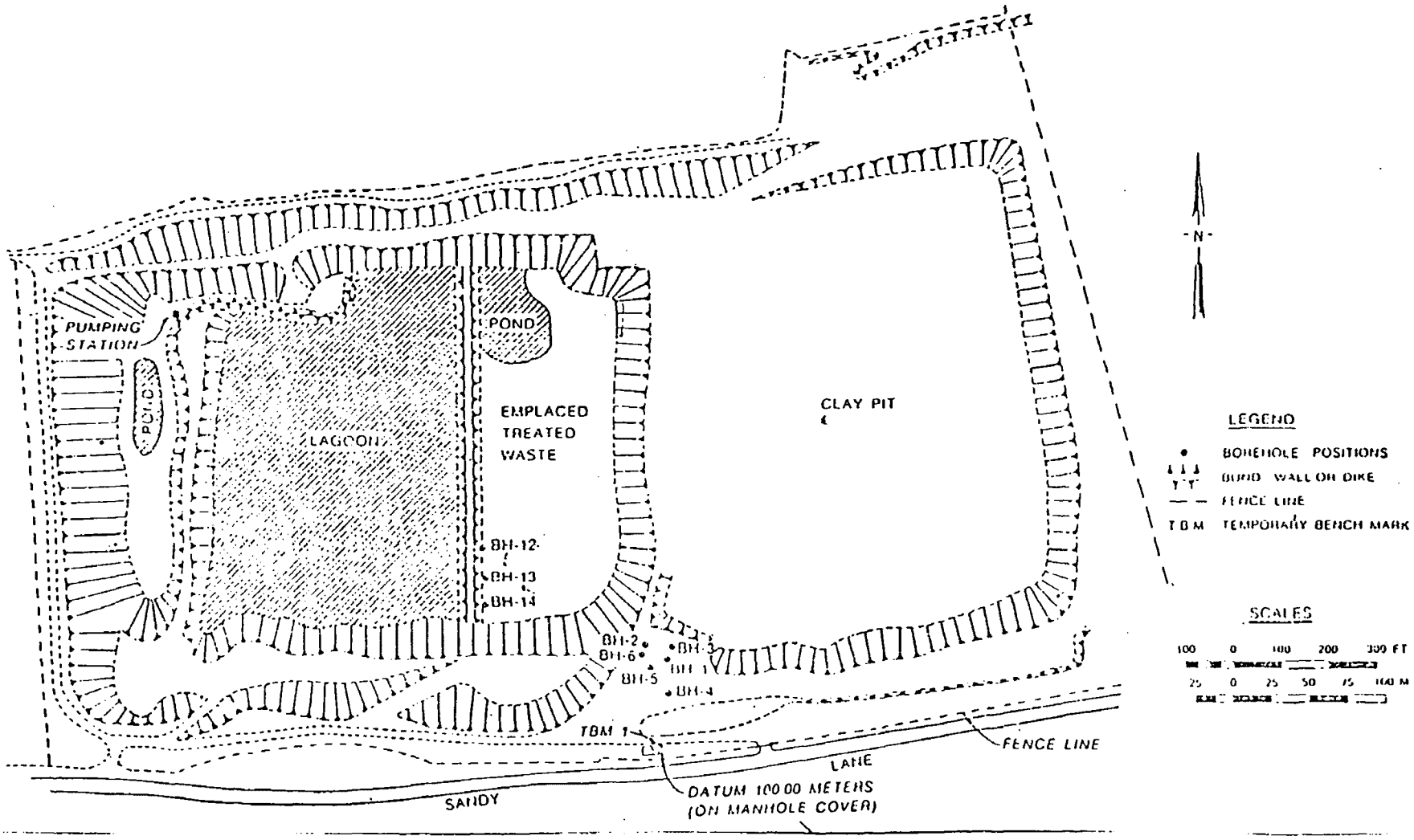

Fig. 8. Sketch map of the Aveley Clay Pit showing locations of the boreholes used in sampling the Sealosafe® -treated wastes and underlying geologic materials.

The other five holes were drilled at the Thurrock Chalk Quarry site (Fig. 9). The chalk at the base of the waste contained nodules of flint that caused difficulties in recovering the chalk core. In some borings, the total chalk core could not be recovered because the chalk fragmented. Although the chalk below the waste was soft and damp; no water was observed infiltrating into the bore holes.

The treated wastes and underlying geologic materials were sampled using a tracked vehicle with a boom-mounted, coring drill rig (Fig. 10) equipped with a 2.6-in. (6.60-cm) diamond-tipped bit and a 5-ft- (1.6-meter) long core barrel (Fig. 11). Compressed air was forced into the hole (instead of drilling fluid) to remove cuttings and cool the drill bit. Rotary diamond drilling with compressed air allowed the cores to be collected without being washed by drilling fluid. The core was recovered in 1.6-meter-long runs. The drill was allowed to penetrate 1.6 meters, then was withdrawn and the core barrel was disassembled and the core was removed and laid out for inspection and logging. The core barrel was cleaned by blowing off any material lodged in or stuck on the barrel using compressed air. No attempt was made to rinse the core barrel with water since the barrel would immediately go back into the waste and would have to pass through the waste before coring another interval. After cleaning, the core barrel was then reassembled and drilled down another 1.6 m. The holes were not cased but remained open long enough to allow the coring to be completed. In all borings where the waste material could be cored, the core barrel was drilled down into the underlying clay or chalk. The changes in color, odor, and consistency made it easy to distinguish waste from geologic materials.

As each borehole was opened, a tube was inserted into the boring and borehole gas was pulled through a chemical HCN detector. This was done primarily as a safety measure to protect the field party. In no case was there any indication of HCN in any borehole. Each borehole was grouted with neat cement immediately after all sampling was complete.

All cores were logged at the site and each section was marked as to position in the borehole. Logs prepared by the WES contractor are given in Appendix A. The logged core materials were sealed in tubes of heavyweight polyethylene film and packed in core boxes. Each box was labeled, banded, and sealed by the WES field supervisor prior to secure storage at the Stablex Thurrock plant and subsequent shipping. Access to the storage area was controlled by the WES field supervisor. The core boxes on arrival at WES on April 22, 1982, were inspected to assure the seals and bands were intact and then stored in a secure area at WES prior to logging, subsampling, and photography.

Location of Sampling Points

The location of each bore hole and the elevation of the top of each boring was determined by a survey crew supplied by the contractor. Approximate locations of surface water sampling points at the Aveley Clay Pit were determined by the contractor when samples were taken. The locations of the ground-water monitoring wells at the Thurrock Chalk Quarry were taken from a base map supplied by Stablex Corporation.

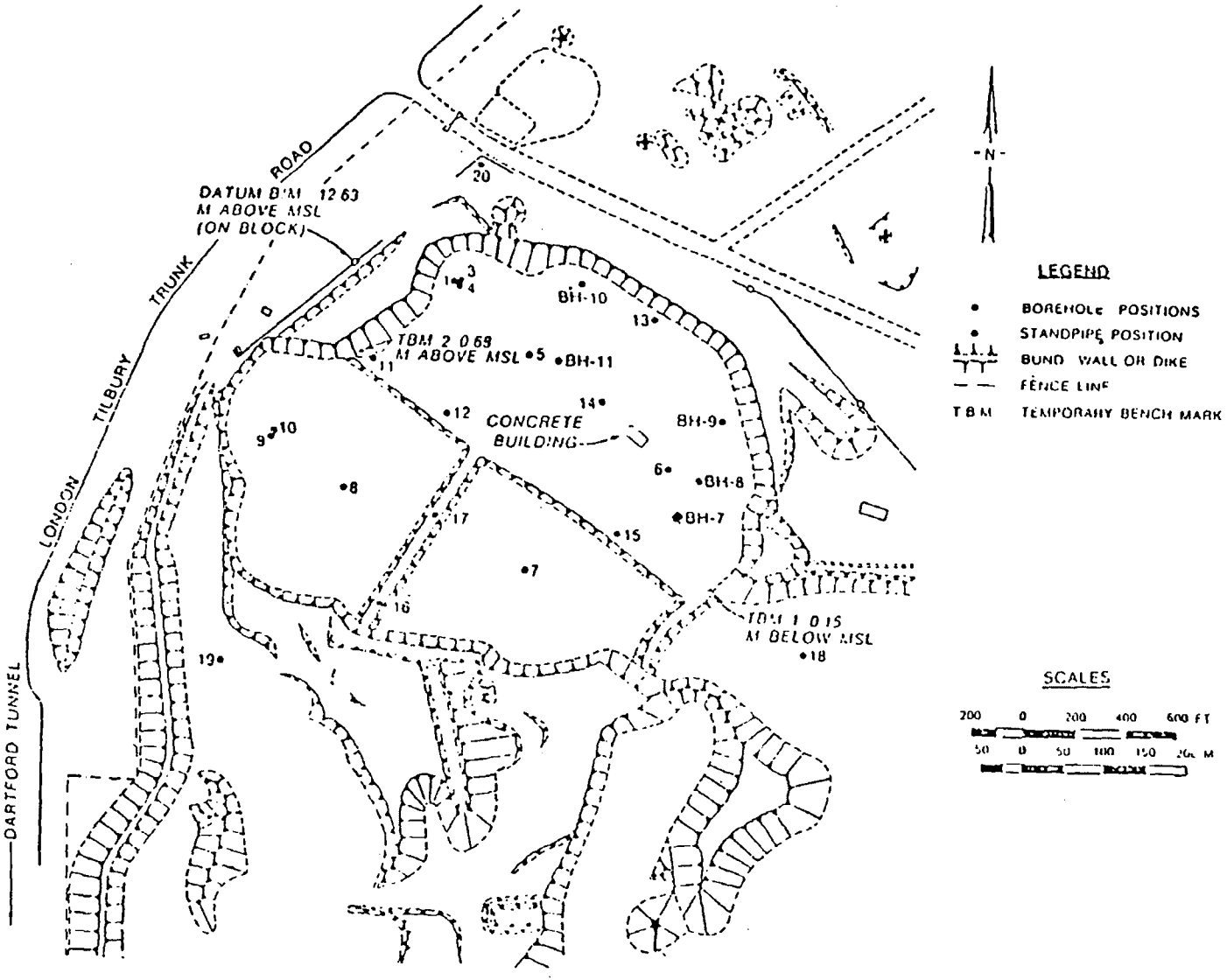

Fig. 9. Sketch map of the Thurrock Chalk Quarry showing locations of the boreholes used in sampling the Sealosafe®-treated wastes and the underlying geologic materials. (The locations of the monitoring wells are also shown.)

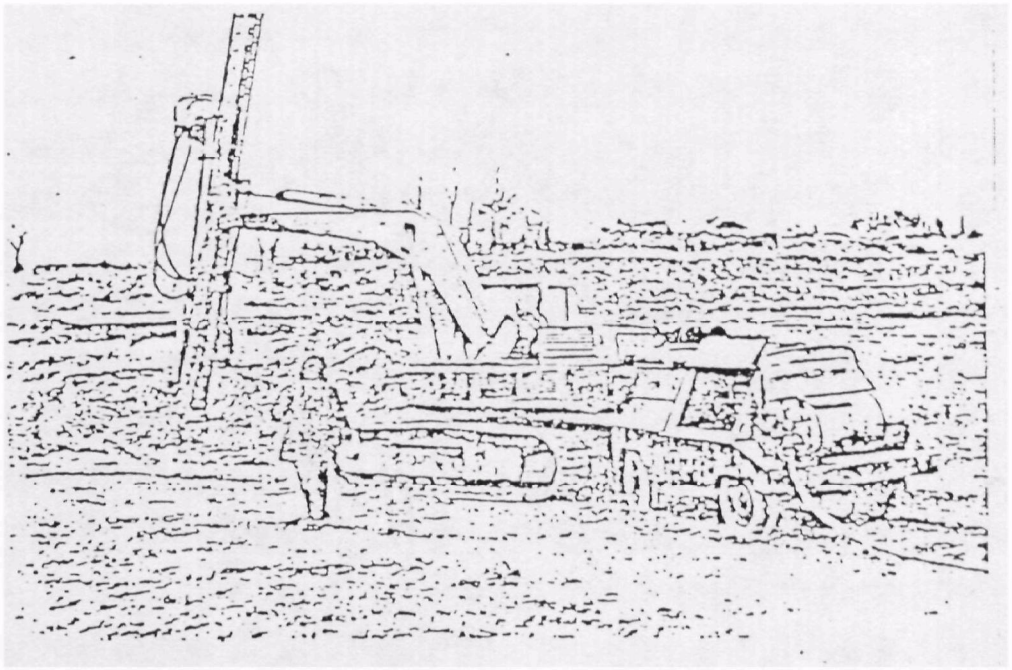

Fig. 10. Photo of tracked vehicle with boom-mounted rotary drill. The compressor furnished the compressed air to clear cuttings and cool the drill bit.

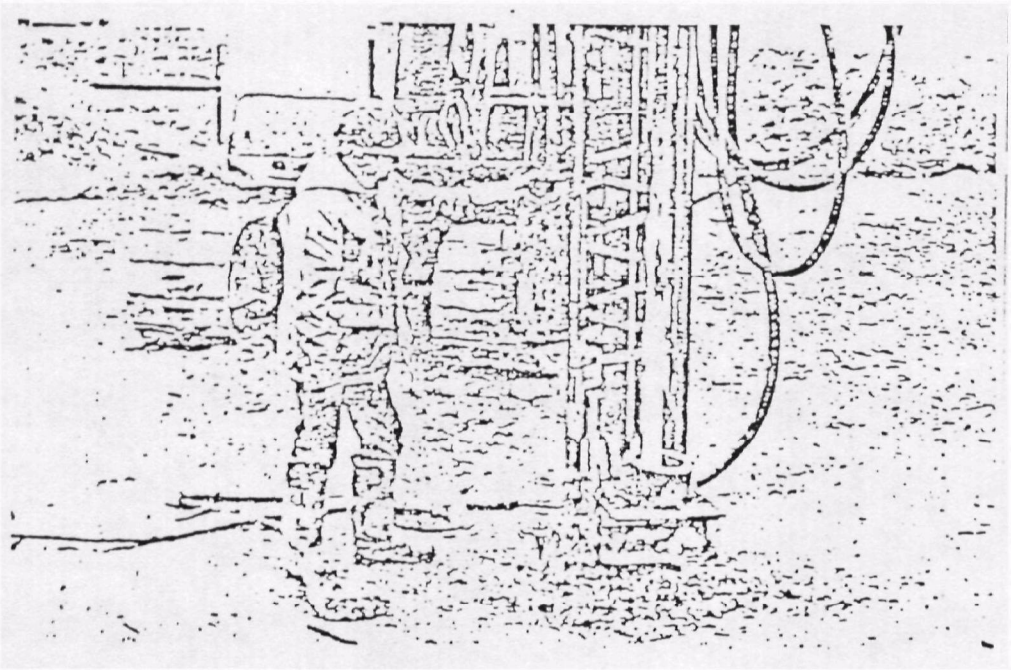

Fig. 11. Photo of drill stem and core barrel being raised from the borehole.

Logging, Subsampling, and Photography of Cored Waste Materials

At WES, the core boxes were opened and each core was gently scraped and brushed clean to remove the outer contaminated layer of material, measured, and checked against the driller's log. Each core was subdivided into eight sections based on differences in characteristic hardness, color, and texture. Each section or interval was measured and photographed. A hand penetrometer was used to judge approximate hardness. Color descriptions were based on comparison of samples with standard color chip charts. Samples of the cleaned, photographed materials from each interval were then placed in clean, labelled, wide-mouth, plastic jars and stored in a locked facility until preparation for analysis.

Logging, Subsampling, and Photography of Clay and Chalk Samples

The clay and chalk beneath the treated waste showed little change in the one- to two-meter interval that was sampled. These cores were divided and subsampled in approximately three equal intervals. The measurements of each interval and the core description is given in Appendix B (Table B15).

SECTION 4

SAMPLE PREPARATION, TESTING, AND ANALYSIS

QUALITY CONTROL AND QUALITY ASSURANCE PROGRAM

A quality control (QC) program involves those procedures used in the laboratory to assure accuracy, reliability, and comparability of results. Quality assurance involves the total analytical program including interlaboratory sample splits and evaluation and resolution of analytical problem areas. In this solid waste evaluation program, replicate runs on single specimens, spiked samples, standards, and splits of samples between laboratories (side-by-side analysis) were used to evaluate the quality and reliability of the testing and analysis. Duplicate analyses for some samples were performed by the U. S. EPA Environmental Monitoring and Support Laboratory (EMSL), Las Vegas. Split samples of the water samples, treated wastes, and soil were also supplied to the Stablex Corporation for analyses, but no data was submitted by the Stablex Corporation for incorporation in the report.

Representative Sampling

Sub-sampling of all materials, except the Structural Integrity Procedure (monolithic) samples and soil samples, was done only after the material had been thoroughly mixed to assure replicate samples could be obtained. Liquid and slurry materials were shaken or stirred while powdered samples were tumbled. All subsamples were prepared under chain-of-custody procedures and placed in clean, non-contaminating, labelled containers.

Quality Control at Analysis

Instrument Calibration and Verification--

An EPA Quality Control sample was analyzed following instrument calibration and prior to project sample analysis. Results within 10% of the EPA published value were obtained or recalibration with fresh standards was undertaken. Instrument drift was monitored by rerunning a working standard every sixth sample. The instrument was recalibrated if drift exceeded 10%.

Analysis of Spiked Samples--

Spikes were introduced into approximately 20% of the samples being analyzed at both WES and the U.S. EPA Environmental Monitoring and Support Laboratory (EMSL) Las Vegas. Recoveries within ±15% of the spike value were considered acceptable. These low limits were used because the replicates were run by the same operator on the same instrument during one sequence of analyses.

Duplicate Analyses--

Duplicate analyses within the laboratory were performed on approximately 20% of the samples analyzed at the WES and on all of the sample materials submitted to the EMSL. The samples were reanalyzed if reproducibility within the laboratory was not within ±25%. These duplicates were not necessarily run during the same analytical session by the same operator, consequently a larger variation was permitted.

Sample Security

All samples used in this project were maintained under chain-of-custody. Core and soil samples were kept in a locked storage facility. Samples subject to deterioration were stored in a locked refrigerator. Access to analytical laboratory areas where work was being done was limited to authorized laboratory personnel. All shipping of samples was done under chain-of-custody procedures.

Data Validation

Analytical data validation was performed by Ann B. Strong, Chief, WES Analytical Laboratory Group. Data from EMSL was validated by Steven J. Simon, Lockheed Principal Scientist (Lockheed is a contractor to EMSL).

Cooperative Testing and Analysis at U. S. EPA

Three samples of composited treated wastes from cores 5, 10, and 13 were prepared specifically for QA/QC use. The samples were carried through the EP test procedure by WES and EMSL, and the resultant extracts were analyzed and the results compared. [Stablex Corporation was also furnished splits of the material.] This procedure compared the performance of the laboratories in both running the EP test and performing the analytical work on the leachate. The EP test is a partial digestion that may introduce variation in the samples; therefore agreement similar to that obtained from running analytical standards that are totally digested or in homogeneous solution was not expected. The results of the laboratory cross-check on EP testing and extractant analysis on ground wastes are given in Tables 5 through 7.

Large variations in analyses of extracts were noted in some of the EP samples when the laboratories did separate EP testing. No guidelines are presently available to indicate acceptable variations in EP test data. In order to determine how much variation in the result was due to chemical analytical techniques employed at each laboratory, a sample of extractant prepared by WES was analyzed by both WES and EMSL. The results are presented in Tables 8 through 10. Agreement within ±50% would usually be expected. However, two of the elements, chromium and selenium, did not fall in these guidelines. The chromium data showed slightly higher levels of variation between laboratories with WES showing a slight negative bias. Selenium, on the other hand, indicated a major analytical problem. The laboratories had separate techniques for running this element; EMSL used a heated graphite atomizer (HGA) technique while WES used a hydride generation system. The difficulties were thought to result from chemical interferences in the matrices associated with the extracts. Therefore, duplicate samples were sent to a

TABLE 5. RESULTS OF TESTING AND ANALYSIS OF COMPOSITED SAMPLES OF DRIED, GROUND WASTE FROM BHS

Parameters	EMSL Results			WES Results			% Difference†
	5A	5B	Mean	5A	5B	Mean	
Ag	<0.01*	<0.01	--	<0.001	<0.001	--	
As	0.029	0.032	0.030	0.016	0.016	0.016	+88%
Ba	0.14	0.11	0.125	0.092	0.092	0.092	+36%
Be	<0.01	<0.01	--	<0.005	<0.005	--	
Cd	0.004	0.004	0.004	<0.050	<0.050	--	
Co	0.010	0.005	--	<0.050	<0.050	--	
Cr	0.24	0.25	0.240	0.215	0.235	0.225	+7%
Cu	<0.10	<0.10	--	0.088	0.102	0.095	
Fe	<0.10	<0.10	--	0.198	0.106	0.152	
Hg	<0.005	<0.005	--	0.007	<0.0002	--	
Mn	0.033	0.032	0.032	0.144	0.750	0.447	-93%
Ni	<0.01	<0.01	--	0.078	0.149	0.114	
Pb	<0.005	<0.005	--	0.002	0.002	0.002	
Se	0.48	0.77	0.62	0.305	0.245	0.275	+125%
Sn	<0.005	<0.005	--	<0.050	<0.050	--	
Sr	<4.73	4.60	4.66	4.72	4.82	4.77	-2.3%
Zn	<0.10	<0.10	--	<0.050	<0.050	--	

* All values are in mg/l.

† $\%\ \text{Difference} = \frac{\text{EMSL Mean} - \text{WES Mean}}{\text{WES Mean}} \times 100$

TABLE 6. RESULTS OF TESTING AND ANALYSIS OF COMPOSITED SAMPLES OF DRIED, GROUND WASTE FROM BH10

Parameters	EMSL Results			WES Results			% Difference†
	10A	10B	Mean	10A	10B	Mean	
Ag	<0.01**	0.01	--	<0.001	<0.001	--	
As	0.011	0.015	0.013	0.008	0.009	0.008	+62%
Ba	0.091	0.091	0.091	0.042	0.038	0.040	+128%
Be	<0.01	<0.01	--	<0.005	<0.005	--	
Cd	<0.002	<0.002	--	<0.050	<0.050	--	
Co	<0.005	<0.005	--	<0.050	<0.050	--	
Cr	0.19	0.16	0.17	0.154	0.140	0.147	+16%
Cu	<0.10	<0.10	--	0.126	0.127	0.126	
Fe	<0.10	0.10	--	0.222	0.218	0.220	
Hg*	1.79	1.53	1.66	1.71	1.68	1.70	-2.4%
Mn	0.012	0.011	0.011	<0.050	<0.050	--	
Ni	<0.01	<0.01	--	0.062	0.066	0.064	
Pb	<0.005	<0.005	--	0.002	0.002	0.002	
Se	0.39	0.41	0.40	0.180	0.180	0.180	+122%
Sn	<0.005	<0.005		<0.050	<0.050		
Sr	6.95	6.83	6.84	6.62	6.62	6.62	+4.0%
Zn	<0.10	<0.10	--	<0.050	<0.050	--	

* Mercury was introduced into the sample at the Stablex Corp. Laboratory in England when company personnel were drying the sample.

** All values are in mg/l.

† % Difference = $\frac{\text{EMSL Mean} - \text{WES Mean}}{\text{WES Mean}} \times 100$

TABLE 7. RESULTS OF TESTING AND ANALYSIS OF COMPOSITED SAMPLES OF DRIED GROUND WASTE FROM BH13

Parameters	EMSL Results	WES Results			% Difference†
	13	13A	13B	Mean	
Ag	<0.01*	<0.001	<0.001	--	
As	0.12	0.005	0.005	0.005	+2300
Ba	0.12	0.125	0.115	0.120	0
Be	<0.01	<0.005	<0.005	--	
Cd	0.004	<0.050	<0.050	--	
Co	<0.005	<0.050	<0.050	--	
Cr	0.28	0.224	0.238	0.231	+21
Cu	<0.10	0.128	0.126	0.127	
Fe	0.19	0.317	0.324	0.320	-41
Hg	<0.005	0.0006	<0.0002	0.0003	
Mn	0.010	<0.050	<0.050	<0.050	
Ni	<0.01	0.072	0.066	0.069	
Pb	<0.005	0.002	0.001	0.001	
Se	0.47	0.260	0.290	0.275	+71
Sn	<0.005	<0.050	<0.050	<0.050	
Sr	5.72	5.53	5.57	5.55	-3
Zn	<0.10	0.151	0.147	0.149	

* All values are in mg/l.

† $\%\ \text{Difference} = \frac{\text{EMSL Mean} - \text{WES Mean}}{\text{WES Mean}} \times 100$

TABLE 8. SUMMARY OF DUPLICATE ANALYSES OF WES EP EXTRACTS OF COMPOSITED CORE 5

	EMSL Results			WES Results			
Parameter	5A	5B	Mean	5A	5B	Mean	% Difference**
Cr	0.28*	0.26	0.27	0.22	0.24	0.23	+17
Pb	<0.005	<0.005	--	<0.005	0.005	--	
Se	0.49	0.43	0.46	0.30	0.24	0.27	+70
Sn	<0.005	<0.005	--	<0.005	<0.005	--	
Sr	4.68	4.87	4.78	4.72	4.82	4.77	+0.2

* All values are in mg/l.

** % Difference = $\frac{\text{EMSL Mean - WES Mean}}{\text{WES Mean}} \times 100$

TABLE 9. SUMMARY OF DUPLICATE ANALYSES OF WES EP EXTRACTS OF COMPOSITED CORE 10

Parameter	EMSL Results			WES Results			% Difference†
	10A	10B	Mean	10A	10B	Mean	
Cr	0.19*	0.20	0.20	0.15	0.14	0.14	+42
Pb	<0.005	<0.005	--	<0.005	<0.005	--	
Se	0.30	0.46	0.38	0.18	0.18	0.18	+111
Sn	<0.005	<0.005	--	<0.050	<0.050	--	
Sr	4.77	6.70	5.74	6.62	6.62	6.62	-13

* All values are in mg/l.

† % Difference = $\frac{\text{EMSL Mean - WES Mean}}{\text{WES Mean}} \times 100$

TABLE 10. SUMMARY OF DUPLICATE ANALYSES OF WES EP EXTRACTS OF COMPOSITED CORE 13

	EMSL Results			WES Results			
Parameter	13A	13B	Mean	13A	13B	Mean	% Difference†
Cr	0.29	0.30	0.29	0.22	0.24	0.23	+26
Pb	<0.005	<0.005	--	<0.005	<0.005	--	
Se	0.91	0.81	0.86	0.26	0.29	0.28	+207
Sn	<0.005	<0.005	--	<0.050	<0.050	--	
Sr	5.53	5.58	5.56	5.53	5.57	5.55	+0.18

* All values are in mg/l.

† % Difference = $\frac{\text{EMSL Mean - WES Mean}}{\text{WES Mean}} \times 100$

contract laboratory (General Activation Analysis, Inc. San Diego, CA) for selenium analysis by neutron activation, a technique remarkably free from matrix problems for this element.

The samples and comparator standards were irradiated for 30 minutes in a TRIGA Mark I nuclear reactor at a flux of 1.8×10^{12} neutrons/cm^2-sec. After decaying for seven days, 10 days, 14 days, and 17 days, the samples were counted on a Ge(Li) detector coupled to a multichannel gamma-ray spectrometer. Selenium produces selenium-75 with a half-life of 120 days. All results are reported in Table 11.

The WES results obtained using the hydride generation system with atomic absorption showed a strong consistently negative bias (lower values when compared to activation analysis). The EMSL results obtained by direct atomic absorption analysis with a heated graphite atomizer were equivalent to those obtained by neutron activation. While the hydride generation system is an EPA-accepted procedure, the data obtained in this project suggest that its use with some EP extractant matrices may result in low values. Therefore, selenium values obtained using the hydride method at WES should be interpreted as being low estimates and selenium levels may be higher than reported.

In addition, three of the analyses--2E, 3B, and 6A--indicated levels in the EP leachate for mercury that are higher than the level set as part of the Stablex delisting decision. However, these values could not be correct based on the low levels of mercury found in the bulk analysis data. Positive chemical interferences from organics in the samples are considered to have produced these anomalous values.

EMSL provided a second set of analyses on approximately 20% of the routine samples tested in the project by WES. Significant differences (i.e., more than 50% difference in EP concentration between WES and EMSL) in EP results was obtained in some cases "Appendix C." This was expected, however, from the composite waste samples (Cores 5, 10, and 13) and may be attributed to the complex procedure involved in the partial solution of the sample where the amount of acid added (and the amount of waste dissolved) depended on a series of pH readings made during the extraction. Identical amounts of acid were not added during EP testings, so identical extractants would not be expected. In addition samples that could not be homogenized to produce a uniform sample (monolithic waste samples and soil samples) were also analyzed by both laboratories to evaluate variation, with the understanding that these were not true duplicates. Results are presented in Appendix C. The monolithic waste samples all gave concentrations of the constituents selected for analysis that were close to the limit of detection. The soil samples were digested and the differences in concentrations may be directly related to the normal variation between contiguous (but not identical) samples.

The EP test procedure used in the Stablex delisting decision is a go, no-go test as it is employed in the contingency provisions of the Stablex delisting decision. If the concentration for any of the EP toxic metals exceeds 30 times the National Interim Primary Drinking Water Standard (NIPDWS) or exceeds 20 ppm for nickel, the material is considered hazardous. When the

TABLE 11. COMPARISON OF DIFFERENCES IN SELENIUM ANALYSES OF EP EXTRACTANT SPLITS SUBMITTED TO GENERAL ACTIVATION ANALYSIS, INC., EMSL AND WES

Sample	Results from General Activation Analysis* (Neutron Activation Method)	Results from EMSL (Heated Graphite Atomizer AA)	Results from WES (Hydride Technique)
5A	0.510**	0.49 (-4)	0.305 (-40)
5B	0.477	0.43 (-10)	0.245 (-49)
10A	0.503	0.30 (-40)	0.180 (-64)
10B	0.490	0.46 (-6)	0.180 (-63)
13A	0.843	0.91 (+8)	0.260 (-69)
13B	0.781	0.81 (+4)	0.290 (-63)

* General Activation Analysis, Inc. San Diego, CA.

** All results are in mg/l.

Numbers in parentheses are percent difference between results from activation analysis and other methods.

TABLE 12. TECHNIQUES AND INSTRUMENTATION USED IN THE ANALYSIS OF GROUND-WATER AND SURFACE WATER SAMPLES

Parameter	Method	Instrument	Lowest reporting conc (ppm)	Reference
Ag	Heated Graphite Atomizer (HGA)	Perkin Elmer (PE) 5000	0 001	U.S. EPA, 1980
As	Hydride generation (U.S. EPA Method 206.3)	PE 305 with MHS-10	0.005	U.S. EPA, 1980
Ba	DC Argon Plasma (DCAP)	Spectrametric Spectra-span III	0.050	Spectrametrics, 1981
Be	DCAP	Same as above	0.005	Spectrametrics, 1981
Cd	DCAP/HGA	Spectraspan III/PE5000	0.100/0.001	Spectrametrics, 1981 U.S. EPA, 1980
Co	DCAP	Spectraspan III	0.001	Spectrametrics, 1981
Cr	DCAP/HGA (U.S. EPA Method 213.2)	Spectraspan III/PE5000	0.100/0.001	Spectrametrics, 1981 U.S. EPA, 1980
Cu	HGA (U.S. EPA Method 220.2)	PE306	0.001	U.S. EPA, 1980
Fe	HGA (U.S. EPA Method 236.2)	PE5000	0.010	U.S. EPA, 1980
Hg	Cold Vapor Atomic Absorption (U.S. EPA Method 245.1)	PE503	0.0002	U.S. EPA, 1980
Mn	HGA (U.S. EPA Method 243.2)	PE5000	0.001	U.S. EPA, 1980
Ni	HGA (U.S. EPA Method 249.2)	PE306	0.001	U.S. EPA, 1980
Pb	HGA (U.S. EPA Method 239.2)	PE5000	0.001	U.S. EPA, 1980
Se	Hydride generation (U.S. EPA Method 270.3)	PE305 with MHS-10	0.005	U.S. EPA, 1980

(continued)

TABLE 12. (concluded)

Parameter	Method	Instrument	Lowest reporting conc (ppm)	Reference
Sn	HGA (U.S. EPA Method 282.2)	PE5000	0.001	U.S. EPA, 1980
Sr	DCAP	Spectraspan III	0.100	Spectrametrics, 1981
Zn	DCAP	Spectraspan III	0.050	Spectrametrics, 1981
Total CN*	Colorimetric (U.S. EPA Method 335.3)	Technicon Autoanalyzer	0.010	U.S. EPA, 1980
CN amendable to chlorination*	Colorimetric (U.S. EPA Method 335.1)	Technicon Autoanalyzer	0.010	U.S. EPA, 1980

* These analyses were run on unfiltered, unacidified samples.

TABLE 13. ANALYSES OF SURFACE WATER SAMPLES COLLECTED AT THE AVELEY CLAY PIT DISPOSAL SITE.

Parameter	Sampling Locations			
	L1	L2	L3	L4
Ag	0.016*	0.003	<0.001	<0.001
As	<0.005	<0.005	<0.005	<0.005
Ba	0.136	0.136	0.121	0.136
Be	<0.005	<0.005	<0.005	<0.005
Cd	<0.010	<0.010	<0.010	<0.010
Co	0.138	0.004	0.004	<0.001
Cr	0.064	0.018	0.019	<0.001
Cu	1.34	0.020	0.012	0.005
Fe	0.486	0.050	0.035	0.071
Hg	0.0046	0.0020	0.0006	<0.0002
Mn	0.003	0.034	0.025	0.050
Ni	0.234	0.018	0.012	0.008
Pb	0.005	0.001	0.193	0.035
Se	0.170	0.008	0.008	<0.005
Sn	0.112	0.138	0.268	0.199
Sr	8.89	4.75	4.56	1.11
Zn	<0.050	0.050	<0.050	3.18
CN**	13.0	0.016	0.016	0.066
CN amenable to chlorination	11.0	0.010	0.010	0.056

* All values are in mg/l.

** CN and CN-amenable to chlorination were determined on a separate, non-acidified sample.

TABLE 14. ANALYSES OF GROUND-WATER SAMPLES COLLECTED AT THE THURROCK CHALK QUARRY DISPOSAL SITE (WELLS B1 B3-B6).

Parameters	Monitoring Well Numbers				
	B1	B3	B4	B5	B6
Ag	<0.001*	<0.001	<0.001	<0.001	<0.001
As	<0.005	<0.005	<0.005	<0.005	<0.005
Ba	0.071	0.116	0.080	0.116	0.138
Be	<0.005	<0.005	<0.005	<0.005	<0.005
Cd	<0.010	<0.010	<0.010	<0.010	<0.010
Co	<0.001	<0.001	<0.001	<0.001	<0.001
Cr	<0.001	<0.001	0.014	0.010	0.020
Cu	0.008	0.014	0.004	0.006	0.004
Fe	0.341	0.064	0.042	0.086	0.048
Hg	<0.0002	<0.0002	<0.0002	<0.0002	0.0010
Mn	0.022	0.049	0.001	0.028	0.015
Ni	0.006	0.006	0.004	0.006	0.007
Pb	0.107	0.001	0.008	0.018	0.018
Se	<0.005	<0.005	<0.005	<0.005	<0.005
Sn	0.043	0.045	0.088	0.086	0.121
Sr	0.757	0.587	0.625	0.634	0.634
Zn	<0.050	0.130	<0.050	0.082	0.846
CN**	0.024	0.030	0.058	0.104	0.176
CN amenable to chlorination	0.010	0.020	<0.010	0.016	0.078

* All values are in mg/l.

** CN and CN-amenable to chlorination were determined on a separate, non-acidified sample.

TABLE 15. ANALYSES OF GROUND-WATER SAMPLES COLLECTED AT THE THURROCK CHALK QUARRY DISPOSAL SITE (WELLS B7, B8, B10-12).

Parameters	Monitoring Well Numbers				
	B7	B8	B10	B11	B12
Ag	<0.001*	<0.001	<0.001	<0.001	0.002
As	<0.005	<0.005	<0.005	<0.005	<0.005
Ba	0.090	0.118	0.092	0.085	0.132
Be	<0.005	<0.005	<0.005	<0.005	<0.005
Cd	<0.010	<0.010	<0.010	<0.010	<0.010
Co	0.004	0.002	0.002	0.005	0.004
Cr	0.034	0.038	0.032	0.012	0.027
Cu	0.008	0.004	0.010	0.023	0.008
Fe	0.062	0.055	0.068	0.152	0.068
Hg	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Mn	0.077	0.003	0.011	0.127	0.041
Ni	0.016	0.004	0.006	0.012	0.006
Pb	0.042	0.025	0.022	0.034	0.017
Se	0.006	0.005	<0.005	<0.005	<0.005
Sn	0.118	0.109	0.093	0.082	0.089
Sr	0.695	0.707	0.730	0.642	0.718
Zn	<0.050	0.162	0.126	0.053	0.051
CN**	0.465	0.180	0.282	0.258	2.16
CN amenable to chlorination	0.078	0.084	0.056	0.085	1.724

* All values are in mg/l.

** CN and CN-amenable to chlorination were determined on a separate, non-acidified sample.

TABLE 16. ANALYSES OF GROUND-WATER SAMPLES COLLECTED AT THE THURROCK CHALK QUARRY DISPOSAL SITE (WELLS B13-B17

Parameters	Monitoring Well Numbers				
	B13	B14	B15	B16	B17
Ag	0.001*	0.003	0.003	0.001	0.003
As	<0.005	<0.005	<0.005	<0.005	<0.005
Ba	0.146	0.202	0.110	0.157	0.178
Be	<0.005	<0.005	<0.005	<0.005	<0.005
Cd	<0.010	<0.010	<0.010	<0.010	<0.010
Co	0.001	0.006	0.003	0.002	0.016
Cr	0.039	0.008	0.052	0.051	0.010
Cu	0.004	0.006	0.010	0.002	0.028
Fe	0.048	0.065	0.025	0.030	0.117
Hg	<0.0002	<0.0002	<0.0002	<0.0002	0.0016
Mn	0.001	0.266	0.010	0.004	0.420
Ni	0.004	0.018	0.008	0.006	0.027
Pb	0.014	0.022	0.007	0.011	0.002
Se	<0.005	<0.005	<0.005	<0.005	0.014
Sn	0.138	0.066	0.089	0.131	0.261
Sr	0.690	0.738	0.718	0.698	0.977
Zn	0.052	0.065	0.050	0.663	0.073
CN**	1.88	0.309	0.314	0.028	0.103
CN amenable to chlorination	1.56	<0.010	<0.010	<0.010	0.006

* All values are in mg/l.

** CN and CN-amenable to chlorination were determined on a separate, non-acidified sample.

TABLE 17. ANALYSES OF GROUND-WATER SAMPLES COLLECTED AT THE THURROCK CHALK QUARRY DISPOSAL SITE (WELLS B18-B20).

Parameter	Monitoring Well Numbers		
	B18	B19	B20
Ag	< 0.001*	< 0.001	< 0.001
As	< 0.005	< 0.005	< 0.005
Ba	0.091	0.071	0.069
Be	< 0.005	< 0.005	< 0.005
Cd	< 0.010	< 0.010	< 0.010
Co	< 0.001	< 0.001	< 0.001
Cr	0.008	0.032	0.030
Cu	0.002	0.004	0.006
Fe	0.022	0.018	0.032
Hg	< 0.0002	< 0.0002	< 0.0002
Mn	0.042	0.178	0.144
Ni	0.004	0.008	0.008
Pb	0.008	0.010	0.013
Se	< 0.005	< 0.005	< 0.005
Sn	0.049	0.077	0.079
Sr	0.748	1.04	1.04
Zn	< 0.050	< 0.050	0.050
CN**	< 0.010	< 0.010	0.024
CN amenable to chlorination	< 0.010	< 0.010	0.014

* All values are in mg/l.

** CN and CN-amenable to chlorination were determined on a separate, non-acidified sample.

criteria were applied to the EP results that were obtained in duplicate, the laboratories are in agreement on the decision as to which materials in each would or would not cause the sample to be classed as hazardous. The differences in analytical procedures and the variability within the EP test, therefore, were not of such magnitude as to produce any differences in regulatory decisions based on these EP data.

ANALYSES AND RESULTS

Subsampling and Analysis of Surface Water and Groundwater Samples

The water samples were stored in sealed glass bottles at 4°C in a locked refrigerator. Subsamples of the filtered, acidified samples were run for the metals shown in Table 12 using the methods and instrumentation specified. Analyses were begun on May 6, 1982, and completed October 28, 1982. The analyses for all metals except lead and tin were completed within the 180-day time limit recommended for storage of acidified samples (U.S. EPA, 1980). Lead and tin samples showed some chemical interference and these analyses were completed 203 days after sample collection. The results of the analyses are presented in Tables 13-17.

Splits of the unpreserved water samples supplied by the WES contractor were run to determine the concentration of total cyanide and the concentration of cyanide amenable to chlorination. The samples were over aged for cyanide determination (over 24 hours old) and had not been preserved at pH 12.0 with NaOH as is standard practice (U.S. EPA, 1980). The cyanide concentrations in these samples, thus, should be lower than that found in freshly collected water samples. These results are also presented in Tables 13-17 and should be considered as minimum concentrations.

Testing and Analyses of Sealosafe® Slurry Samples

The two slurry samples of treated wastes were tested twice using the EP, (each time the EP was run in duplicate). The slurry samples were first tested when they arrived at WES in April, 1982, and retested in June. Each slurry sample was digested for bulk analysis. Moisture determinations were also made. The EP was performed in the manner described in 40 CFR 261, Appendix II.

The slurry was soft and putty-like with no filterable water. The slurry samples were mixed by hand in plastic collection jars. Clean plastic spatulas were used to thoroughly blend each sample. Homogeneous subsamples of approximately 100 grams each were prepared for use in the EP. Separate subsamples of each sludge were taken for moisture determination and bulk analyses.

Bulk Analysis of Sealosafe® Uncured Slurry --

Samples for bulk analysis were digested in HNO_3 - H_2O_2 - HCl using the procedure outlined in U. S. EPA (1979), CRL Method 571-598. An undigested sediment sample was used for determination of mercury, cyanide, and moisture content.

The slurry digestates were analyzed using the procedures and instrumentation specified in Table 18 except for mercury. The mercury analyses were performed using the technique for mercury in sediment (CRL Method 393) given in U. S. EPA, 1979. Method CRL 393 was used because the routine drying procedure for waste digestion can volatilize some mercury compounds and cause mercury to escape. Cyanide analyses and the determination of cyanide amenable to chlorination were carried out using the methods (CRL Method 366 and EPA method 335.1) given in U. S. EPA, 1979 and U. S. EPA, 1980. Moisture content was determined on a separate sample aliquot by drying at 105°C in two hours cycles (drying and cooling) until a constant weight was attained. The results of the analyses are presented in Table 19.

Extraction Procedure Testing --

No solid-liquid separation of the material was necessary; in addition the samples were not submitted to the structural integrity procedure or ground. The pH adjustment was done manually and the samples were stirred in a paddle stirrer in an all-glass stirring apparatus. The separation of the EP extract was done using pressure filtration.

EP extractants were analyzed using the methods and instrumentation given in Table 18. The results of the analyses are presented in Tables 20 and 21. Averages and ranges for parameters measured in the extracts are given in Table 22.

Testing and Analysis of Samples of Sealosafe® Treated Waste

The Sealosafe®-treated industrial waste cores were described and each core was divided into eight intervals, designated A-H, based on differences in characteristic, color, and texture. A description of the eight core sections and their positions with respect to the ground surface are given in Appendix B. A randomization procedure (Dixon and Massey, 1957) was used to select four samples from each of the 13 cores for extraction (EP) testing in a ground condition. The intervals selected in each core are given in Table 23.

Preparation of Bulk Analysis Samples of Sealosafe®-treated Wastes --

Ground Stablex® samples prepared for EP testing (dried and ground) were digested and analyzed to determine bulk composition. Samples of dried material were digested in HNO_3 - H_2O_2 - HCl using the procedure outlined in U. S. EPA (1979) CRL Method 571-598. In each case, a separate undried, unground sample of the corresponding core interval was also submitted for determination of cyanide, mercury, moisture content, and total organic carbon (TOC). These parameters could not be reliably determined in the dried, ground materials because of possible losses due to volatilization during drying.

Analyses of Sealosafe®-treated Wastes --

The sample acid digestates were analyzed using the procedures and instrumentation specified in Table 18. Moisture contents of the unground core material were determined by drying preweighed samples at 105°C until a constant weight was obtained. Mercury analyses were performed on unground moist core slices using the technique (CRL Method 393) given in U.S. EPA (1979). Analyses for total organic carbon were made using the method outlined in EPA 415.1

(U.S. EPA, Methods 335.3 and 335.1), respectively. The results of the analyses of the acid digests are given in Tables 24 through 36. The results of the analyses performed on the moist core slides are given in Tables 37-49.

Preparation of Samples for EP Testing in Ground Condition --

Samples for EP testing in ground condition were selected and where necessary brushed clean with a nylon-bristled brush. Each sample was placed in a clean, labelled Pyrex beaker and dried for 12 hours at 105°C. Drying was required to allow the samples to be ground and sieved. In some cases, it was necessary to break the core up with a ceramic mortar and pestle to assure that the material dried thoroughly. Some volatile constituents can be lost in drying, but this step had to be introduced to produce homogeneous samples.

The dried samples were ground in a ball mill in plastic jars using ceramic grinding balls. The powdered samples were sieved through clean 100-mesh nylon sieve cloth and stored in clean, labelled, plastic containers. All preparation of sample was done in a secure area and the samples were stored in locked facilities.

Preparation of Samples for EP Testing in a Monolithic Condition --

Six cores were randomly selected for testing using the Structural Integrity Procedure (SIP) and EP. The four samples (or intervals) from the original eight intervals in these cores that were not selected for ground EP testing were used for SIP/EP testing (see Table 23). At the EPA's direction, all samples that were not hard, brittle materials that would fracture (rather than deform plasticly) were rejected from SIP/EP testing. The selection of only hard, brittle samples resulted in the rejection of eight soft samples and the acceptance of 16 samples for SIP/EP testing.

Structural Integrity Testing of Monolithic Samples --

Samples for testing using the Structural Integrity Procedure were prepared by cutting out an axial cylinder 3.3 cm (1.3 inches) in diameter from the center section (parallel to the axis) of the 6.6-cm diameter core sample. A specially designed, diamond-tipped bit was used in a low-speed concrete sampling drill. Compressed air was used to cool the bit and clear cuttings as necessary. The 3.3 cm diameter cylindrical sample was trimmed to 7.1 cm in length using a clean, steel, hacksaw blade. The resulting monolith was tested using the Structural Integrity Procedure outlined in 40 CFR 261, Appendix II.

EP Testing of Sealosafe®-treated Wastes --

The samples of Sealosafe®-treated waste (both ground and monolithic) were subjected to the EP as described in 40 CFR 261, Appendix II. Stirring of the samples was done using an all-glass paddle stirring apparatus. All pH adjustments (acid addition) were done manually. Pressure filtration was used to separate solid and liquid phases. All EP extracts were stored under refrigeration. The samples of extractant from the EP testing from the monolithic core material were composited to form a single extractant sample from each core. The extractants from the ground samples were each analyzed separately.

TABLE 18. TECHNIQUES AND INSTRUMENTATION USED IN THE ANALYSIS OF EP EXTRACTS AND BULK DIGEST OF SEALOSAFE WASTES AND SUBWASTE CHALK AND CLAY.

Parameter	Method	Instrument	Lowest reporting conc (ppm)	Reference
Ag	DC Argon Plasma (DCAP)	Spectrametrics Spectraspan III	0.050	Spectrametrics, 1981
As	Hydride generation (U.S. EPA Method 206.3)	Perkin-Elmer (P-E) 305 with MHS-10	0.005	U.S. EPA, 1980
Ba	DCAP	Spectrametrics Spectraspan III	0.050	Spectrametrics, 1981
Be	DCAP	Spectrametrics Spectraspan III	0.050	Spectrametrics, 1981
Cd	DCAP	Spectrametrics Spectraspan III	0.050	Spectrametrics, 1981
Co	DCAP	Spectrametrics Spectraspan III	0.050	Spectrametrics, 1981
Cr	DCAP	Spectrametrics Spectraspan III	0.050	Spectrametrics, 1981
Cu	DCAP	Spectrametrics Spectraspan III	0.050	Spectrametrics, 1981
Fe	DCAP	Spectrametrics Spectraspan III	0.050	Spectrametrics, 1981
Hg	Cold vapor Atomic Absorption (U.S. EPA Method 245.1)	P-E503	0.0002	U.S. EPA, 1980
Mn	DCAP	Spectrametrics Spectraspan III	0.050	Spectrametrics, 1981
Ni	DCAP	Spectrametrics Spectraspan III	0.050	Spectrametrics, 1981

(continued)

TABLE 18. (concluded)

Parameter	Method	Instrument	Lowest reporting conc (ppm)	Reference
Pb	DCAP/Heated Graphite Atomizer (HGA) (U.S. EPA Method 239.2)	Spectrametrics Spectraspan III	0.050/0.001	Spectrametrics, 1981
Se	Hydride generation (U.S. EPA Method 270.3)	P-E305 with MHS-10	0.005	U.S. EPA, 1980
Sn	DCAP	Spectrametrics Spectraspan III	0.050	Spectrametrics, 1981
Sr	DCAP	Spectrametrics Spectraspan III	0.050	Spectrametrics, 1981
Zn	DCAP	Spectrametrics Spectraspan III	0.050	Spectrametrics, 1981

TABLE 19. BULK ANALYSES OF SEALOSAFE® SLURRY SAMPLES.

Parameter	Sample 1	Sample 2	Average
Ag	8.4*	8.1	8.25
As	190.0	240.0	215.0
Ba	229	249	239
Be	3.85	3.85	3.85
Cd	77.8	75.7	76.75
Co	49.6	49.1	49.35
Cr	1040	1030	1035
Cu	1030	1045	1037.5
Fe	22950	22800	22875
Hg**	0.0007	0.0005	0.0006
Mn	16100	15750	15925
Ni	729	715	722
Pb	1460	1230	1345
Se	78.0	78.0	78.0
Sn	51.9	54.2	53.05
Sr	305	287	296
Zn	5075	4875	4975
CN	188	203	195.5
CN amenable to chlorination	< 1	< 1	< 1
% Solids	44.26	44.32	44.29

* All analyses are in mg/kg dry wt.
** Hg, CN, and % solids analyses were determined on moist samples.

TABLE 20. ANALYSES OF EP EXTRACTS FROM SEALOSAFE® SLURRY SAMPLE NO. 1.*

Parameter	1A	1B	1C	1D
Ag	<0.050**	<0.050	<0.050	<0.050
As	0.015	0.009	0.006	0.006
Ba	0.251	0.210	0.110	0.159
Be	<0.005	<0.005	0.005	0.010
Cd	0.909	0.915	0.832	0.840
Co	0.454	0.452	0.451	0.342
Cr	0.798	0.814	1.31	0.958
Cu	2.12	0.608	1.46	2.57
Fe	0.334	0.279	0.126	0.191
Hg†	<0.0004	<0.0004	<0.0004	<0.0004
Mn	144.0	162.0	138.0	116.0
Ni	4.14	4.62	3.82	3.59
Pb	0.132	0.041	0.074	0.168
Se	0.020	0.024	0.020	0.012
Sn	0.177	0.184	0.144	0.138
Sr	5.00	5.01	4.71	4.64
Zn	50.0	38.6	53.6	53.7

* These EP tests were performed in April, 1982.
** All analyses are in mg/l.
† Analyses for Hg were performed as indicated in Table 18.

TABLE 21. ANALYSES OF EP EXTRACTS FROM SEALOSAFE® SLURRY SAMPLE NO. 2.*

Parameter	2A	2B	2C*	2D**
Ag	< 0.050†	< 0.050	< 0.050	< 0.050
As	0.005	0.007	0.006	0.006
Ba	0.191	0.188	0.186	0.184
Be	0.005	0.005	0.006	0.007
Cd	0.465	0.554	0.434	0.724
Co	0.165	0.234	0.207	0.329
Cr	0.996	0.646	0.930	1.28
Cu	0.655	1.02	1.63	2.48
Fe	0.131	0.155	0.095	0.190
Hg††	< 0.0004	< 0.0004	< 0.0004	< 0.0004
Mn	42.8	67.8	73.8	109.0
Ni	1.62	2.04	2.34	3.66
Pb	0.060	0.041	0.176	0.160
Se	0.014	0.015	0.014	0.016
Sn	0.199	0.164	0.072	0.123
Sr	3.88	4.10	4.46	4.50
Zn	13.0	19.9	28.7	47.0

* These EP tests were performed in June, 1982

** Analyses were made on two separate splits of each of these extracts. Results presented are averages.

† All analyses are in mg/l.

†† Hg analyses were performed as indicated in Table 18.

TABLE 22. SUMMARY OF ANALYSES OF EP EXTRACTS FROM SEALOSAFE® SLURRY SAMPLES.

Parameter	Average* Slurry Sample No. 1	Average* Slurry Sample No. 2	Mean of all Analyses	Range
Ag	B**	B	B	< 0.005
As	0.009†	0.006	0.007	0.005 - 0.015
Ba	0.182	0.187	0.184	0.110 - 0.251
Be	B	B	B	< 0.005 - 0.010
Cd	0.874	0.544	0.709	0.434 - 0.915
Co	0.425	0.234	0.330	0.165 - 0.454
Cr	0.970	0.963	0.966	0.646 - 1.31
Cu	1.69	1.45	1.57	0.608 - 2.12
Fe	0.232	0.143	0.188	0.095 - 0.279
Hg	B	B	B	< 0.0004
Mn	140.0	73.35	106.7	42.8 - 162.0
Ni	4.04	2.42	3.23	1.62 - 4.62
Pb	0.104	0.069	0.086	0.041 - 0.168
Se	0.019	0.015	0.017	0.014 - 0.024
Sn	0.275	0.270	0.272	0.072 - 0.491
Sr	4.84	4.24	4.54	3.88 - 5.01
Zn	49.0	27.1	38.0	13.0 - 53.7

* Each value is average of four separate extractions

** B = 50% or more of values are below the limit of detection for the analytical technique employed.

† All values are in mg/l.

TABLE 23. SUMMARY OF SAMPLES SELECTED FOR EP TESTING IN GROUND CONDITION AND STRUCTURAL INTEGRITY PROCEDURE AND EP TESTING

	Sample Position							
Bore Hole	A	B	C	D	E	F	G	H
1	SIP/EP	EP	SIP/EP	EP	SIP/EP	EP	EP/MEP	SIP/EP
2	EP**	EP	SIP/EP	SIP/EP	EP*/MEP	SIP/EP	SIP/EP	EP**
3	EP**	EP	NA	EP**	NA	NA	EP*	NA
4	EP	EP	NA	EP**	EP	NA	NA	NA
5	EP	SIP/EP	EP	SIP/EP	EP*	EP*/MEP	SIP/EP	SIP/EP
6	EP/MEP	NA	EP	NA	EP	EP*	NA	NA
7	EP*	SIP/EP	SIP/EP	EP*	EP**	EP*	SIP/EP	SIP/EP
8	EP	EP*	EP	EP**	SIP/EP	SIP/EP	SIP/EP	SIP/EP
9	NA	EP	NA	EP	EP	NA	EP	NA
10	NA	EP	EP**	EP	NA	NA	EP	NA
11	EP	EP	EP	NA	NA	NA	EP*	NA
12	NA	EP*	EP**	NA	NA	NA	EP*	EP*
13	SIP/EP	EP*/MEP	EP*	EP**	SIP/EP	SIP/EP+	SIP/EP	EP*

SIP/EP = Structural Integrity Procedure done at WES, Environmental Monitoring System Laboratory (EMSL).
EP = Sample for extraction procedure at WES in ground condition.
EP* = Sample for extraction procedure at WES in ground condition (Samples sent to EMSL).
EP** = Samples for extraction procedure in ground condition at WES and EMSL.
NA = Samples not selected via the random selection procedure.
+ = Sample amenable to SIP was not available for EMSL.
SIP/EP = Sample randomly selected was not amenable to SIP at WES.
MEP = Sample selected for multiple extraction procedure testing.

TABLE 24. ANALYSES OF DIGESTS OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 1

Parameter	Borehole Interval			
	B	D	F	G
Ag	4.04*	3.16	3.51	3.64
As	128	138	137	340
Ba	961	826	841	962
Be	7.19	7.34	7.12	5.02
Cd	10.4	5.53	5.46	23.4
Co	25.4	27.6	26.1	27.3
Cr	194	141	140	488
Cu	317	233	228	1040
Fe	20900	27200	22200	16800
Hg	0.0494	0.0355	0.0688	0.0460
Mn	384	374	355	329
Ni	158	119	117	360
Pb	872	964	1390	2250
Se	35.2	25.2	22.9	146
Sn	12.0	15.0	19.3	87.3
Sr	397	326	359	628
Zn	770	630	622	2400

* All values are in mg/kg dry wt.

TABLE 25. ANALYSES OF DIGESTS OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 2

Parameter	Borehole Interval			
	A	B	E	H
Ag	3.88*	4.31	3.63	2.90
As	249	134	206	223
Ba	1185	875	252	1250
Be	7.51	7.28	7.27	7.55
Cd	15.8	4.51	18.0	17.9
Co	29.2	28.2	26.3	27.1
Cr	452	140	485	482
Cu	643	233	695	700
Fe	29150	22100	26200	26400
Hg	0.1067	0.0370	0.1260	0.1246
Mn	557	383	560	569
Ni	264	115	295	290
Pb	1075	987	1002	1152
Se	92.5	24.9	126	135
Sn	25.9	6.61	23.5	85.8
Sr	399	351	407	413
Zn	1660	611	1730	1740

* All values are in mg/kg dry wt.

TABLE 26. ANALYSES OF DIGESTS OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 3

Parameter	Borehole Interval			
	A	B	D	G
Ag	5.72*	3.94	13.3	6.30
As	213	158	229	260
Ba	969	1030	832	1200
Be	6.69	7.30	6.76	6.90
Cd	9.11	6.31	10.8	16.7
Co	28.7	29.4	28.2	25.2
Cr	218	159	281	451
Cu	354	245	433	651
Fe	26300	23600	28300	25700
Hg	0.0517	0.0301	0.0531	0.1462
Mn	426	386	478	548
Ni	165	128	189	270
Pb	1230	1110	1630	1120
Se	28.1	22.7	61.6	114
Sn	36.2	7.10	16.9	28.1
Sr	368	332	369	398
Zn	1280	739	1550	1650

* All values are in mg/kg dry wt.

TABLE 27. ANALYSES OF DIGESTS OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 4

Parameter	Borehole Interval			
	A	B	D	E
Ag	3.00*	2.99	2.66	2.46
As	496	149	236	571
Ba	229	916	101	98.3
Be	6.10	7.36	4.53	8.37
Cd	14.7	9.95	28.4	48.2
Co	19.3	25.2	19.3	28.9
Cr	200	185	515	1012
Cu	397	315	1050	1465
Fe	15300	20500	16100	29050
Hg	0.0884	0.0339	0.3772	0.3326
Mn	381	389	914	762
Ni	170	139	296	531
Pb	901	663	443	728
Se	69.0	34.3	120	191
Sn	4.30	6.17	19.6	21.5
Sr	389	412	591	358
Zn	1040	723	2390	3655

* All values are in mg/kg dry wt.

TABLE 28. ANALYSES OF DIGESTS OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 5

Parameter	Borehole Interval			
	A	C	E	F
Ag	3.40*	7.22	7.27	12.5
As	173	158	242	299
Ba	93.5	787	835	822
Be	8.00	6.73	6.03	5.88
Cd	41.7	5.64	6.00	7.27
Co	22.8	27.2	25.6	24.4
Cr	590	141	161	185
Cu	1230	247	282	296
Fe	19400	22500	24500	25100
Hg	0.2175	0.0337	0.0416	0.0431
Mn	687	378	402	389
Ni	464	119	134	134
Pb	911	1030	1320	2090
Se	214	25.2	30.9	43.8
Sn	4.00	6.92	15.4	45.2
Sr	355	322	326	311
Zn	2130	631	1050	1360

* All values are in mg/kg dry wt.

TABLE 29. ANALYSES OF DIGESTS OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 6

Parameter	Borehole Interval			
	A	C	E	F
Ag	18.1*	6.17	1.78	7.95
As	635	269	277	268
Ba	174	944	224	1230
Be	7.74	5.97	8.10	7.36
Cd	56.8	8.46	18.0	17.3
Co	28.6	27.5	26.9	27.5
Cr	1100	203	453	455
Cu	1740	348	700	662
Fe	29800	27000	26800	25800
Hg	0.3484	0.0520	0.1080	0.1117
Mn	792	416	577	554
Ni	645	159	296	278
Pb	1260	1687	979	844
Se	278	34.3	90 9	93.4
Sn	5.36	12.0	18.0	10.1
Sr	327	349	414	405
Zn	4300	1280	1810	1680

* All values are in mg/kg dry wt.

TABLE 30. ANALYSES OF DIGESTS OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 7

Parameter	Borehole Interval			
	A	D	E	F
Ag	10.1	2.8	3.94	6.26
As	198	50	128	149
Ba	918	460	1020	1160
Be	3.67	1.6	3.84	3.98
Cd	23.2	79.1	36.2	39.9
Co	22.2	13.3	26.2	26.8
Cr	394	287	455	477
Cu	830	456	782	832
Fe	15300	10400	18500	19800
Hg	0.0958	**	0.1300	0.1524
Mn	339	243	390	380
Ni	298	175	335	378
Pb	1260	389	656	835
Se	109	1275	47.3	66.6
Sn	10.7	57.6	62.2	43.2
Sr	601	408	572	572
Zn	2140	1110	1800	-2030

* All values are in mg/kg dry wt.

** Analyses not available.

TABLE 31. ANALYSES OF DIGESTS OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 8

Parameter	Borehole Interval			
	A	B	C	D
Ag	3.00*	5.67	6.26	1.55
As	150	109	129	193
Ba	833	1020	1100	732
Be	6.60	4.27	4.67	3.87
Cd	5.70	39.9	44.4	17.6
Co	27.7	27.2	28.0	17.4
Cr	139	338	395	350
Cu	236	719	818	713
Fe	22400	18100	18400	13200
Hg	0.0720	0.0595	0.1335	0.1088
Mn	396	398	424	277
Ni	110	326	358	239
Pb	1130	480	662	1320
Se	26.5	63.6	60.6	89.0
Sn	9.40	10.4	10.4	42.9
Sr	352	551	517	578
Zn	638	1660	1670	1830

* All values are in mg/kg dry wt.

TABLE 32. ANALYSES OF DIGESTS OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 9

Parameter	Borehole Interval			
	B	D	E	G
Ag	5.10*	5.65	2.18	3.04
As	224	119	109	108
Ba	81.5	1130	1010	568
Be	4.10	5.25	3.86	4.71
Cd	20.5	41.7	39.6	40.0
Co	27.7	29.7	26.6	27.6
Cr	322	380	323	394
Cu	849	787	703	794
Fe	13600	18600	17300	18100
Hg	0.1106	0.1562	0.1476	0.1554
Mn	305	405	387	397
Ni	310	327	303	314
Pb	1650	641	549	494
Se	146	64.5	61.4	51.0
Sn	18.0	39.1	36.9	24.8
Sr	586	590	530	534
Zn	2190	1560	1660	1430

* All values are in mg/kg dry wt.

TABLE 33. ANALYSES OF DIGESTS OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 10

Parameter	Borehole Interval			
	B	C	D	G
Ag	5.35*	1.26	3.00	3.20
As	139	126	90.9	95.2
Ba	134	775	101	122
Be	3.35	3.50	3.90	3.10
Cd	14.4	24.2	36.4	33.2
Co	21.7	19.5	29.6	28.5
Cr	228	324	268	220
Cu	586	565	658	591
Fe	11700	14600	14900	15300
Hg	0.0850	0.0924	0.1870	0.1784
Mn	277	312	367	377
Ni	216	230	273	241
Pb	1270	746	577	498
Se	59.0	45.7	57.0	61.0
Sn	1.60	38.5	5.90	58.0
Sr	577	594	476	583
Zn	1440	1440	1370	1420

* All values are in mg/kg dry wt.

TABLE 34. ANALYSES OF DIGESTS OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 11

Parameter	Borehole Interval			
	A	B	C	G
Ag	5.45*	3.70	3.70	3.15
As	216	69.0	76.7	88.7
Ba	62.0	97.8	59.0	858
Be	3.80	2.80	3.40	3.35
Cd	17.5	21.1	28.7	36.9
Co	18.9	23.7	25.5	21.6
Cr	284	256	243	293
Cu	736	570	548	642
Fe	13200	12900	13900	16600
Hg	0.0893	0.0902	0.1063	0.1133
Mn	291	296	334	368
Ni	267	178	238	284
Pb	1275	376	269	479
Se	124	30.5	55.0	60.1
Sn	2.10	28.0	1.90	22.1
Sr	620	614	533	526
Zn	1860	1330	1220	1710

* All values are in mg/kg dry wt.

TABLE 35. ANALYSES OF DIGESTS OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 12

Parameter	Borehole Interval			
	B	C	G	H
Ag	9.33*	2.95	13.4	4.01
As	169	290	420	117
Ba	1450	1650	1530	734
Be	4.47	5.70	6.75	5.28
Cd	45.9	41.6	34.3	6.10
Co	30.0	33.2	24.6	21.9
Cr	508	718	674	214
Cu	943	1305	997	262
Fe	17400	19350	21900	18800
Hg	0.1456	0.2619	0.2882	0.0866
Mn	624	652	640	399
Ni	497	526	380	122
Pb	1040	811	1350	434
Se	163	227	225	147
Sn	55.7	113	62.2	13.4
Sr	574	564	371	438
Zn	2380	2580	2440	607

* All values are in mg/kg dry wt.

TABLE 36. ANALYSES OF DIGESTS OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 13

Parameter	Borehole Interval			
	B	C	D	H
Ag	7.46*	9.12	9.15	7.63
As	368	268	259	89.2
Ba	710	1730	1550	901
Be	3.78	5.55	5.57	3.47
Cd	18.1	43.3	27.0	27.3
Co	33.8	33.1	28.0	21.9
Cr	596	638	627	426
Cu	1060	1120	1120	744
Fe	26800	18000	16700	16300
Hg	0.1695	0.2706	0.2940	0.1856
Mn	3490	605	625	353
Ni	485	506	418	245
Pb	3320	1000	943	485
Se	203	248	274	42.6
Sn	80.3	83.6	64.4	61.0
Sr	300	577	532	616
Zn	3410	2530	2480	1800

* All values are in mg/kg dry wt.

TABLE 37. ANALYSES OF MOIST SAMPLES OF TREATED WASTE CORE FROM BOREHOLE 1

Parameter	Borehole Interval			
	B	D	F	G
Total CN	68.8*	31.4	24.1	42.5
CN amenable to chlorination	5.0	<1	<1	<1
Hg**	0.0274	0.0138	0.012	0.0170
TOC	5230	5675	14300	12700
Moisture Content (%)	40.0	39.2	37.1	36.2

* All values except moisture content are in mg/kg dry weight

** These analyses were performed on a separate, moist sample of unhomogenized material and may be greater or less than Hg concentrations determined on dried material from the same borehole interval.

TABLE 38. ANALYSES OF MOIST SAMPLES OF TREATED WASTE CORE FROM BOREHOLE 2

Parameter	Borehole Interval			
	A	B	E	H
Total CN	45.5*	33.0	95.0	73.3
CN amenable to chlorination	< 1	< 1	< 1	6.2
Hg**	0.0232	0.0198	0.0732	0.0804
TOC	4845	5265	5730	7175
Moisture Content (%)	48.8	35.9	52.3	49.1

* All values except moisture content are in mg/kg dry weight

** These analyses were performed on a separate moist sample of unhomogenized material and may be greater or less than Hg concentrations determined on dried material from the same borehole interval.

TABLE 39. ANALYSES OF MOIST SAMPLES OF TREATED WASTE CORE FROM BOREHOLE

Parameter	Borehole Interval			
	A	B	D	G
Total CN	73.8*	38.0	52.0	89.9
CN amenable to chlorination	13.6	<1	<1	<1
Hg**	0.0491	0.0525	0.0694	0.0786
TOC	5135	5675	5925	6280
Moisture Content (%)	42.5	42.1	51.3	50.0

* All values except moisture content are in mg/kg dry weight

** These analyses were performed on a separate moist sample of unhomogenized material and may be greater or less than Hg concentrations determined on dried material from the same borehole interval.

TABLE 40. ANALYSES OF MOIST SAMPLES OF TREATED WASTE CORE FROM BOREHOLE 4

Parameter	Borehole Interval			
	A	B	D	E
Total CN	75.1*	58.8	30.2	72.1
CN amenable to chlorination	14.4	12.5	<1	<1
Hg**	0.0484	0.0242	0.0251	0.0164
TOC	5670	4505	4250	6875
Moisture Content (%)	41.6	40.0	29.8	27.9

* All values except moisture content are in mg/kg dry weight

** These analyses were performed on a separate moist sample of unhomogenized material and may be greater or less than Hg concentrations determined on dried material from the same borehole interval.

TABLE 41. ANALYSES OF MOIST SAMPLES OF TREATED WASTE CORE FROM BOREHOLE 5

Parameter	Borehole Interval			
	A	C	E	F
Total CN	110.1*	32.1	35.9	52.8
CN amenable to chlorination	< 1	< 1	< 1	7.7
Hg**	0.0819	0.0290	0.0212	0.0242
TOC	6290	4355	4940	4740
Moisture Content (%)	41.1	36.0	35.7	46.2

* All values except moisture content are in mg/kg dry weight

** These analyses were performed on a separate moist sample of unhomogenized material and may be greater or less than Hg concentrations determined on dried material from the same borehole interval.

TABLE 42. ANALYSES OF MOIST SAMPLES OF TREATED WASTE CORE FROM BOREHOLE 6

Parameter	Borehole Interval			
	A	C	E	F
Total CN	133.4*	66.7	153.6	132.2
CN amenable to chlorination	< 1	< 1	12.4	< 1
Hg**	0.0692	0.0237	0.0224	0.0205
TOC	7195	5035	6235	5700
Moisture Content (%)	50.0	47.2	49.8	49.2

* All values except moisture content are in mg/kg dry weight

** These analyses were performed on a separate moist sample of unhomogenized material and may be greater or less than Hg concentrations determined on dried material from the same borehole interval.

TABLE 43. ANALYSES OF MOIST SAMPLES OF TREATED WASTE CORE FROM BOREHOLE 7

Parameter	Borehole Interval			
	A	D	E	F
Total CN	80.6*	37.4	50.3	7.49
CN amenable to chlorination	< 1	6.7	< 1	< 1
Hg**	0.0164	0.0195	0.0213	0.0264
TOC	4060	3440	4180	4975
Moisture Content (%)	43.6	39.0	42.2	47.6

* All values except moisture content are in mg/kg dry weight

** These analyses were performed on a separate moist sample of unhomogenized material and may be greater or less than Hg concentrations determined on dried material from the same borehole interval.

TABLE 44. ANALYSES OF MOIST SAMPLES OF TREATED WASTE CORE FROM BOREHOLE 3

Parameter	Borehole Interval			
	A	B	C	D
Total CN	98.7*	166.4	70.7	75.4
CN amenable to chlorination	< 1	165.3	14.5	28.0
Hg**	0.0167	0.0094	0.0278	0.0294
TOC	4950	4335	5440	4290
Moisture Content (%)	46.6	46.2	40.7	39.2

* All values except moisture content are in mg/kg dry weight

** These analyses were performed on a separate moist sample of unhomogenized material and may be greater or less than Hg concentrations determined on dried material from the same borehole interval.

TABLE 45. ANALYSES OF MOIST SAMPLES OF TREATED WASTE CORE FROM BOREHOLE 9

Parameter	Borehole Interval			
	B	D	E	G
Total CN	75.9*	69.1	50.9	93.7
CN amenable to chlorination	<1	18.6	13.3	14.0
Hg**	0.0114	0.0319	0.0290	0.0256
TOC	3740	4825	4100	4210
Moisture Content (%)	48.2	40.0	37.7	38.2

* All values except moisture content are in mg/kg dry weight

** These analyses were performed on a separate moist sample of unhomogenized material and may be greater or less than Hg concentrations determined on dried material from the same borehole interval.

TABLE 46. ANALYSES OF MOIST SAMPLES OF TREATED WASTE CORE FROM BOREHOLE 10

Parameter	Borehole Interval			
	B	C	D	G
Total CN	114.9*	44.5	95.7	48.9
CN amenable to chlorination	44.5	<1	27.0	1.6
Hg**	0.0132	0.0178	0.0282	0.0236
TOC	3130	3480	4565	3810
Moisture Content (%)	37.4	39.1	38.8	35.0

* All values except moisture content are in mg/kg dry weight

** These analyses were performed on a separate moist sample of unhomogenized material and may be greater or less than Hg concentrations determined on dried material from the same borehole interval.

TABLE 47. ANALYSES OF MOIST SAMPLES OF TREATED WASTE CORE FROM BOREHOLE 11

Parameter	Borehole Interval			
	A	B	C	G
Total CN	73.9*	52.4	71.0	61.7
CN amenable to chlorination	14.6	<1	<1	<1
Hg**	0.0122	0.0176	0.0200	0.0122
TOC	4190	3695	3525	4645
Moisture Content (%)	41.5	37.4	36.7	38.6

* All values except moisture content are in mg/kg dry weight

** These analyses were performed on a separate moist sample of unhomogenized material and may be greater or less than Hg concentrations determined on dried material from the same borehole interval.

TABLE 48. ANALYSES OF MOIST SAMPLES OF TREATED WASTE CORE FROM BOREHOLE 12

Parameter	Borehole Interval			
	B	C	G	H
Total CN	135.0*	108.7	162.7	76.1
CN amenable to chlorination	13.6	< 1	< 1	30.2
Hg**	0.0335	0.0414	0.0096	0.0072
TOC	5170	4355	7030	5415
Moisture Content (%)	50.2	48.4	54.2	53.7

* All values except moisture content are in mg/kg dry weight

** These analyses were performed on a separate moist sample of unhomogenized material and may be greater or less than Hg concentrations determined on dried material from the same borehole interval.

TABLE 49. ANALYSES OF MOIST SAMPLES OF TREATED WASTE CORE FROM BOREHOLE 13

Parameter	Borehole Interval			
	B	C	D	H
Total CN	459.9*	100.9	77.6	72.5
CN amenable to chlorination	1	26.5	1	1
Hg**	0.0156	0.0398	0.0452	0.0196
TOC	14750	5890	5435	5350
Moisture Content (%)	50.2	50.0	46.4	53.6

* All values except moisture content are in mg/kg dry weight

** These analyses were performed on a separate moist sample of unhomogenized material and may be greater or less than Hg concentrations determined on dried material from the same borehole interval.

Analyses of EP extracts --

The EP extractants were analyzed using the methods and instrumentation given in Table 18. The results of the analyses of the extracts of the monolithic samples (composited for the samples from each core) are presented in Table 50. The results of the analyses of extracts from the ground core are presented in Tables 51 through 63.

Leaching of Ground Sealosafe®-treated Wastes for Cyanide--

Eight dried, ground samples of treated waste were subjected to a distilled water leaching test for total cyanide. The eight samples selected from available material that had previously been tested using the EP procedure were rerun in a similar extraction to the EP, but distilled water (not dilute acetic acid) was used as an extractant. No pH adjustment was made; the suspended waste was simply stirred with distilled water for 24 hours. Analyses for cyanide were run using U.S. EPA Method 335.3. The results are presented in Table 64 along with CN concentrations found in bulk analyses of moist core slices from the same interval.

Multiple Extraction of Ground, Treated Wastes

Five samples of residue from the EP testing were selected for Multiple Extraction Procedure (MEP) testing on the basis of high contaminant concentrations in the EP extracts or bulk analyses. The details of the MEP procedure are given in Appendix D. The MEP involves the use of a dilute nitric and sulfuric acid mixture (at pH 3) to leach the residue. The results of the MEP tests are presented in Tables 65 through 69. Careful attention was paid to background levels in blanks carried through the nine successive extractions. Some contamination was noted from the acid mixture and the accumulated filter paper. All values reported are corrected for blanks.

Analyses of Extracts of Clay and Chalk Below the Treated Wastes

Samples of soil were selected from the top, middle, and bottom portions of each clay or chalk core obtained from beneath the Sealosafe®-treated waste. The position of each sample beneath the waste interface and a description of each core are given in Appendix B, Table B15. The clay or chalk samples were digested using the technique specified in CRL Method Nos. 571-593 (U. S. EPA 1979). Analysis of the digests were performed using the techniques for metals specified in Table 18. The results of the analyses are presented in Tables 70-82.

TABLE 50. ANALYSES OF EP EXTRACTS FROM MONOLITHIC SAMPLES OF TREATED WASTE CORE MATERIAL

Parameter	Borehole					
	1*	2	5	7	8	13
Ag	<0.050**	<0.050	<0.050	<0.050	<0.050	<0.050
As	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ba	0.001	0.064	0.040	0.096	0.050	0.077
Be	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cd	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Co	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cr	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cu	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fe	<0.050	0.052	<0.050	0.091	<0.050	<0.050
Hg†	<0.0004	<0.0004	<0.0004	0.005	<0.0004	0.0014
Mn	<0.050	<0.050	<0.050	0.053	<0.050	1.74
Ni	<0.050	<0.050	<0.050	<0.050	<0.050	0.054
Pb	0.003	0.001	0.003	0.005	0.002	0.011
Se††	<0.005	0.084	0.021	0.031	<0.005	0.054
Sn	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Sr	0.114	0.223	0.172	0.677	0.506	0.794
Zn	<0.050	<0.050	0.050	0.248	<0.050	0.411

* Samples analyzed were composites of EP extracts from two to four sample intervals from each core.

** All values are in mg/l.

† Hg analyses were performed as indicated in Table 18.

†† Se analyses may be low estimates due to the analytical technique employed (See QA/QC discussion).

TABLE 51. ANALYSES OF EXTRACTANT FROM EP TEST OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 1.

Parameter	Borehole Interval			
	B	D	F	G
Ag	<0.050*	<0.050	<0.050	<0.050
As	0.029	0.025	0.024	0.024
Ba	0.156	0.211	0.280	0.198
Be	<0.005	<0.005	<0.005	<0.005
Cd	<0.050	<0.050	<0.050	0.244
Co	<0.050	<0.050	<0.050	0.078
Cr	0.106	0.095	<0.050	<0.050
Cu	<0.050	<0.050	<0.050	0.215
Fe	0.173	0.074	0.117	0.108
Hg**	0.0006	<0.0014	<0.0004	0.0010
Mn	<0.050	0.150	0.132	1.59
Ni	0.077	0.067	0.052	0.362
Pb	0.002	0.001	0.004	0.269
Se†	0.290	0.104	0.106	0.045
Sn	<0.050	<0.050	<0.050	<0.050
Sr	5.39	5.28	5.05	4.38
Zn	0.70	<0.050	<0.050	8.49

* All values are in mg/l.

** Hg analyses were performed as indicated in Table 18.

† Se analyses may be low due to the analytical technique employed (See QA/QC discussion).

TABLE 52. ANALYSES OF EXTRACTANT FROM EP TEST OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 2.

Parameter	Borehole Interval			
	A*	B	E	H
Ag	<0.050**	<0.050	<0.050	<0.050
As	0.028	0.009	0.042	0.029
Ba	0.234	0.287	0.174	0.224
Be	<0.005	<0.005	<0.005	<0.005
Cd	<0.050	0.113	0.130	<0.050
Co	<0.050	0.063	0.072	<0.050
Cr	0.066	<0.050	<0.050	0.074
Cu	0.119	0.069	0.084	0.102
Fe	0.202	<0.050	0.417	0.144
Hg†	0.0026	0.0060	0.1402	0.0007
Mn	<0.050	1.26	26.1	0.175
Ni	<0.050	0.234	0.521	0.091
Pb	0.004	0.220	0.005	0.003
Se	0.310	0.040	0.205	0.308
Sn	0.050	<0.050	0.388	<0.050
Sr	5.16	5.05	5.83	5.29
Zn	0.053	2.46	0.159	0.0509

* Values are averages of duplicate extractions.

** All values are in mg/l.

† Hg analyses were performed as indicated in Table 18.

†† Se analyses may be low due to the analytical technique employed (See QA/QC discussion).

TABLE 53. ANALYSES OF EXTRACTANT FROM EP TEST OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 5.

Parameter	Borehole Interval			
	A*	B	D*	G
Ag	<0.050**	<0.050	<0.050	<0.050
As	0.041	0.013	0.038	0.027
Ba	0.274	0.260	0.152	0.240
Be	<0.005	<0.005	0.005	<0.005
Cd	<0.050	<0.050	<0.050	<0.050
Co	<0.050	<0.050	<0.050	<0.050
Cr	<0.050	0.067	0.062	0.595
Cu	0.081	<0.050	0.088	0.129
Fe	0.088	0.114	0.092	0.272
Hg†	0.0030	0.0970	0.0017	0.0019
Mn	0.357	0.176	0.237	0.210
Ni	0.098	0.068	0.096	0.141
Pb	<0.005	0.004	0.003	<0.001
Se††	0.132	0.091	0.213	0.255
Sn	<0.050	<0.050	<0.050	<0.050
Sr	4.64	4.60	4.87	5.49
Zn	0.214	<0.050	0.138	0.103

* Values are averages of duplicate extractions.

** All values are in mg/l.

† Hg analyses were performed as indicated in Table 18.

†† Se analyses may be low due to the analytical technique employed (See QA/QC discussion).

TABLE 54. ANALYSES OF EXTRACTANT FROM EP TEST OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 4.

Parameter	Borehole Interval			
	A	B	D*	E
Ag	<0.050**	<0.050	<0.050	<0.050
As	0.029	0.024	0.009	0.013
Ba	0.048	0.183	0.142	0.146
Be	<0.005	<0.005	<0.005	0.005
Cd	<0.050	<0.050	<0.050	<0.050
Co	<0.050	<0.050	<0.050	<0.050
Cr	0.102	0.080	0.156	0.090
Cu	0.064	0.075	0.123	0.156
Fe	0.518	0.112	0.153	0.171
Hg†	0.0011	0.0012	0.0032	0.0011
Mn	<0.050	0.072	0.099	0.139
Ni	0.204	0.054	0.060	<0.050
Pb	<0.001	0.003	0.006	0.001
Se††	0.330	0.155	0.235	0.390
Sn	0.058	<0.050	<0.050	<0.050
Sr	6.07	5.66	6.48	4.26
Zn	<0.050	<0.050	<0.050	<0.050

* Values are averages of duplicate extractions.

** All values are in mg/l.

† Hg analyses were performed as indicated in Table 18.

†† Se analyses may be low due to the analytical technique employed (See QA/QC discussion).

TABLE 55. ANALYSES OF EXTRACTANT FROM EP TEST OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 5.

Parameter	Borehole Interval			
	A	C	E	F
Ag	<0.050*	<0.050	<0.050	<0.050
As	0.020	0.012	0.038	0.115
Ba	0.088	0.217	0.144	0.207
Be	<0.005	<0.005	<0.005	<0.005
Cd	<0.050	<0.050	<0.050	<0.050
Co	<0.050	<0.050	<0.050	<0.050
Cr	0.356	0.156	0.151	<0.050
Cu	0.096	<0.050	<0.050	0.084
Fe	0.494	0.081	0.120	0.112
Hg**	0.0010	0.0008	0.0008	0.0004
Mn	<0.050	0.335	0.060	<0.050
Ni	<0.050	0.106	0.090	0.050
Pb	<0.001	0.004	0.003	0.004
Se†	0.490	0.078	0.145	0.225
Sn	0.062	<0.050	0.381	<0.050
Sr	4.59	5.29	5.25	4.75
Zn	<0.050	<0.050	<0.050	<0.050

* All values are in mg/l.

** Hg analyses were performed as indicated in Table 18.

† Se analyses may be low due to the analytical technique employed (See QA/QC discussion).

TABLE 56. ANALYSES OF EXTRACTANT FROM EP TEST OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 6.

Parameter	Borehole Interval			
	A	C	E	F
Ag	<0.050*	<0.050	<0.050	<0.050
As	0.022	0.042	0.060	0.027
Ba	0.219	0.178	0.127	0.195
Be	<0.005	<0.005	<0.005	<0.005
Cd	<0.050	<0.050	<0.050	<0.050
Co	<0.050	<0.050	<0.050	<0.050
Cr	1.09	0.187	0.436	0.564
Cu	0.173	0.092	0.127	0.112
Fe	0.179	0.209	0.330	0.353
Hg**	0.1380	<0.0004	<0.0004	<0.0005
Mn	0.274	<0.050	<0.050	0.110
Ni	0.168	<0.050	<0.050	0.100
Pb	0.002	0.004	<0.001	0.005
Se†	0.195	0.290	0.500	0.400
Sn	0.084	<0.050	<0.050	0.356
Sr	4.43	5.00	5.74	5.42
Zn	<0.050	<0.050	0.050	<0.050

* All values are in mg/l.

** Hg analyses were performed as indicated in Table 18.

† Se analyses may be low due to the analytical technique employed (See QA/QC discussion).

TABLE 57. ANALYSES OF EXTRACTANT FROM EP TEST OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 7.

Parameter	Borehole Interval			
	A	D	E	F
Ag	<0.050*	<0.050	<0.050	<0.050
As	0.019	0.010	0.006	0.007
Ba	0.161	0.140	0.130	0.190
Be	<0.005	<0.005	<0.005	<0.005
Cd	<0.050	<0.050	0.067	<0.050
Co	<0.050	<0.050	<0.050	<0.050
Cr	0.315	0.282	0.252	0.346
Cu	0.135	0.130	0.127	0.132
Fe	0.296	0.188	0.238	0.276
Hg**	0.0011	<0.0004	0.0005	0.0006
Mn	<0.050	<0.050	0.158	0.164
Ni	<0.050	<0.050	0.068	0.061
Pb	0.006	0.005	0.008	0.013
Se†	0.118	0.096	0.076	0.090
Sn	<0.050	<0.050	<0.050	<0.050
Sr	8.54	7.16	7.28	7.67
Zn	<0.050	<0.050	<0.050	<0.050

* All values are in mg/l.

** Hg analyses were performed as indicated in Table 18.

† Se analyses may be low due to the analytical technique employed (See QA/QC discussion).

TABLE 58. ANALYSES OF EXTRACTANT FROM EP TEST OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 8.

Parameter	Borehole Interval			
	A	B	C	D*
Ag	<0.050**	<0.050	<0.050	<0.050
As	0.012	0.018	0.008	0.007
Ba	<0.001	0.093	0.129	0.195
Be	<0.005	<0.005	<0.005	<0.005
Cd	<0.050	<0.050	<0.050	<0.050
Co	<0.050	<0.050	<0.050	<0.050
Cr	0.146	0.377	0.201	0.117
Cu	0.100	0.128	0.127	0.176
Fe	0.269	0.531	0.155	0.139
Hg†	0.0005	<0.0004	<0.0004	0.0007
Mn	<0.050	<0.050	0.377	0.370
Ni	<0.050	0.083	0.111	0.085
Pb	0.0004	0.003	0.003	0.005
Se††	0.268	0.255	0.104	0.083
Sn	0.054	0.617	0.085	<0.050
Sr	3.40	7.77	7.76	6.38
Zn	<0.050	<0.050	0.064	0.498

* Values are averages of duplicate extractions.

** All values are in mg/l.

† Hg analyses were performed as indicated in Table 18.

†† Se analyses may be low due to the analytical technique employed (See QA/QC discussion).

TABLE 59. ANALYSES OF EXTRACTANT FROM EP TEST OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 9.

Parameter	Borehole Interval			
	B	D	E	G
Ag	<0.050*	<0.050	<0.050	<0.050
As	0.016	0.012	0.011	0.009
Ba	0.058	0.188	0.176	0.135
Be	<0.005	<0.005	<0.005	<0.005
Cd	<0.050	<0.050	<0.050	<0.050
Co	<0.050	<0.050	<0.050	<0.050
Cr	0.373	0.535	0.533	0.487
Cu	0.126	0.117	0.089	0.120
Fe	0.861	0.219	0.222	0.211
Hg**	0.0005	<0.0004	<0.0004	<0.0004
Mn	<0.050	0.171	<0.050	0.424
Ni	<0.050	0.081	0.067	0.169
Pb	<0.001	0.005	0.006	0.002
Se†	0.220	0.109	0.128	0.106
Sn	0.066	0.376	0.071	0.399
Sr	7.42	8.60	7.73	7.12
Zn	<0.050	0.053	<0.050	0.099

* All values are in mg/l.

** Hg analyses were performed as indicated in Table 18.

† Se analyses may be low due to the analytical technique employed (See QA/QC discussion).

TABLE 60. ANALYSES OF EXTRACTANT FROM EP TEST OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 10.

Parameter	Borehole Interval			
	B	C*	D	G
Ag	<0.050**	<0.050	<0.050	<0.050
As	0.014	0.005	0.012	0.007
Ba	0.053	0.225	0.064	0.069
Be	<0.005	<0.005	<0.005	<0.005
Cd	<0.050	<0.050	<0.050	<0.050
Co	<0.050	<0.050	<0.050	<0.050
Cr	0.136	0.238	0.278	0.245
Cu	0.080	0.131	0.116	0.071
Fe	0.593	0.260	0.520	0.447
Hg†	<0.0004	0.0004	0.0005	0.0004
Mn	<0.050	0.250	<0.050	0.217
Ni	<0.050	0.075	0.135	0.074
Pb	0.002	0.005	<0.001	<0.001
Se††	0.110	0.035	0.225	0.056
Sn	0.050	<0.050	0.057	0.053
Sr	8.37	8.27	6.12	7.74
Zn	<0.050	0.170	<0.050	<0.050

* Values are averages of duplicate extractions.

** All values are in mg/l.

† Hg analyses were performed as indicated in Table 18.

†† Se analyses may be low due to the analytical technique employed (See QA/QC discussion).

TABLE 61. ANALYSES OF EXTRACTANT FROM EP TEST OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 11.

Parameter	Borehole Interval			
	A	B	C	G
Ag	<0.050*	<0.050	<0.050	<0.050
As	0.008	<0.005	0.008	0.009
Ba	0.037	0.040	0.031	0.202
Be	<0.005	<0.005	<0.005	<0.005
Cd	<0.050	<0.050	<0.050	<0.050
Co	<0.050	<0.050	<0.050	<0.050
Cr	0.178	0.107	0.168	0.259
Cu	0.104	0.071	0.084	0.145
Fe	0.613	0.427	0.526	0.185
Hg**	0.0005	<0.0004	0.0004	0.0008
Mn	0.050	<0.050	<0.050	0.067
Ni	0.090	<0.050	0.110	<0.050
Pb	<0.001	<0.001	<0.001	<0.001
Se†	0.135	0.053	0.165	0.082
Sn	0.053	0.048	0.054	<0.050
Sr	8.02	8.26	7.01	7.76
Zn	<0.050	<0.050	<0.050	<0.050

* All values are in mg/l.

** Hg analyses were performed as indicated in Table 18.

† Se analyses may be low due to the analytical technique employed (See QA/QC discussion).

TABLE 62. ANALYSES OF EXTRACTANT FROM EP TEST OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 12.

Parameter	Borehole Interval			
	B	C*	G	H
Ag	<0.050**	<0.050	<0.050	<0.050
As	0.011	0.008	0.025	0.010
Ba	0.174	0.093	0.096	0.476
Be	<0.005	0.005	<0.005	<0.005
Cd	<0.050	<0.050	<0.050	<0.050
Co	<0.050	<0.050	<0.050	<0.050
Cr	0.419	0.330	0.554	0.125
Cu	0.154	0.130	0.126	0.097
Fe	0.692	0.238	0.63[illegible]	0.140
Hg†	<0.0004	0.0005	0.0014	0.0047
Mn	<0.050	0.180	0.050	0.265
Ni	0.067	0.066	0.087	0.088
Pb	<0.001	0.004	0.007	0.008
Se††	0.250	0.240	0.56[illegible]	0.295
Sn	0.075	<0.050	0.588	<0.050
Sr	7.67	6.15	5.81	6.02
Zn	<0.050	0.057	<0.050	0.102

* Values are averages of duplicate extractions.

** All values are in mg/l.

† Hg analyses were performed as indicated in Table 18.

†† Se analyses may be low due to the analytical technique employed (See QA/QC discussion).

TABLE 63. ANALYSES OF EXTRACTANT FROM EP TEST OF GROUND SEALOSAFE®-TREATED WASTES FROM BOREHOLE 13.

Parameter	Borehole Interval			
	B	C*	D*	H
Ag	<0.050**	<0.050	<0.050	<0.050
As	0.024	0.010	0.008	0.017
Ba	0.095	0.073	0.192	0.336
Be	<0.005	<0.005	<0.005	<0.005
Cd	<0.050	<0.050	<0.050	<0.050
Co	<0.050	<0.050	<0.050	<0.050
Cr	0.150	0.329	0.370	0.194
Cu	0.091	0.164	0.154	0.107
Fe	0.229	0.234	0.262	0.228
Hg†	0.0511	0.0012	0.0010	0.0017
Mn	0.400	<0.050	0.129	<0.050
Ni	0.148	<0.050	0.074	<0.050
Pb	0.003	0.015	0.016	0.002
Se††	0.273	0.425	0.328	0.255
Sn	0.436	<0.050	<0.050	<0.050
Sr	5.40	6.21	6.26	5.60
Zn	<0.050	0.071	0.126	<0.050

* Values are averages of duplicate extractions.

** All values are in mg/l.

† Hg analyses were performed as indicated in Table 18.

†† Se analyses may be low due to the analytical technique employed (See QA/QC discussion).

TABLE 64. EXTRACTABLE CYANIDE IN DRIED, GROUND, TREATED WASTE

SAMPLE	CN in extractant	CN in bulk analyses
5A	1.31*	110.1**
6A	1.38	133.4
6E	1.65	153.6
8B	1.91	166.4
9G	0.97	93.7
10D	1.37	95.7
12B	3.44	135.0
12G	2.38	162.7

* All values are in mg/liter.

** All values in mg/kg (dry wt)

TABLE 65. RESULTS OF ANALYSIS OF MULTIPLE EXTRACTIONS OF SAMPLE 1C

Parameter	Extraction 1	2	3	4	5	6	7	8	9
Ag	<0.050*	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
As	0.072	0.102	0.104	0.102	0.114	0.118	0.128	0.172	0.138
Ba	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Be	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cd	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Co	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cr	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cu	<0.050	<0.050	<0.092	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fe	0.064	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Hg**	0.0104	0.0117	0.0106	0.0049	0.0035	0.0056	0.0083	0.0145	0.0069
Mn	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Ni	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Pb	0.016	0.012	0.002	0.002	<0.001	0.001	0.029	0.006	0.015
Se†	0.075	0.097	0.075	0.065	0.065	0.060	0.080	0.140	0.085
Sn	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Sr	0.332	0.256	0.265	0.331	0.118	0.148	0.134	0.122	0.123
Zn	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050

* All values are in mg/l.

** Hg analyses were performed as indicated in Table 18.

† Se analyses may be low due to the analytical technique employed (see QA/QC discussion).

TABLE 66. RESULTS OF ANALYSIS OF MULTIPLE EXTRACTIONS OF SAMPLE 2E

Parameter	Extraction								
	1	2	3	4	5	6	7	8	9
Ag	<0.050*	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
As	0.038	0.034	0.026	0.048	0.052	0.048	0.050	0.054	0.050
Ba	0.159	0.097	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Be	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cd	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Co	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cr	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cu	0.11[illegible]	0.097	0.054	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fe	0.076	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.058	<0.050
Hg**	0.0226	0.0169	0.0107	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0004
Mn	2.26	2.71	3.10	0.832	0.524	0.661	0.598	0.499	0.436
Ni	<0.050	0.114	0.064	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Pb	0.019	0.019	<0.001	0.002	<0.001	<0.001	<0.013	0.009	0.016
Se†	0.110	0.160	0.200	0.230	0.220	0.195	0.180	0.185	0.170
Sn	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Sr	1.04	0.983	0.396	0.331	0.207	0.220	0.239	0.175	0.164
Zn	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050

* All values are in mg/l.

** Hg analyses were performed as indicated in Table 18.

† Se analyses may be low due to the analytical technique employed (see QA/QC discussion).

TABLE 67. RESULTS OF ANALYSIS OF MULTIPLE EXTRACTIONS OF SAMPLE 5F

Parameter	Extraction								
	1	2	3	4	5	6	7	8	9
Ag	<0.050*	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
As	0.110	0.102	0.092	0.106	0.102	<0.050	0.130	0.152	0.130
Ba	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Be	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cd	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Co	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cr	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cu	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fe	0.064	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Hg**	0.0086	0.0110	0.0119	0.0039	0.0025	0.0024	0.0189	0.0154	0.0084
Mn	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Ni	<0.050	<0.050	<0.050	0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Pb	0.013	0.015	<0.001	0.005	<0.001	<0.001	0.007	0.014	0.011
Se†	0.120	0.080	0.090	0.060	0.055	0.040	0.070	0.085	0.065
Sn	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Sr	0.189	0.199	0.245	0.133	0.105	0.136	0.120	0.110	0.123
Zn	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050

* All values are in mg/l.

** Hg analyses were performed as indicated in Table 18.

† Se analyses may be low due to the analytical technique employed (see QA/QC discussion).

TABLE 68. RESULTS OF ANALYSIS OF MULTIPLE EXTRACTIONS OF SAMPLE 6A

Parameter	Extraction 1	2	3	4	5	6	7	8	9
Ag	<0.050*	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
As	0.034	0.036	0.046	0.048	0.050	0.050	0.062	0.142	0.073
Ba	0.158	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Be	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cd	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Co	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cr	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.080	0.065
Cu	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fe	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Hg**	0.0259	0.0250	0.0087	0.0118	0.0023	0.0037	0.0051	0.0041	0.0034
Mn	<0.050	0.093	0.060	<0.050	0.0023	<0.050	<0.050	<0.050	<0.050
Ni	<0.050	0.091	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Pb	0.018	0.005	0.001	0.001	0.003	<0.001	0.004	0.011	0.001
Se†		0.235	0.272	0.285	0.310	0.360	0.275	0.280	0.225
Sn	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Sr	0.800	0.585	0.505	0.437	0.548	0.329	0.213	0.151	0.134
Zn	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050

* All values are in mg/l.

** Hg analyses were performed as indicated in Table 18.

† Se analyses may be low due to the analytical technique employed (see QA/QC discussion).

TABLE 69. RESULTS OF ANALYSIS OF MULTIPLE EXTRACTIONS OF SAMPLE 13B

Parameter	Extraction								
	1	2	3	4	5	6	7	8	9
Ag	<0.050*	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
As	0.038	0.042	0.040	0.050	0.056	0.068	0.091	0.088	0.106
Ba	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Be	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cd	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Co	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cr	<0.050	0.057	<0.050	<0.050	0.059	<0.050	<0.050	<0.050	<0.050
Cu	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fe	0.132	0.93	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Hg	0.0271	0.0093	0.0087	0.0079	0.0077	0.0073	0.0085	0.0092	0.0060
Mn	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Ni	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Pb	0.013	0.006	0.001	0.002	0.001	<0.001	0.003	<0.001	0.007
Se†	0.180	0.290				0.290	0.180	0.230	0.170
Sn	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Sr	0.461	0.395	0.360	0.223	0.171	0.183	0.154	0.087	0.104
Zn	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050

* All values are in mg/l.

** Hg analyses were performed as indicated in Table 18.

† Se analyses may be low due to the analytical technique employed (see QA/QC discussion).

TABLE 70. ANALYSES OF ACID DIGESTS OF CLAY FROM BELOW THE TREATED WASTES IN BOREHOLE 1

Parameters	Sample Designation J	K	L
Ag	9.1*	<6.0	<6.0
As	10.9	15.8	9.80
Ba	57.2	86.0	49.3
Be	1.65	1.70	1.10
Cd	<1.50	<1.50	<1.50
Co	<20	20	<20
Cr	70.0	70.0	51
Cu	31	31	30
Fe	34900	36100	30800
Hg	<0.0001	<0.0001	0.0001
Mn	230	243	232
Ni	51	55	43
Pb	<20	<20	<20
Se	<0.50	<0.50	<0.50
Sn	5.45	<5.0	<5.0
Sr	136	207	125
Zn	98.0	100	96.8

* All values are in mg/kg dry wt.

TABLE 71. ANALYSES OF ACID DIGESTS OF CLAY FROM BELOW THE TREATED WASTES IN BOREHOLE 2

Parameters	Sample Designation J	K	L
Ag	<6.0*	<6.0	<6.0
As	10.8	15.6	10.6
Ba	85.8	49.5	79.3
Be	1.70	1.30	0.90
Cd	<1.5	<1.5	<1.5
Co	<20	<20	<20
Cr	74	61	49
Cu	30	25	27
Fe	32100	29800	27200
Hg	<0.0001	<0.0001	<0.0005
Mn	166	168	161
Ni	42	42	35
Pb	20	22	21
Se	<0.50	<0.50	<0.50
Sn	<5.0	<5.0	<5.0
Sr	233	138	227
Zn	92.8	79.5	79.4

* All values are in mg/kg dry wt.

TABLE 72. ANALYSES OF ACID DIGESTS OF CLAY FROM BELOW THE TREATED WASTES IN BOREHOLE 3

Parameters	Sample Designation		
	J	K	L
Ag	<6.0*	<6.0	<6.0
As	12.2	8.40	10.6
Ba	57.8	42.5	48.2
Be	1.40	1.50	1.55
Cd	<1.5	<1.5	1.5
Co	<20	<20	20.5
Cr	59	57	63
Cu	29	29	39.5
Fe	32800	31300	36000
Hg	0.0008	0.0007	<0.0001
Mn	240	220	250
Ni	49	48	52
Pb	<20	<20	<20
Se	<0.50	<0.50	0.50
Sn	<5.0	<5.0	<5.0
Sr	179	138	143
Zn	91.8	94.4	137

* All values are in mg/kg dry wt.

TABLE 73. ANALYSES OF ACID DIGESTS OF CLAY FROM BELOW THE TREATED WASTES IN BOREHOLE 4

Parameters	Sample Designation		
	J	K	L
Ag	<6.0*	<6.0	<6.0
As	10.3	13.6	12.8
Ba	35.8	47.5	70.8
Be	1.95	1.90	1.90
Cd	<1.5	<1.5	<1.5
Co	20	20	20
Cr	73	69	69
Cu	33.5	30	31.5
Fe	34500	34850	34100
Hg	0.0001	<0.0001	<0.0001
Mn	234	222	229
Ni	50	50	45
Pb	<20	<20	<20
Se	0.80	0.65	0.50
Sn	<5.0	<5.0	<5.0
Sr	28.8	110	154
Zn	100.2	98.15	98

* All values are in mg/kg dry wt.

TABLE 74. ANALYSES OF ACID DIGESTS OF CLAY FROM BELOW THE TREATED WASTES IN BOREHOLE 5

Parameters	Sample Designation J	K	L
Ag	<6.0*	<6.0	<6.0
As	10.1	6.80	7.30
Ba	60.3	50.8	65.8
Be	1.85	2.15	1.55
Cd	<1.5	<1.5	<1.5
Co	<20	<20	<20
Cr	64	81.5	61
Cu	32	36	30
Fe	36300	34550	29250
Hg	<0.0001	<0.0001	0.0001
Mn	242	216	208
Ni	45.5	44	39.5
Pb	<20	<20	<20
Se	0.55	0.60	<0.50
Sn	6.5	7.5	<5.0
Sr	177	117	174
Zn	99.9	102	84.8

* All values are in mg/kg dry wt.

TABLE 75. ANALYSES OF ACID DIGESTS OF CLAY FROM BELOW THE TREATED WASTES IN BOREHOLE 6

Parameters	Sample Designation		
	J	K	L
Ag	<6.0*	<6.0	<6.0
As	13.8	15.8	8.5
Ba	95.5	75.8	111
Be	1.50	1.60	1.60
Cd	<1.5	<1.5	<1.5
Co	26	<20	<20
Cr	62	72	62
Cu	34	32	32
Fe	30800	34750	31750
Hg	0.0004	0.0005	0.0005
Mn	182	189	186
Ni	55	41	38
Pb	<20	<20	<20
Se	0.050	0.50	0.050
Sn	<5.0	6.3	<5.0
Sr	174	130	194
Zn	86.3	93.0	88.8

* All values are in mg/kg dry wt.

TABLE 76. ANALYSES OF ACID DIGESTS OF CHALK FROM BELOW THE TREATED WASTES IN BOREHOLE 7

Parameters	Sample Designation J	K	L
Ag	<6.0*	<6.0	<6.0
As	0.600	<0.500	<0.500
Ba	82.8	85.3	108.5
Be	<0.50	<0.50	<0.50
Cd	<1.5	<1.5	<1.5
Co	<20	<20	<20
Cr	15	15	13
Cu	<10	<10	<10
Fe	424	453	606
Hg	<0.0001	<0.0001	<0.0001
Mn	170	179	182
Ni	<15	<15	<15
Pb	<20	<20	<20
Se	<0.50	<0.50	<0.50
Sn	<5.0	<5.0	<5.0
Sr	56.3	54.5	69.5
Zn	19.6	14.7	13.8

* All values are in mg/kg dry wt.

TABLE 77. ANALYSES OF ACID DIGESTS OF CHALK FROM BELOW THE TREATED WASTES IN BOREHOLE 3

Parameters	Sample Designation J	K	L
Ag	<6.0*	<6.0	<6.0
As	<0.500	<0.500	0.500
Ba	151.8	141.3	148.5
Be	0.50	0.50	0.50
Cd	<1.5	<1.5	<1.5
Co	<20	<20	<20
Cr	14	14	15
Cu	<10	<10	<10
Fe	405	477	823
Hg	<0.0001	<0.0001	0.0007
Mn	166	177	191
Ni	<15	<15	<15
Pb	<20	<20	<20
Se	<0.50	<0.50	<0.50
Sn	<5.0	<5.0	<5.0
Sr	845	763	913
Zn	13.8	14.2	22.1

* All values are in mg/kg dry wt.

TABLE 78. ANALYSES OF ACID DIGESTS OF CHALK FROM BELOW THE TREATED WASTES IN BOREHOLE 9

Parameters	Sample Designation** J
Ag	<6.0*
As	2.40
Ba	106.8
Be	0.70
Cd	2.0
Co	<20
Cr	18
Cu	21
Fe	1800
Hg	<0.0001
Mn	313.5
Ni	<15
Pb	<20
Se	0.80
Sn	<5.0
Sr	716
Zn	35.4

* All values are in mg/kg dry wt.

** Only a single sample was available from this boring.

TABLE 79. ANALYSES OF ACID DIGESTS OF CHALK FROM BELOW THE TREATED WASTES IN BOREHOLE 10

Parameters	Sample Designation J	K	L
Ag	<6.0*	<6.0	<6.0
As	0.80	<0.50	<0.50
Ba	15	107	86.5
Be	0.90	0.60	0.70
Cd	<1.5	<1.5	<1.5
Co	<20	<20	<20
Cr	17	15	15
Cu	<10	<10	<10
Fe	783	634	525
Hg	<0.0001	<0.0001	0.0003
Mn	212	194	204
Ni	<15	<15	<15
Pb	<20	<20	<20
Se	<0.50	<0.50	<0.50
Sn	<5.0	<5.0	<5.0
Sr	723	730	750
Zn	22.8	15.7	15.0

* All values are in mg/kg dry wt.

TABLE 30. ANALYSES OF ACID DIGESTS OF CHALK FROM BELOW THE TREATED WASTES IN BOREHOLE 11

Parameters	Sample Designation		
	J	K	L
Ag	<6.0*	<6.0	<6.0
As	<0.50	<0.50	<0.50
Ba	92.3	109.5	30.0
Be	0.50	0.60	0.80
Cd	<1.5	<1.5	<1.5
Co	<20	<20	20
Cr	14	14	14
Cu	<10	<10	<10
Fe	508	519	464
Hg	0.0003	0.0001	0.0001
Mn	214	230	182
Ni	<15	<15	<15
Pb	<20	<20	<20
Se	<0.50	<0.50	<0.50
Sn	5.4	<5.0	<5.0
Sr	590	590	675
Zn	14.8	14.5	15.0

* All values are in mg/kg dry wt.

TABLE 81. ANALYSES OF ACID DIGESTS OF CLAY FROM BELOW THE TREATED WASTES IN BOREHOLE 12

Parameters	Sample Designation J	K	L
Ag	6.0*	6.0	6.0
As	10.3	9.00	9.40
Ba	60.2	36.8	39.8
Be	1.80	1.45	1.20
Cd	1.5	1.5	1.5
Co	20	20	20
Cr	69	52	49
Cu	39	29.5	28
Fe	32200	27850	28200
Hg	0.0002	0.0001	0.0003
Mn	168	182	148
Ni	38	30	31
Pb	20	20	20
Se	0.60	0.50	0.60
Sn	5.0	5.0	5.0
Sr	130	130	127
Zn	75.7	78.8	74.2

* All values are in mg/kg dry wt.

TABLE 32. ANALYSES OF ACID DIGESTS OF CLAY FROM BELOW THE TREATED WASTES IN BOREHOLE 13

Parameters	Sample Designation J	K	L
Ag	<6.0*	<6.0	<6.0
As	10.2	11.8	8.80
Ba	51.3	55.3	86.5
Be	1.20	1.40	1.30
Cd	<1.5	<1.5	<1.5
Co	<20	<20	<20
Cr	58	47	51
Cu	33	33	31
Fe	24600	32200	29600
Hg	0.0013	0.0005	0.0004
Mn	174	208	191
Ni	34	37	35
Pb	<20	<20	<20
Se	4.80	0.60	0.70
Sn	<5.0	<5.0	<5.0
Sr	148	191	175
Zn	82.7	90.1	75.9

* All values are in mg/kg dry wt.

SECTION 5

DISCUSSION

DISCUSSION OF ANALYSES

SURFACE WATER SAMPLES

Four surface water samples were collected at the Aveley Clay Pit Disposal Site. One sample was taken from a pond at the base of the disposal area while the other three samples were collected from a large lagoon and a small pond that are just west of the emplaced treated waste (see Figure 4 for location of ponds and sampling points). In reviewing this data, several observations can be made (see Table 13 for analytical data). Samples collected at points L2, L3, and L4--ponds that are west of the emplaced treated waste -- were found to contain very little, if any, contamination. This is not unexpected, however, since these ponds received primarily surface water run-off from the surrounding area. (Although a channel existed in the dike to enable free flow from the pond at the base of the waste emplacement area into the lagoon that is west of the disposal area, a very small amount of water is discharged into the lagoon.)

In particular, in comparing[1] the analytical data to EPA's Water Quality Criteria (WQC) for human health, it is found that most of the levels reported by WES are[2] below the cited criteria (see Table 83 for specific Water Quality Criteria). In some cases, the analytical data reported by WES were above

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1 EPA's Water Quality Criteria for human health represents, for non-carcinogens, a level at which exposure to a single chemical is not anticipated to produce adverse effects in man while the criteria for suspect or proven carcinogens represents a concentration in water associated with a range of incremental cancer risks to man. More specifically, the criteria for cadmium, chromium, cyanide, lead, mercury, nickel, selenium, and silver are based on a calculated level, for non-carcinogens, which is protective to human health against the ingestion of contaminated water and contaminated aquatic organisms, while the criteria for arsenic and beryllium, which are suspect or proven carcinogens, are based on an incremental increase of cancer risk of 10^{-6} over a life time of exposure through ingestion of contaminated water and contaminated aquatic organisms (see 45 FR 79318, November 28, 1980).

2 It should be remembered that the Stablex licensee located in West Thurrock, England is not subject to any U.S.-based standards/guidelines. Rather, they are subject to the standards/limitations imposed by the Thames Water Authority.

TABLE 83. WATER QUALITY CRITERIA

Parameter	Water Quality Criteria[1] (µg/l)
Ag	50
As	.022
Be	.037
Cd	10
Cr	50
Cu	1000[2]
Hg	.144
Ni	635[3]
Pb	50
Se	10
Zn	5000[2]
Cn	200

1 Except as otherwise noted, the values cited represent the Water Quality Criteria for human health through ingestion of contaminated water and contaminated aquatic organisms.

2 These Water Quality Criteria represent a level to control taste and odor in water.

3 The Water Quality Criterion for nickel that was originally published was 13.4 µg/l. However, based on a further review, it was determined that the study used by EPA to derive this level may have had some technical problems. Therefore, based on another study, the Office of Solid Waste has been using a level of 635 µg/l for nickel as an interim water quality standard.

the water quality criteria (e.g., sample L2 reported a level for mercury of 2 ug/l whereas the WQC is 0.144 ug/l; sample L3 reported a level for lead of 193 ug/l whereas the WQC is 50 ug/l; etc.). However, these values should not be directly compared with the WQC since these ponds are not used as a direct source of drinking water nor are they used as a recreational facility. Rather, the water from these ponds are eventually pumped to a surface water system which drains to the Thames River (estuary). Thus, the concentration of these toxicants downstream is expected to be much lower.

With respect to those metals for which no human health water quality criteria have been established, the values reported by WES, based on existing information, do not appear high. For example, the water quality criteria for copper and zinc have been established using available organoleptic data for controlling undesireable taste and odor in water (see Table 83). Based on these criteria--1.0 mg/l for copper and 5.0 mg/l for zinc--the values reported by WES, in most instances, were two orders of magnitude lower.

In addition, it should be remembered that these samples were grab samples and, thus, may not accurately reflect the average concentration of the toxic heavy metals and cyanide over time. For example, in comparing the analyses reported by WES with that performed by the Thames Water Authority (TWA) on samples collected in 1981 for similar collecting stations, it is noted that the levels reported by WES were, in many instances, lower (see Tables 84 and 85). Thus, the concentration of these toxicants as reported by WES for the water samples collected at points L2, L3, and L4 are not considered high.

With respect to the sample collected at the point L1, the analytical results also indicate that, for most of the toxicants, the values reported by WES were below the cited water quality criteria, although several values were above these limits. However, for a number of the heavy metals and cyanide (i.e., cobalt, copper, cyanide, iron, nickel, selenium, and silver), the difference between the values reported at sample point L1 and sampling points L2, L3, and L4 varied by as much as an order of magnitude or more. Therefore, there may be some potential for contamination from the Sealosafe treatment residue, especially in its uncured conditions.

This contamination may result from one of several sources. First, this contamination could result from drainage of excess process water not used in the polymerization reaction, especially since this pond receives some discharge water directly from the polymer dumping or tipping point. Concrete made from Portland Cement normally contains 17 percent water, 22 percent cement, and 61 percent aggregate, by weight. This is a water:cement ratio of 0.77. This is sufficient water to assure that the Portland Cement is hydrated. Water in excess of this, however, will evaporate or "weep out" of the hardening product. Thus, any soluble contaminants in the waste could be released in the weep water and form encrustations or efflorescences on the solidified waste surface during setting. Any soluble salts on the surface of the exposed hardening waste would then dissolve and be washed into the site pond during rainfall.

A second source could be from the uncured waste that runs into the pond. It could be that the uncured material has different leaching properties and

TABLE 84. COMPARISON OF ANALYSES OF SURFACE WATER SAMPLES COLLECTED BY THE THAMES WATER AUTHORITY AND BY WES AT THE AVELEY CLA' PIT SITE (EAST END OF PIT ADJACENT TO DISPOSAL AREA)

Parameter	Thames Water Authority Sample V2163*	Thames Water Authority Sample V2215**	Thames Water Authority Sample P0235***	WES Sample L2†
Cr	0.04††	0.03	ND†	0.018
Cu	0.04	0.20	ND	0.020
Fe	0.3	0.5	ND	0.050
Ni	0.07	0.06	ND	0.018
Pb	0.12	0.15	ND	0.005
Zn	0.02	0.09	ND	<0.050
pH (units)	8.1	8.4	8.4	8.05
Conductivity (micro S/cm)	5990	5850	ND	4480

* Collected June 10, 1981

** Collected July 2, 1981

*** Collected Sept 15, 1981

† Collected April 6; 1982

†† All values are in mg/l except as noted.

††† ND = not determined

TABLE 85. COMPARISON OF ANALYSES OF SURFACE WATER SAMPLES COLLECTED BY THE THAMES WATER AUTHORITY AND BY WES AT THE AVELEY CLAY PIT SITE (NORTHWEST CORNER OF PIT)

Parameter	Thames Water Authority Sample V2164*	Thames Water Authority Sample V2213**	Thames Water Authority Sample P0233***	WES Sample L3†
Cr	0.03††	0.02	ND†	0.019
Cu	0.04	0.09	ND	0.012
Fe	0.24	0.44	ND	0.035
Ni	0.08	0.04	ND	0.012
Pb	0.1	0.13	ND	0.193
Zn	0.02	0.09	ND	<0.050
pH (units)	8.1	8.4	8.1	8.1
Conductivity (micro S/cm)	5760	5450	ND†††	4500

* Collected June 10, 1981

** Collected July 2, 1981

*** Collected Sept 15, 1981

† Collected April 6, 1981

†† All values are in mg/l except as noted.

††† ND = not determined

different setting-up characteristics when under water. A third source would involve direct release of the toxicants from the solidified waste by rainwater and surface run-off. This mechanism, however, appears very unlikely. The results from EP testing of monolithic samples using the Structural Integrity Procedure (SIP), a scenario most closely depicting actual field conditions, indicates the toxicants do not leach from the waste. Thus, such contamination from the weep water or from the uncured waste that flows into the pond appears to be a logical conclusion.

In reviewing the analytical data from sample point L1, the reader must be cautioned not to conclude that this is a problem, especially since most of the data obtained by WES is shown to be below the cited water quality criteria. However, this is an area that requires further investigation to determine if there is a problem. Additional testing at Stablex' facility in Blainsville, Quebec may be appropriate to resolve this point.

GROUND-WATER SAMPLES

Samples of ground-water were collected from all eighteen of the monitoring wells located at the Thurrock Chalk Quarry site. In evaluating this data, it shows that, in general, the ground water contains very low levels of the toxic heavy metals (see Tables 14 to 17 for ground water levels). In particular, levels for arsenic, barium, cadmium, lead, mercury, selenium, and silver were below the National Interim Primary Drinking Water Standard (NIPDWS) while levels for copper, iron, and zinc were below the Secondary Drinking Water Standard (SDWS). See Table 86 for specific drinking water standards.)

In a few of the monitoring wells, however, certain of the toxic heavy metals were found at concentrations slightly above the U.S.-based drinking water standard.[3] More specifically, sample B1 reported a level for iron and lead of 0.341 and 0.107 mg/l, respectively, whereas the drinking water standard for iron and lead are 0.30 and 0.05 mg/l, respectively; samples B15 and B16 reported levels for chromium of 0.052 and 0.051 mg/l, respectively, whereas the drinking water standard for chromium is 0.05 mg/l; and sample B17 reported a level for selenium of 0.014 mg/l whereas the drinking water standard for selenium is 0.01 mg/l. This data can not be evaluated independently, however, without also reviewing background ground-water monitoring data to determine whether the slightly higher concentrations of these toxicants were caused by leaching from the Sealosafe treatment residue or whether these levels existed in the ground water prior to placement of the treatment residue.

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3 As indicated earlier, the Stablex licensee in West Thurrock, England is not subject to any U.S.-based standards/guidelines; thus, the Agency is not implying that the facility is not in compliance with the TWA, the regulatory authority governing Stablex Limited in West Thurrock, England. Rather, this comparison is made simply to assist the Agency in evaluating the ground-water monitoring data.

TABLE 86: DRINKING WATER STANDARDS

Parameter	Source	Drinking Water Standard (mg/l)
Ag	NIPDWS*	0.05
As	NIPDWS	0.05
Ba	NIPDWS	1.0
Cd	NIPDWS	0.01
Cr	NIPDDW	0.05
Cu	SDWS**	1.0
Fe	SDWS	0.30
Hg	NIPDWS	0.002
Pb	NIPDWS	0.05
Se	NIPDWS	0.01
Zn	SDWS	5.0

* NIPDWS - National Interim Primary Drinking Water Standard

** SDWS - Secondary Drinking Water Standard

Therefore, to make this determination, WES reviewed previous ground-water monitoring data from the West Thurrock facility provided by the Stablex Corporation in support of their exclusion petition for their proposed facility in Hooksett New Hampshire (see letter dated October 28, 1980 from S.W. Robinson-Todd to S.I. Taub). However, since these ground-water samples were also collected after placement of the Sealosafe treatment residue, no conclusions could be reached.[4] Water quality data available from the Anglian Water Authority for water samples collected from wells B18, B19, and B20 in 1981 and 1982 (wells located outside the quarry) were also evaluated. These data indicated levels roughly comparable to the WES samples in all three sampling wells (see Tables 87 to 89). However, no conclusions could be reached from this data regarding metal contamination of wells located inside the quarry.

Therefore, in an attempt to resolve this point, WES then evaluated analyses performed on clay and chalk samples taken from below the treated waste. These soil samples were analyzed for metals to determine whether a concentration gradient exists with increasing core depth (i.e., a pattern of increasing metal concentrations in the clay or chalk directly under the waste would be strong presumptive evidence of potentially polluting materials being leached from the treated waste). In reviewing this data (see Tables 69 to 81), no consistent pattern of increasing metal concentration toward the waste interface could be detected that would suggest that the toxic heavy metals have, in fact, leached from the waste. Therefore, it can not be concluded that heavy metal contamination in the groundwater was due to placement of the Sealosafe treatment residue. (Regardless of the above, background levels in the ground water should be determined to conclusively determine whether ground-water contamination occurred due to placement of the Sealosafe treatment residue.

The ground-water samples were also analyzed for cyanide. This data indicates that a number of the monitoring wells--B7, B10, B11, B12, B13, B14, and B15--contained cyanide at levels above the U.S. Public Health Service suggested drinking water standard of 0.20 mg/l.[5] Unlike the toxic heavy metals, cyanide is not expected to be immobilized by the Sealosafe® treatment process; this is true for any other pozzolonic stabilization process. Thus, if cyanide is not destroyed, during pretreatment, it is not unexpected to find it in the ground-water. Although Stablex does pretreat their cyanide wastes at their

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4 These ground-water samples were collected and analyzed by Stablex Limited and the Anglian Water Authority in 1979 and 1980 after initial placement of the Sealosafe® treatment residue in the summer of 1979.. The Sealosafe® treatment residue was placed in a pit, 5 meters x 5 meters x 5 meters, as an experiment before the major discharge of treatment residue in the Chalk Quarry Pit in the Fall of 1981.

5 As indicated earlier, the ground-water samples for cyanide analysis were over aged for cyanide determination (over 24 hours olds) and had not been preserved at pH 12.0 with NaOH as is standard practice. Therefore, the cyanide concentrations in the ground-water samples are lower than may be expected if these samples were preserved and analyzed within the specified time period.

TABLE 87. COMPARISON OF ANALYSES OF GROUND-WATER SAMPLES COLLECTED BY THE ANGLIAN WATER AUTHORITY AND BY WES AT THE THURROCK CHALK QUARRY DISPOSAL SITE (BOREHOLE 18)

Parameter	Anglian Water Authority Sample 4068*	Anglian Water Authority Sample 3370**	WES Sample B18***
Cd	<0.009†	<0.02	<0.010
Cr	<0.005	<0.15	0.008
Cu	<0.012	<0.05	0.002
Fe	0.075	0.18	0.022
Mn	<0.025	<0.05	0.042
Ni	<0.027	<0.05	0.004
Pb	0.072	<0.2	0.013
Zn	0.030	<0.05	<0.050
CN	0.02	ND††	0.010
pH (units)	7.0	7.0	7.0
Conductivity (micro S/cm)	1800	1900	1550

* Collected Dec 9, 1981

** Collected Feb 10, 1982

*** Collected April 6, 1982

† All values are in mg/l except as noted

†† ND = not determined

TABLE 88. COMPARISON OF ANALYSES OF GROUND-WATER SAMPLES COLLECTED BY THE ANGLIAN WATER AUTHORITY AND BY WES AT THE THURROCK CHALK QUARRY DISPOSAL SITE (BOREHOLE 19)

Parameter	Anglian Water Authority Sample 3369*	Anglian Water Authority Sample 4061**	WES Sample B19***
Cd	<0.009†	<0.02	<0.010
Cr	<0.025	<0.15	0.032
Cu	<0.012	<0.05	0.004
Fe	0.075	0.17	0.018
Mn	<0.025	<0.05	0.178
Ni	<0.027	<0.05	0.008
Pb	<0.032	<0.2	0.010
Zn	0.123	0.28	<0.050
CN	<0.02	ND††	<0.010
pH (units)	7.4	7.5	6.9
Conductivity (micro S/cm)	1500	1400	3406

* Collected Dec 9, 1981

** Collected Feb 10, 1982

*** Collected April 6, 1982

† All values are in mg/l except as noted

†† ND = not determined

TABLE 89. COMPARISON OF ANALYSES OF GROUND-WATER SAMPLES COLLECTED BY THE ANGLIAN WATER AUTHORITY AND BY WES AT THE THURROCK CHALK QUARRY DISPOSAL SITE (BOREHOLE 20)

Parameter	Anglian Water Authority Sample 3368*	Anglian Water Authority Sample 4062**	WES Sample B20***
Cd	<0.009†	<0.02	<0.010
Cr	0.046	<0.15	0.030
Cu	<0.012	<0.05	0.006
Fe	0.706	0.19	0.032
Mn	0.063	<0.05	0.144
Ni	<0.027	<0.05	0.008
Pb	0.048	<0.2	0.013
Zn	0.031	<0.05	<0.050
CN	0.04	ND††	0.024
pH (units)	7.4	7.1	7.2
Conductivity (micro S/cm)	3400	1700	3000

* Collected Dec 9, 1981.

** Collected Feb 10, 1982.

*** Collected April 6, 1982.

† All values are in mg/l except as noted.

†† ND = not determined.

West Turrock facility, they may not treat it to the level necessary to prevent cyanide from entering ground-water.

UNSOLIDIFIED (SLURRY) TREATED WASTES

Two samples of the uncured Sealosafe® treated waste were collected from hopper trucks discharging into the Aveley Clay Pit disposal site to determine the extent that heavy metals are immobilized in the uncured treatment residue. Due to logistics, however, these slurry samples were not extracted and analyzed until at least 20 days later, thus, adequate time had elapsed for the waste to set-up. The slurry material as received at WES was putty-like and had no free (filterable) water.

These slurry samples were evaluated using the EP toxicity test (see Tables 20, 21, and 22 for EP leachates). In reviewing this data, all analyses indicated concentrations lower than the EP toxicity thresholds identified in 40 CFR Part 261.24. In addition, all metals, except cadmium, had concentrations in the EP extract below the level set as part of the contingency plan incorporated into the Stablex delisting decision.[6] Thus, most of the data show that these metals are generally immobilized before the residue has completely set-up.[7]

Cadmium, however, exceeded the contingency levels in all samples analyzed, ranging in values between .434 mg/l (43 times the NIPDWS) and .909 mg/l (91 times the NIPDWS). As already indicated, a contingency plan has been incorporated into the Stablex delisting decision to ensure that the treatment process is operated as it was designed. Therefore, if these levels were obtained at their U.S.-based facilities, these batches would have to be handled as hazardous, in accordance with Subtitle C of RCRA.

EP TESTING OF MONOLITHIC TREATED WASTE CORES

Six of the waste cores collected at the West Thurrock facility were randomly selected for testing using the Structural Integrity Procedure (SIP) instead of grinding (see Table 50 for EP leachates). In reviewing this data, it shows that all of the EP leachates are at very low levels. In most cases, the toxic heavy metals were present at or below the limit of detection of the

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6 As part of the Stablex delisting decision, the Agency is requiring the company to test each batch of Stablex for: (1) leachable metals using the EP toxicity test, (2) total organic carbon (TOC), and (3) cyanide content (both complexed and free). If the organic content exceeds 0.1 percent, free cyanide exceeds 0.001 percent, the extract concentrations of any of the EP toxic metals exceeds 30 times the NIPDWS, or if the extract concentration for nickel exceed 0.002 percent, then the material will either be treated again or disposed of as a hazardous waste at an approved Subtitle C hazardous waste disposal facility.

7 As indicated above, no data was obtained on the "uncured" treatment residue; therefore, no final determination can be made on this material.

analytical techniques employed in the testing. However, these results are not unexpected or surprising; in fact, to the extent that the Sealosafe treated residue stays in a monolithic form, the less likely it is that any leaching will occur. However, as will be discussed in the next subsection, grinding of the Sealosafe treated residue does not significantly increase the levels of leaching of most of the toxic heavy metals.

EP TESTING OF GROUND SEALOSAFE® MATERIAL

Thirteen cores were taken of the emplaced Sealosafe® treated waste from both the Aveley Clay Pit and Thurrock Chalk Quarry Disposal site. A randomization procedure was then used to select four samples from each of the thirteen cores for testing. These 52 samples were dried and then ground to pass through a 100-mesh nylon sieve. The grinding simulates worst case physical weathering conditions, exposing a much greater surface area to the extractant than would normally be expected in a solid mass with low permeability.

The ground stabilized residue was evaluated using the EP toxicity test (see Tables 51 to 63 for EP leachates). In reviewing this data, it shows that, in general, the concentration of the toxic heavy metals in the EP extract are below the level set as part of the contingency plan incorporated into the Stablex delisting decision (i.e., less than 30 times the NIPDWS for the EP toxicants and less than 20 ppm for nickel).[8] In many cases, the level in the EP extracts were less than the drinking water standards. Thus, these results indicate that, in general, the toxic heavy metals are present in essentially an immobile form. See Table 90 for percentage of EP leachates that fall at different concentration limits.

For one of the metals, however, some of the analyses indicated levels in the EP leachates that are higher than the level set as part of the Stablex delisting decision. In this case, selenium was shown to leach at levels above the contingency level in 11 of the 52 samples (from six of the 13 borings). (As discussed in Section 4, the values reported for selenium in the EP extract are probably low because of analytical difficulties; therefore, more than 11 samples may actually have exceeded the contingency level (see Table 91).)[9]

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8 As indicated in Section 4, several of the EP extracts (i.e., 2E, 3B, and 6A,) indicated levels of mercury above the level set as part of the Stablex delisting decision. However, as already discussed, these levels could not be correct based on the low levels of mercury found in the treatment residue. (See Section 4 for details.)

9 It should be noted that none of the leach test previously published on the leaching potential of the Sealosafe® treated residue mention any problems with regard to selenium. However, selenium was not usually analyzed for in the EP extract. One leaching test on a treated copper waste did analyze for selenium. However, the waste contained only 0.36 mg/kg of selenium and the concentration in the leachate was only 0.020 mg/l.

TABLE 90. PERCENTAGE OF TOXIC HEAVY METALS THAT LEACH FROM THE GROUND SEALOSAFE® TREATED WASTES

Parameter	No. of Samples Analyzed	% of Samples less than DWS*	% of Samples Between DWS and 30 times DWS	% of Samples Greater than DWS
Ag	52	100%	---	---
As	52	96%	4%	---
Ba	52	100%	---	---
Cd	52	---	100%	---
Cr	52	11.5%	88.5%	---
Cu	52	100%	---	---
Fe	52	71%	29%	---
Hg	52	87%	7.5%	5.5%
Pb	52	96%	4%	---
Se	52	---	79%	21%
Zn	52	98%	2%	---

* DWS - Drinking Water Standard

TABLE 91. SUMMARY OF DATA ON SELENIUM CONCENTRATIONS IN EP EXTRACTS AND BULK ANALYSIS SAMPLES OF SELECTED TREATED WASTES*

Sample	Concentration in EP Leachate	Concentration in Bulk Analyses
2A	0.310**	92.5***
2H	0.308	135
4A	0.330	69.0
4E	0.390	191
5A	0.490	214
6A	0.395	278
6E	0.500	90.9
6F	0.400	93.4
12G	0.588	225
13C	0.425	248
13D	0.328	274

* As discussed earlier, the values reported for Selenium in the EP extract are probably low because of analytical problems (see Section 5 for details).

** Values are in mg/l.

*** Values are in mg/kg dry wt.

In evaluating this data, it indicates that the eleven samples come from both the old and newly emplaced treated waste at the Aveley Clay Pit and include samples from both the top and bottom of the cores. None of the samples from the Thurrock Chalk Quarry Pit, however, showed EP extract concentrations above the level set as part of the Stablex delisting decision. In an attempt to correlate this data to determine whether a maximum allowable level of selenium should be set in the final treatment residue, a very low correlation was found (r=0.241) (see Figure 12 which plots the selenium concentrations in the EP leachates from the 11 samples with bulk analyses for selenium in the same samples of treated waste). Therefore, further investigation is necessary regarding the leaching potential of selenium from the Sealosafe® treated waste.

BULK ANALYSES FOR CYANIDE AND DISTILLED WATER LEACH TEST OF GROUND SEALOSAFE® MATERIAL FOR CYANIDE

In addition to analyzing the extracts for the toxic heavy metals, eight samples were selected from six boreholes to determine the concentration of cyanide released from the Sealosafe® treated waste (see Table 64 for extractable cyanide). These samples were extracted with distilled water only (i.e. no dilute acetic acid), however to ensure that cyanide was not released during the extraction process. (A distilled water extract is used instead of acetic acid since it is more agressive for cyanide.) Moreover, 52 samples of the Sealosafe treated waste were also analyzed for both total and free cyanide (see Tables 37 to 49).

In evaluating this data, it shows that in two of the eight samples analyzed, cyanide was reported in the distilled water extracts at levels higher than the U.S. Public Health Service suggested drinking water standard. These two samples were obtained from core 12 which was removed from the south side of the Aveley Clay Pit where the recently treated waste was emplaced. Furthermore, the bulk analyses generally indicate that the concentration of cyanide in the treated waste itself is higher than would be expected;[10] in fact, 16 of the 52 samples analyzed for free cyanide (i.e., cyanide amenable to chlorination) were at levels above that set as part of Stablex' contingency plan. As already discussed, pozzolonic stabilization processes are not expected to immobilize cyanide. It is important, therefore, that any cyanide wastes treated by Stablex be properly treated.

MULTIPLE EXTRACTION PROCEDURE TESTING OF GROUND SEALOSAFE® MATERIAL

Concern has been raised over the eventual decrease in buffering capacity of stabilized wastes (i.e., Sealosafe® treated waste) causing the leaching of toxic heavy metals. In order to deal with the concern, EPA developed a multiple extraction test (MEP) to assist in predicting the long-term leachability of stabilized wastes. The test incorporates nine sequential extractions on the same sample using synthetic rain (pH 3.0) to simulate multiple washings of

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10 As already indicated, although Stablex does pretreat their cyanide wastes at their West Thurrock facility, they may not be required to treat it to the same levels as will be required at their proposed U.S.-based facilities.

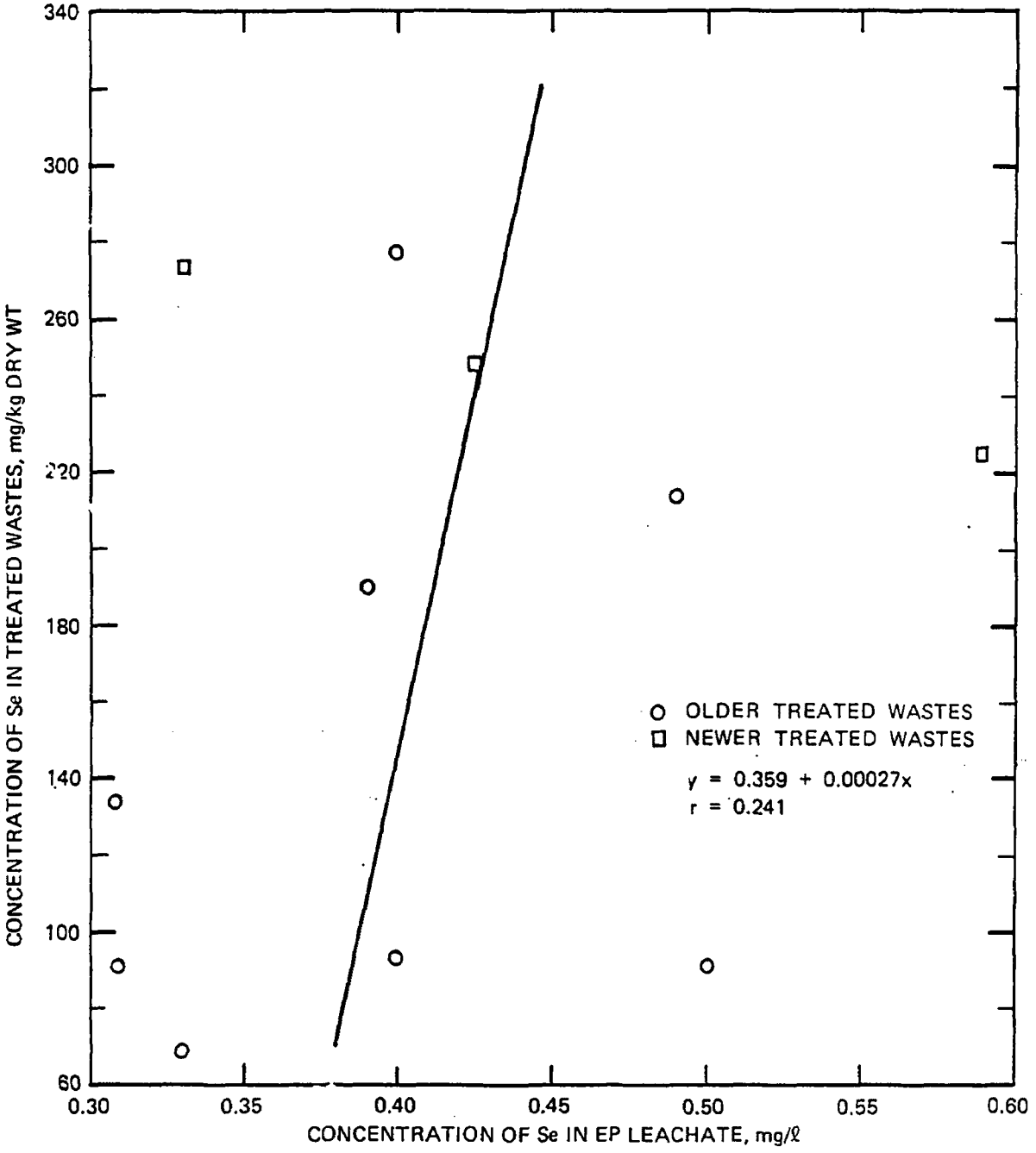

Figure 12. Variation of the SE concentration in the EP leachate with the Se concentration in the treated waste.

percolating rainfall in the field (the details of the MEP are provided in Appendix D).

Five samples of residue from the EP testing were selected for MEP testing. These samples were selected based on the EP Leachate results and bulk analyses of the Sealosafe® treated residue. However, since the EP leachate results, in general, were low, the decision on which samples to test was based primarily on the concentration of heavy metals in the treated waste. The results of the MEP tests are presented in Tables 65 to 69.

The test results, in general, indicate that very low levels of the toxic heavy metals leach from the waste after the final extraction, again indicating the relative immobility of the toxic heavy metals. Only one parameter (selenium) in two samples showed concentrations in the MEP extract at levels greater than the level set as part of the Stablex delisting decision. This confirms, however, that selenium leaching may be a problem in the Sealosafe treated residue.

It should be noted that for a number of the toxic heavy metals (i.e., arsenic, lead, mercury, and selenium), the concentration of these contaminants in the extract either increased from the first to last extraction or the concentration fluctuates over the nine extractions (see, for example, arsenic in samples 1G and 13B and mercury in sample 5F). However, in some cases, the concentration of the contaminant in the extract does not even exceed the drinking water standard (see, for example, lead in samples 1G, 2E, and 5F). Therefore, the MEP data supports the EP testing results in this report and indicates that the toxic heavy metals with the possible exception of selenium are in a relatively immobile form in the Sealosafe® treated residue.

ANALYSIS OF WASTE FOR TOTAL ORGANIC CARBON

This project also evaluated the effect organic contaminants may have on the mobility of the toxic heavy metals.[11] In particular, certain organic compounds (e.g., sugars) are known to have a detrimental effect on the ability of the cement mixture to set-up and, thus, increase the leaching potential of the toxic heavy metals. The Stablex Corporation has stated that concentrations of three to five percent of total organic carbon (TOC) is commonly found in the Sealosafe treated waste generated at their English facilities with no inhibitory effects on the solidification of the treated waste and no effects on the leachability of the bound constituents. Therefore the Sealosafe treated residue was analyzed for TOC to determine if the organic content in the waste has any effect on the leaching potential of the toxic heavy metals (see Tables 37 to 49 for TOC analyses).

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11 It has also been argued that the Stablex process will not immobilize organic contaminants. Thus, if the level of organics in the Sealosafe treated residue is too high, the potential exists for organic toxicants to leach from the residue.

In evaluating this data, it indicates that the concentration of TOC found in the samples appear to have no affect on metal leachability. The levels found -- 0.3 to 1.5 percent TOC -- were less than the three to five percent estimate provided by Stablex so that it is not possible, based on this data, to validate their claim.

ANALYSES OF SUBWASTE CLAY AND CHALK SAMPLES

In collecting cores of the Sealosafe® treated residue, the contractor also collected samples of clay and chalk from below the treated waste. These soil samples were analyzed for metals to determine if the metals have, in fact, leached from the emplaced Sealosafe® treated waste. This was done by analyzing slices taken from the top, middle, and bottom of the core to determine if a concentration gradient exists with increasing core depth. These samples were partially digested and the digestate was analyzed for metal concentration (see Tables 69 to 81).

As already discussed, no consistent pattern of increasing metal concentration toward the waste interface could be detected. Neither the chalk nor the clay samples showed systematic changes in chemical composition that could be related to the leaching of metals from the treated waste. Therefore, little, if any, leaching of toxic heavy metals has occurred at the West Thurrock facility to date. However, since only four years has passed since the first Sealosafe® material has been placed in the ground, the absence of any contamination does not in itself indicate long-term stability of the treated material.

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APPENDIX A

LOGS OF BORINGS AT STABLEX DISPOSAL AREAS

TABLE A1. LOG OF BORING 1 AT THE STABLEX WASTE DISPOSAL FACILITY, AVELEY CLAY PIT SITE

Type of Material	From	To	Core run* No	Core run* From	Core run* To	Core Recovery From	Core Recovery To
Weathered, soft grey material	0.00	0.30**	1	0.10	2.10	0.10	2.10
Hard, grey, wet material	0.30	2.10	2	2.10	3.30	2.10	3.30
			3	3.30	3.80	3.30	3.71
Hard, grey material	2.10	3.40	4	3.80	4.20	3.80	4.20
Firm, dark brown clay, core lost from 3.71 - 3.80m.	3.40	4.20					

* All coring was done with 2.6-inch (6.67 cm) diam. diamond coring bits.

** All measurements are in meters below ground surface. Ground surface is 5.58 m below Local Datum (TBM1 in Fig. 4).

TABLE A2. LOG OF BORING 2 AT THE STABLEX WASTE DISPOSAL FACILITY, AVELEY CLAY PIT SITE

Type of Material	From	To	Core run* No	Core run* From	Core run* To	Core Recovery From	Core Recovery To
Weathered, friable, grey material	0.00	0.15**	1	0.00	1.60	0.00	1.60
Hard, dark, grey, fine-grained materials	0.15	1.40	2	1.60	2.20	1.60	2.20
			3	2.20	3.60	2.20	3.60
			4	3.60	4.20	3.60	4.20
Wet, grey, fine-grained material	1.40	1.70	5	4.20	5.40	4.20	5.05
			6	5.40	6.60	5.40	5.90
Wet, grey, fine-to-medium-grained material	1.70	2.40					
Hard, wet, dark, grey, fine-grained pitted material with soft horizons at 3.50-3.60, 3.85-3.90, 4.1-4.2 metres.	2.40	5.00					
Soft, brown clay	5.00	5.05					
Core lost	5.05	5.40					
Firm, grey-brown clay	5.40	6.60					

* All coring was done with 2.6-inch (6.67 cm) diam. diamond coring bits.

** All measurements are in meters below ground surface. Ground surface is 6.38 m below Local Datum (TBM1 in Fig. 4).

TABLE A3. LOG OF BORING 3 AT THE STABLEX WASTE DISPOSAL FACILITY, AVELEY CLAY PIT SITE

Type of Material	From	To	Core run* No	Core run* From	Core run* To	Core Recovery From	Core Recovery To
Weathered, brown, soft material	0.00	0.05**	1	0.00	0.98	0.00	0.98
			2	0.98	1.45	0.98	1.45
Hard, grey, fine-grained material	0.05	2.20	3	1.45	2.20	1.45	2.20
			4	2.20	2.90	2.20	2.90
			5	2.90	3.70	2.90	3.42
Hard, grey, fine-to-medium-grained wet material with soft horizon at 2.85-2.90	2.20	3.42	6	3.70	5.65	3.70	5.65
Core lost	3.42	3.70					
Firm, brown clay	3.70	5.65					

* All coring was done with 2.6-inch (6.67 cm) diam. diamond coring bits.

** All measurements are in meters below ground surface. Ground surface is 6.69 m below Local Datum (TBM1 in Fig. 4).

TABLE A4. LOG OF BORING 4 AT THE STABLEX WASTE DISPOSAL FACILITY, AVELEY CLAY PIT SITE

Type of Material	From	To	Core run* No	Core run* From	Core run* To	Core Recovery From	Core Recovery To
Hard, brown, fine-grained material	0.00	0.40**					
Broken, hard, grey material	0.40	1.04	1	0.00	1.50	0.00	1.50
			2	1.50	2.84	1.50	2.84
Hard, grey, wet material with a soft horizon at 2.34-2.52	1.04	2.95	3	2.84	3.46	2.84	3.46
			4	3.46	4.46	3.46	4.30
Pebbles and sand	2.95	3.27					
Firm, grey-brown clay	3.27	4.30					
Core lost	4.3	4.46					

* All coring was done with 2.6-inch (6.67 cm) diam. diamond coring bits.

** All measurements are in meters below ground surface. Ground surface is 3.51 m below Local Datum (TBM1 in Fig. 4).

TABLE A5. LOG OF BORING 5 AT THE STABLEX WASTE DISPOSAL FACILITY, AVELEY CLAY PIT SITE

Type of Material	From	To	Core run* No	Core run* From	Core run* To	Core Recovery From	Core Recovery To
Hard, grey, fine-grained, pitted material with soft horizons at 0.28–0.30 and 1.50–1.55m.	-0.00	1.55**	1	0.00	1.55	0.00	1.55
			2	1.55	2.45	1.55	2.45
Wet, hard, grey material	1.55	3.20	3	2.45	3.60	2.45	3.60
			4	3.60	4.90	3.60	4.90
Firm, brown clay	3.20	4.90					

* All coring was done with 2.6-inch (6.67 cm) diam. diamond coring bits.

** All measurements are in meters below ground surface. Ground surface is 5.73 m below Local Datum (TBM1 in Fig. 4).

TABLE A6. LOG OF BORING 6 AT THE STABLEX WASTE DISPOSAL FACILITY, AVELEY CLAY PIT SITE

Type of Material	From	To	Core run* No	Core run* From	Core run* To	Core Recovery From	Core Recovery To
Hard, damp, grey, fine-grained pitted material. Broken between 1.25-1.30m.	0.00	1.30	1	0.00	1.30	0.00	1.30
Soft, damp, grey material	1.30	1.46	2	1.30	2.00	1.30	2.00
			3	2.00	2.60	2.00	2.60
Hard, damp, grey, fine-grained material	1.46	2.60	4	2.60	3.65	2.60	3.65
			5	3.65	4.25	3.65	4.25
			6	4.25	5.90	4.25	4.45
Hard, wet, grey, fine-grained material	2.60	4.00	7	5.90	7.60	5.90	7.60
Soft, wet, grey material	4.00	4.25					
Hard, grey, fine-grained material	4.25	4.45					
Core lost	4.45	5.90					
Firm, brown clay	5.90	7.60					

* All coring was done with 2.6-inch (6.67 cm) diam. diamond coring bits.

** All measurements are in meters below ground surface. Ground surface is 6.39 m below Local Datum (TBM1 in Fig. 4).

TABLE A7. LOG OF BORING 7 AT THE STABLEX WASTE DISPOSAL FACILITY, THURROCK CHALK QUARRY SITE

Type of Material	From	To	Core run* No	Core run* From	Core run* To	Core Recovery From	Core Recovery To
Hard, grey, material with pink, mottled spots. Dry, soft horizons at 0.3m, 0.68m, 1.16m, 1.61m, 1.98-2.00m.	0.00	2.00**	1	0.00	1.54	0.00	1.54
			2	1.54	2.54	1.54	2.54
			3	2.54	3.70	2.54	2.96
Soft, wet chalk	2.00	2.54					
Hard, white chalk	2.54	2.80					
Soft, chalk	2.80	2.96					
Core lost	2.96	3.70					

* All coring was done with 2.6-inch (6.67 cm) diam. diamond coring bits.

** All measurements are in meters below ground surface. Ground surface is 0.80 m above MSL.

TABLE A8. LOG OF BORING 8 AT THE STABLEX WASTE DISPOSAL FACILITY, THURROCK CHALK QUARRY SITE

Type of Material	From	To	Core run* No	Core run* From	Core run* To	Core Recovery From	Core Recovery To
Hard, grey, pitted material with pink, mottled spots. Dry, soft horizons at 1m, 1.07-1.12m, and 1.61-1.70m.	0.00	1.90**	1	0.00	1.90	0.00	1.90
			2	1.90	2.80	1.90	2.80
			3	2.80	3.80	2.80	3.30
Hard, fine-grained, damp, dark-grey material with pink mottled spots. Soft horizon at 2.4m.	1.90	2.76					
Soft, white chalk	2.76	2.80					
Hard, white chalk	2.80	3.11					
Soft, chalk	3.11	3.30					
Core lost	3.30	3.80					

* All coring was done with 2.6-inch (6.67 cm) diam. diamond coring bits.

** All measurements are in meters below ground surface. Ground surface is 1.21 m above MSL.

TABLE A9. LOG OF BORING 9 AT THE STABLEX WASTE DISPOSAL FACILITY, THURROCK CHALK QUARRY SITE

Type of Material	From	To	Core run* No	Core run* From	Core run* To	Core Recovery From	Core Recovery To
Soft, grey, fine-grained material with pink, mottled spots.	0.00	1.10**	1	0.00	2.00	0.00	2.00
			2	2.00	3.00	2.00	3.00
Hard, grey, fine-grained, material with pink, mottled spots. Soft horizons at 0.24-0.30m, 0.74-0.87m, 3.92-3.94m.	1.10	3.94	3	3.00	4.00	3.00	4.00
Soft, white chalk	3.94	4.00					

* All coring was done with 2.6-inch (6.67 cm) diam. diamond coring bits.

** All measurements are in meters below ground surface. Ground surface is 2.76 m above MSL.

TABLE A10. LOG OF BORING 10 AT THE STABLEX WASTE DISPOSAL FACILITY, THURROCK CHALK QUARRY SITE

Type of Material	From	To	Core run* No	Core run* From	Core run* To	Core Recovery From	Core Recovery To
Dry, hard, grey material with pink, mottled spots.	0.00	0.50**	1	0.00	1.50	0.00	1.50
			2	1.50	2.70	1.50	2.70
Damp, broken, hard, grey material	0.50	0.68	3	2.70	3.80	2.70	3.80
Soft, damp, grey, material with pink, mottled spots.	0.68	0.74	4	3.80	4.50	3.80	4.33
Hard, grey material with pink, mottled spots.	0.74	1.43					
Soft, damp, grey, broken material.	1.43	1.50					
Dry, dark-grey material with pink, mottled spots.	1.50	4.17					
Soft, damp chalk.	4.17	4.33					
Core lost	4.33	4.50					

* All coring was done with 2.6-inch (6.67 cm) diam. diamond coring bits.

** All measurements are in meters below ground surface. Ground surface is 4.28 m above MSL.

TABLE A11. LOG OF BORING 11 AT THE STABLEX WASTE DISPOSAL FACILITY, THURROCK CHALK QUARRY SITE

Type of Material	From	To	Core run* No	Core run* From	Core run* To	Core Recovery From	Core Recovery To
Hard, grey, material with pink, mottled spots.	0.00	0.33**	1	0.00	1.70	0.00	1.70
			2	1.70	2.90	1.70	2.90
Soft, damp, grey material with pink, mottled spots.	0.33	0.47	3	2.90	3.65	2.90	3.45
Hard, grey, mottled material with pink, mottled spots.	0.47	0.67					
Soft, grey material with pink, mottled spots.	0.67	0.76					
Hard, grey, mottled material with pink, mottled spots and soft, damp bands.	0.76	1.70					
Hard, damp grey material with pink, mottled spots. Soft bands at 2.37-2.4m, and 2.46-2.52m.	1.70	2.90					
Hard, damp, grey material with pink, mottled spots.	2.90	3.10					
Chalk with flint.	3.10	3.45					
Core lost	3.45	3.65					

* All coring was done with 2.6-inch (6.67 cm) diam. diamond coring bits.

** All measurements are in meters below ground surface. Ground surface is 2.17 m above MSL.

TABLE A12. LOG OF BORING 12 AT THE STABLEX WASTE DISPOSAL FACILITY, AVELEY CLAY PIT SITE

Type of Material	From	To	Core run* No	Core run* From	Core run* To	Core Recovery From	Core Recovery To
Soft, dark grey, fine-grained material.	0.00	1.00**	1	0.00	2.50	0.00	2.50
Soft, damp, grey material with a clay texture	1.00	1.28	2	2.50	3.50	2.50	3.50
Hard, grey-brown, pitted material	1.28	1.70	3	3.50	4.00	3.50	4.00
			4	4.00	5.50	4.00	5.20
Soft, damp, broken grey-brown material	1.70	2.30					
Hard, light-grey, pitted material	2.50	3.50					
Firm, brown clay	3.50	5.20					
Core lost	5.20	5.50					

* All coring was done with 4-inch (10.2 cm) diam. diamond coring bits.

** All measurements are in meters below ground surface. Ground surface is 21.12 m below Local Datum (TBM1 in Fig. 4).

TABLE A13. LOG OF BORING 13 AT THE STABLEX WASTE DISPOSAL FACILITY, AVELEY CLAY PIT SITE

Type of Material	From	To	Core run* No.	Core run* From	Core run* To	Core Recovery From	Core Recovery To
Core lost	0.00	0.10**					
Soft, dark-grey, material.	0.10	1.40	1	0.00	1.40	0.10	1.40
			2	1.40	2.55	1.40	2.55
Hard, wet, grey-brown, pitted material	1.40	1.55	3	2.55	4.10	2.55	4.10
			4	4.10	5.60	4.10	5.60
Soft, broken grey-brown material	1.55	1.71					
Soft, grey-brown material	1.71	1.87					
Hard, grey-brown material	1.87	2.08					
Grey-brown material with alternating soft and hard bands	2.08	2.55					
Soft, broken, damp, brown material	2.55	3.46					
Soft, damp, grey material with hard bands at 3.46-3.58, 3.65-3.69, and 4.00-4.03m.	3.46	4.10					
Soft, wet, grey material	4.10	4.22					
Hard, wet, fine-grained material	4.22	4.34					
Fine-to-medium-grained, hard, grey material	4.34	4.44					
Hard, grey, fine-grained material	4.44	5.17					
Firm, brown clay	5.17	5.60					

* All coring was done with 3-inch (7.62 cm) diam. diamond coring bits.

** All measurements are in meters below ground surface. Ground surface is 20.62 m below Local Datum (TBM1 in Fig. 4).

TABLE A14. LOG OF BORING 14 AT THE STABLEX WASTE DISPOSAL FACILITY, AVELEY CLAY PIT SITE

Type of Material	From	To	Core run* No	Core run* From	Core run* To	Core Recovery From	Core Recovery To
Soft, grey material			1	0.00	3.00**	No recovery	
A bag of loose material recovered from the area was provided.			2	0.00	3.00	No recovery	
			3	3.00	6.00	No recovery	

* All coring was done with 3-inch (7.62 cm) diam. diamond coring bits.

** All measurements are in meters below ground surface. Ground surface is 20.10 m below Local Datum (TBM1 in Fig. 4).

APPENDIX B

DESCRIPTIONS OF CORE SECTIONS SELECTED FOR TESTING AND ANALYSIS

TABLE B1. SECTIONS OF STABLEX® CORE SAMPLED IN BOREHOLE BH1.

Sample designation	Depth to top of interval sampled (cm)	Length (cm)*	Description
A	10	6.1	Soft, fine, gray brown
B	52	11.7	Hard, gray brown mottled
C	91	8.4	Hard, fine, gray brown
D	137	11.2	Hard, gray brown mottled
E	177	10.2	Hard, gray brown weak mottling
F	202	10.5	Hard, fine gray brown
G	255	10.3	Hard, fine gray brown
H	294	7.5	Hard, fine gray brown

* Some lengths are approximate due to the fragmented nature of the core.

TABLE B2. SECTIONS OF STABLEX® CORE SAMPLED IN BOREHOLE BH2.

Sample designation	Depth to top of interval sampled (cm)	Length (cm)*	Description
A	12	8.3	Hard, fine, dusky brown pitted
B	54	10.9	Hard, fine, dusky brown
C	160	10.2	Hard, fine, dusky brown
D	210	12.8	Hard, fine-med, dusky brown
E	290	11.3	Hard, fine, dusky brown, pitted
F	335	11.5	Hard, fine, gray brown
G	405	8.8	Soft, fine, gray brown
H	467	9.7	Soft, fine, gray brown

* Some lengths are approximate due to the fragmented nature of the core.

TABLE B3. SECTIONS OF STABLEX® CORE SAMPLED IN BOREHOLE BH3.

Sample designation	Depth to top of interval sampled (cm)	Length (cm)*	Description
A	7.1	14.9	Hard, fine, dusky brown, pitted, mottled
B	69.8	11.0	Hard, fine, dusky brown
C	127.8	9.3	Hard, fine, dusky brown
D	143.8	9.8	Hard, fine, dusky brown
E	222.4	11.6	Hard, fine-med, dusky brown, pitted
F	259.2	12.8	Hard, fine-med, dusky brown, pitted
G	280.4	12.5	Soft, fine, dusky brown, pitted
H	308.0	7.4	Hard, fine-med, dusky brown, mottled

* Some lengths are approximate due to the fragmented nature of the core.

TABLE B4. SECTIONS OF STABLEX® CORE SAMPLED IN BOREHOLE BH4.

Sample designation	Depth to top of interval sampled (cm)	Length (cm)*	Description
A	7.5	12.5	Hard, fine, dusky brown pitted
B	44.1	10.2	Soft, fine dusky brown
C	83.2	7.9	Hard, fine, dusky brown
D	110.1	11.8	Hard, fine, dusky brown, pitted
E	163.5	11.4	Hard, fine, dusky brown, pitted
F	214.0	9.2	Soft, fine, dusky brown
G	239.1	9.0	Soft, fine, dusky brown
H	230.4	10.3	Hard, fine, dusky brown

* Some lengths are approximate due to the fragmented nature of the core.

TABLE B5. SECTIONS OF STABLEX® CORE SAMPLED IN BOREHOLE BH5.

Sample designation	Depth to top of interval sampled (cm)	Length (cm)*	Description
A	20	10.5	Soft, fine, olive black
B	52.8	10.6	Soft, fine, dusky brown
C	80.9	7.7	Hard, fine, dusky brown
D	130.3	12.2	Hard, fine, dusky brown
E	142.9	12.3	Soft, fine, dusky brown, sparsely mottled
F	170.9	14.5	Soft, fine, dusky brown, sparsely mottled
G	211.6	12.6	Soft, fine, dusky brown
H	264.7	8.4	Soft, fine, dusky brown

* Some lengths are approximate due to the fragmented nature of the core.

TABLE B6. SECTIONS OF STABLEX® CORE SAMPLED IN BOREHOLE BH6.

Sample designation	Depth to top of interval sampled (cm)	Length (cm)*	Description
A	14.2	9.5	Hard, fine, brown, pitted
B	65.3	8.8	Hard, fine, olive black
C	124.1	6.6	Soft, fine, olive black
D	166.7	10.1	Soft, fine, dusky brown, pitted
E	214.3	10.3	Soft, fine, dusky brown, pitted
F	255.9	8.6	Soft, fine dusky brown
G	337.3	7.9	Soft, fine, dusky brown
H	405.1	8.3	Soft, fine, dusky brown, pitted

* Some lengths are approximate due to the fragmented nature of the core.

TABLE B7. SECTIONS OF STABLEX® CORE SAMPLED IN BOREHOLE BH7.

Sample designation	Depth to top of interval sampled (cm)	Length (cm)*	Description
A	16.2	12.1	Soft, fine, brown, pitted, mottled
B	29.4	7.2	Soft, fine, brown, mottled
C	51.0	6.2	Hard, fine, gray brown, mottled
D	72.6	7.0	Hard, fine, gray brown, coarse to fine mottled
E	98.4	9.2	Hard, fine, gray brown, mottled
F	123.6	9.2	Hard, fine, gray brown, mottled
G	154.2	6.8	Hard, fine, gray brown, coarse mottled
H	177.6	7.6	Hard, fine, gray brown, coarse mottled

* Some lengths are approximate due to the fragmented nature of the core.

TABLE B8. SECTIONS OF STABLEX® CORE SAMPLED IN BOREHOLE BH8.

Sample designation	Depth to top of interval sampled (cm)	Length (cm)*	Description
A	5.0	10.4	Hard, fine, brown, pitted, mottled
B	38.3	7.7	Hard, fine, gray brown, coarse pitted, mottled
C	77.0	7.0	Hard, fine, gray brown, coarse pitted, mottled
D	119.2	5.5	Soft, fine, gray brown, pitted, mottled
E	142.0	6.4	Hard, fine, brown, pitted, mottled
F	171.7	8.5	Hard, fine, brown, pitted, mottled
G	214.8	6.6	Soft, fine, gray brown, pitted, mottled
H	253.2	6.4	Soft, fine, gray brown, mottled

* Some lengths are approximate due to the fragmented nature of the core.

TABLE B9. SECTIONS OF STABLEX® CORE SAMPLED IN BOREHOLE BH9.

Sample designation	Depth to top of interval sampled (cm)	Length (cm)*	Description
A	8.6	11.1	Soft, fine, gray brown, pitted, mottled
B	66.4	9.6	Soft, fine, gray brown, mottled
C	127.3	11.3	Soft, fine, brown, mottled
D	185.6	12.8	Hard, fine, gray brown, coarse mottled
E	220.6	10.9	Hard, fine, gray brown, mottled
F	258.1	12.9	Soft, fine, dusky brown, pitted, coarse, mottled
G	318.8	9.5	Hard, fine, dusky brown, coarse mottled
H	359.5	11.8	Hard, fine, dusky brown, mottled

* Some lengths are approximate due to the fragmented nature of the core.

TABLE B10. SECTIONS OF STABLEX® CORE SAMPLED IN BOREHOLE BH10.

Sample designation	Depth to top of interval sampled (cm)	Length (cm)*	Description
A	5.0	11.7	Hard, fine, brown, mottled
B	55.6	12.6	Soft, fine, brown, pitted, mottled
C	103.1	10.3	Soft, fine, gray brown, mottled
D	146.4	10.9	Soft, fine, brown, pitted, mottled
E	230.5	10.3	Soft, fine, dusky brown, pitted, mottled
F	275.6	13.6	Hard, fine, brown, mottled
G	327.6	11.6	Hard, fine, dusky brown, mottled
H	355.8	13.6	Hard, fine, dusky brown, mottled

* Some lengths are approximate due to the fragmented nature of the core.

TABLE B11. SECTIONS OF STABLEX® CORE SAMPLED IN BOREHOLE BH11.

Sample designation	Depth to top of interval sampled (cm)	Length (cm)*	Description
A	10.0	10.6	Soft, fine, dusky brown, pitted, mottled
B	45.2	11.25	Soft, fine, brown, mottled
C	90.3	9.9	Soft, fine, dusky brown, mottled
D	132.1	9.8	Soft, fine, dusky brown, sparsely mottled
E	146.7	10.3	Hard, fine, dusky brown, mottled
F	185.2	9.7	Hard, fine, dusky brown, coarse mottled
G	241.6	10.8	Hard, fine, dusky brown, mottled
H	270.8	11.2	Hard, fine, dusky brown, mottled

* Some lengths are approximate due to the fragmented nature of the core.

TABLE B12. SECTIONS OF STABLEX® CORE SAMPLED IN BOREHOLE BH12.

Sample designation	Depth to top of interval sampled (cm)	Length (cm)*	Description
A	9.0	10.1	Soft, fine, brown
B	31.2	11.4	Soft, fine, brown
C	66.0	12.5	Soft, fine, brown
D	100.1	7.7	Soft, fine, brown
E	121.8	9.0	Soft, fine, brown
F	144.1	10.1	Soft, fine, brown
G	172.6	9.1	Soft, fine, gray brown
H	212.3	12.4	Soft, fine gray brown, pitted

* Some lengths are approximate due to the fragmented nature of the core.

TABLE B13. SECTIONS OF STABLEX® CORE SAMPLED IN BOREHOLE BH13.

Sample designation	Depth to top of interval sampled (cm)	Length (cm)*	Description
A	33.3	15.2	Soft, fine, dusky brown, mottled
B	87.0	12.3	Soft, fine, dusky brown
C	125.3	12.1	Soft, fine, moderate brown
D	235.1	9.3	Soft, fine, moderate brown
E	244.9	8.3	Soft, fine, gray brown
F	311.5	9.4	Soft, fine, dusky brown
G	355.7	10.3	Soft, fine, dusky brown
H	407.6	10.0	Soft, fine, dusky brown

* Some lengths are approximate due to the fragmented nature of the core.

TABLE B14. SECTIONS OF STABLEX® CORE SAMPLED IN BOREHOLE BH14.

Sample designation	Depth to top of interval sampled (cm)	Length (cm)*	Description
A	0	Grab Sample	Soft, fine, black
B			
C			
D			
E			
F			
G			
H			

* Some lengths are approximate due to the fragmented nature of the core.

Two corings to a depth of 6 m, resulted in no core.

TABLE B15. POSITIONS OF SUBWASTE CLAY AND CHALK SAMPLES

Borehole	Sample Depth Below Waste J	K	L	Description	Total Length
1	10.2*	41.2	66.0	Clay, brown	68.6
2	10.2	22.9	43.2	Clay, grey brown	45.7
3	7.6	50.6	91.4	Clay, brown	195.6
4	10.2	45.7	88.9	Clay, grey brown	100.0
5	10.2	45.7	91.4	Clay, brown	116.8
6	7.6	33.0	66.0	Clay, brown	71.1
7	10.2	35.6	71.1	Chalk, white	76.2
8	7.6	30.5	58.4	Chalk, white	63.5
9	7.6**			Chalk, white	15.2
10	5.1	17.8	38.1	Chalk, soft	40.6
11	7.6	25.4	45.7	Chalk, with flint	50.8
12	7.6	30.5	50.8	Clay, brown	55.9
13	2.5	10.2	15.2	Clay, brown	17.8

* All values are in cm measured below the treated waste interface.
** Only one sample taken in this boring.

APPENDIX C

SUMMARY OF ANALYTICAL METHODS USED AT EMSL AND COMPARISONS OF DATA ON DUPLICATE SAMPLES TESTED AT EMSL AND WES

TABLE C-1. TECHNIQUES AND INSTRUMENTATION USED IN ANALYSIS OF QC/QA SAMPLES RUN AT EMSL

Parameter	Method	Instrument	Reference EPA Method
Ag	Flame AAS	Perkin-Elmer (PE) 5000	272.1
As	Heated Graphite Atomizer (HGA)	Same as above	206.2
Ba	Flame AAS/DC plasma	Same as above/ Spectraspan III B	208.1
Be	Flame AAS	Perkin-Elmer 5000	210.1
Cd	Flame AAS	Same as above	213.1
Co	Flame AAS	Same as above	219.1
Cr	Flame AAS/DC plasma	Same as above Spectraspan III B	218.1
Cu	Flame AAS	Perkin-Elmer 5000	220.1
Fe	Flame AAS	Same as above	236.1
Hg	Cold Vapor AAS	PE 603 with MHS-20	245.1
Mn	Flame AAS	Perkin-Elmer 5000	243.1
Ni	Flame AAS	Same as above	249.1
Pb	HGA/Flame AAS	Same as above	239.2/239.1
Se	HGA	Same as above	270.2
Sn	HGA/DC plasma	Same as above/ Spectraspan III B	
Sr	Flame AAS (N_2O/C_2H_2)/ DC Plasma	PE 5000/Spectraspan III B	
Zn	Flame AAS/DC plasma	PE 5000/Spectraspan III B	289.1

TABLE C-2. COMPARISON OF ANALYSES OF EP LEACHATE FROM DRIED GROUND WASTE FROM SAMPLE 2A.

Parameters	EMSL Results			WES Results			†% Difference
	2A1	2A2	Mean	2AA	2AB	Mean	
Ag	<0.01	<0.01	-	<0.050	<0.050	-	-
As	0.024	0.029	0.027	0.031	0.026	0.029	-7
Ba	0.25	0.26	0.26	0.237	0.230	0.234	+11
Be	<0.01	<0.01	-	<0.005	<0.005	-	-
Cd	0.01	<0.01	-	<0.010	<0.010	-	-
Co	<0.01	<0.01	-	<0.050	<0.050	-	-
Cr	0.27	0.13	0.20	0.053	0.079	0.066	+203
Cu	0.07	0.07	0.07	0.115	0.123	0.119	-41
Fe	0.70	0.16	0.43	0.197	0.207	0.202	+113
Hg	0.020	0.015	0.018	0.0019	0.0082	0.0051	+253
Mn	0.07	0.06	0.07	<0.050	<0.050	-	-
Ni	<0.01	<0.01	-	<0.050	<0.050	-	-
Pb	<0.005	<0.005	-	0.004	0.003	0.004	-
Se	0.37	0.46	0.42	0.290	0.330	0.310	+35
Sn	<0.01	<0.01	-	<0.050	<0.050	-	-
Sr	5.57	5.68	5.63	5.21	5.10	5.16	+9
Zn	0.08	0.05	0.07	0.052	0.055	0.54	-87

† % Difference = $\frac{\text{EMSL Mean} - \text{WES Mean}}{\text{WES Mean}} \times 100$

TABLE C-3. COMPARISON OF ANALYSES OF EP LEACHATE FROM DRIED GROUND WASTE FROM SAMPLE 2H.

Parameters	EMSL Results			WES Results			†% Difference
	2H1	2H2	Mean	2HA	2HB	Mean	
Ag	<0.01	<0.01	-	<0.050	<0.050	-	-
As	0.018	0.024	0.021	0.028	0.029	0.029	-26
Ba	0.21	0.23	0.22	0.207	0.233	0.220	0
Be	<0.01	<0.01	-	<0.005	<0.005	-	-
Cd	0.01	0.01	0.01	<0.010	<0.010	-	-
Co	<0.01	<0.01	-	<0.050	<0.050	-	-
Cr	0.15	0.13	0.14	0.075	0.073	0.074	+89
Cu	0.04	0.06	0.05	0.115	0.096	0.106	-53
Fe	<0.10	<0.010	-	0.175	0.129	0.152	-
Hg	<0.010	0.010	-	0.0007	0.0007	0.0007	-
Mn	0.07	0.04	0.06	0.175	0.175	0.175	-66
Ni	<0.01	<0.01	-	0.090	0.092	0.091	-
Pb	<0.005	<0.005	-	0.007	<0.001	-	-
Se	0.46	0.33	0.40	0.335	0.295	0.315	+27
Sn	<0.01	<0.01	-	<0.050	<0.050	-	-
Sr	5.68	5.67	5.68	5.33	5.27	5.30	+7
Zn	0.04	0.02	0.03	<0.050	0.050	-	-

† % Difference = $\frac{\text{EMSL Mean - WES Mean}}{\text{WES Mean}} \times 100$

TABLE C-4. COMPARISON OF ANALYSES OF EP LEACHATE FROM DRIED GROUND WASTE FROM SAMPLE 3A.

Parameters	EMSL Results			WES Results			†% Difference
	3A1	3A2	Mean	3AA	3AB	Mean	
Ag	<0.01	<0.01	-	<0.050	0.050	-	-
As	0.034	0.042	0.038	0.044	0.036	0.040	-5
Ba	0.28	0.26	0.27	0.275	0.273	0.274	-1
Be	<0.01	<0.01	-	<0.005	<0.005	-	-
Cd	0.01	<0.01	-	0.0112	0.0203	0.158	-
Co	<0.01	<0.01	-	<0.050	<0.050	-	-
Cr	0.08	0.04	0.06	<0.050	<0.050	-	-
Cu	0.03	0.03	0.03	0.083	0.078	0.081	-65
Fe	0.30	<0.10	-	0.064	0.076	0.070	-
Hg	<0.010	<0.010	-	0.0035	0.0025	0.0030	-
Mn	0.10	0.08	0.09	0.341	0.388	0.365	-75
Ni	<0.01	<0.01	-	0.095	0.104	0.101	-
Pb	0.035	<0.005	-	0.004	0.005	0.005	-
Se	0.43	0.39	0.41	0.129	0.138	0.124	+230
Sn	<0.01	<0.01	-	<0.050	<0.050	-	-
Sr	6.27	5.20	5.74	4.53	4.88	4.71	+22
Zn	0.06	0.06	0.06	0.211	0.222	0.217	-72

$$\dagger \% \text{ Difference} = \frac{\text{EMSL Mean} - \text{WES Mean}}{\text{WES Mean}} \times 100$$

TABLE C-5. COMPARISON OF ANALYSES OF EP LEACHATE FROM DRIED GROUND WASTE FROM SAMPLE 3D.

Parameters	EMSL Results			WES Results			†% Difference
	3D1	3D2	Mean	3DA	3DB	Mean	
Ag	<0.01	<0.01	-	<0.050	<0.050	-	-
As	0.069	0.076	0.073	0.033	0.043	0.038	+92
Ba	0.23	0.22	0.23	0.154	0.150	0.152	+51
Be	<0.01	<0.01	-	0.004	0.005	0.005	-
Cd	<0.01	<0.01	-	0.0245	<0.010	-	-
Co	<0.01	<0.01	-	<0.050	<0.050	-	-
Cr	0.12	0.10	0.11	0.069	0.055	0.062	+77
Cu	0.04	0.04	0.04	0.093	0.082	0.088	-55
Fe	<0.10	<0.10	-	0.072	0.113	0.093	-
Hg	<0.010	<0.010	-	0.0028	0.0005	0.0017	-
Mn	0.02	0.02	0.02	0.424	<0.050	-	-
Ni	<0.01	<0.01	-	0.142	<0.050	-	-
Pb	<0.005	<0.005	-	0.003	0.003	0.003	-
Se	0.50	0.50	0.50	0.136	0.290	0.213	+135
Sn	<0.01	<0.01	-	<0.050	<0.050	-	-
Sr	5.41	5.00	5.21	4.90	4.85	4.88	7
Zn	<0.01	<0.01	-	0.227	<0.050	-	-

† % Difference = $\frac{\text{EMSL Mean - WES Mean}}{\text{WES Mean}} \times 100$

TABLE C-6. COMPARISON OF ANALYSES OF EP LEACHATE FROM DRIED GROUND WASTE FROM SAMPLE 7E.

Parameters	EMSL Results			WES Results			†% Difference
	7E1	7E2	Mean	7EA	7EB	Mean	
Ag	<0.01	<0.01	-	<0.050	<0.050	-	-
As	0.010	<0.010	-	0.007	0.005	0.006	-
Ba	0.21	0.15	0.18	0.138	0.121	0.130	+38
Be	<0.01	<0.01	-	<0.005	<0.005	-	-
Cd	<0.01	<0.01	-	0.0774	<0.010	-	-
Co	<0.01	<0.01	-	<0.050	<0.050	-	-
Cr	0.51	0.55	0.53	0.252	0.253	0.253	+109
Cu	0.08	0.08	0.08	0.126	0.128	0.127	-37
Fe	0.26	0.18	0.22	0.239	0.236	0.238	-8
Hg	<0.010	<0.010	-	0.0005	0.0005	0.0005	-
Mn	<0.01	<0.01	-	0.267	<0.050	-	-
Ni	0.01	<0.01	-	0.087	<0.050	-	-
Pb	0.005	0.05	-	0.010	0.006	0.008	-
Se	0.56	0.44	0.50	0.065	0.088	0.077	+549
Sn	<0.01	0.01	-	<0.050	0.050	-	-
Sr	7.23	7.47	7.35	7.37	7.19	7.28	+1
Zn	<0.01	0.26	-	<0.050	<0.050	-	-

† % Difference = $\frac{\text{EMSL Mean - WES Mean}}{\text{WES Mean}} \times 100$

TABLE C-7. COMPARISON OF ANALYSES OF EP LEACHATE FROM DRIED GROUND WASTE FROM SAMPLE 4D.

Parameters	EMSL Results			WES Results			†% Difference
	4D1	4D2	Mean	4DA	4DB	Mean	
Ag	<0.01	<0.01	-	<0.050	<0.050	-	-
As	<0.010	<0.010	-	0.009	0.009	0.009	-
Ba	0.22	0.15	0.19	0.141	0.143	0.142	+34
Be	<0.01	<0.01	-	<0.005	<0.005	-	-
Cd	0.10	0.03	0.07	<0.010	<0.010	-	-
Co	<0.01	<0.01	-	<0.050	<0.050	-	-
Cr	0.16	0.23	0.20	0.158	0.155	0.157	+27
Cu	0.04	0.08	0.06	0.122	0.124	0.123	-51
Fe	0.36	0.34	0.35	0.169	0.137	0.153	+129
Hg	0.025	0.017	0.021	0.0028	0.0035	0.0032	+556
Mn	0.35	0.12	0.24	0.114	0.094	0.104	+131
Ni	0.13	0.03	0.08	0.059	0.060	0.060	+33
Pb	0.017	<0.005	-	0.007	0.005	0.006	-
Se	0.40	0.41	0.41	0.205	0.265	0.235	+74
Sn	<0.01	<0.01	-	<0.050	<0.050	-	-
Sr	6.00	6.09	6.05	6.55	6.42	6.49	-7
Zn	1.2	0.11	0.66	<0.050	<0.050	-	-

† % Difference = $\frac{\text{EMSL Mean - WES Mean}}{\text{WES Mean}} \times 100$

TABLE C-8. COMPARISON OF ANALYSES OF EP LEACHATE FROM DRIED GROUND WASTE FROM SAMPLE 8D.

Parameters	EMSL Results			WES Results			†% Difference
	8D1	8D2	Mean	8DA	8DB	Mean	
Ag	<0.01	<0.01	-	<0.050	<0.050	-	-
As	<0.010	<0.010	-	0.008	0.006	0.007	-
Ba	0.12	0.14	0.13	0.154	0.215	0.185	-30
Be	<0.01	<0.01	-	<0.005	<0.005	-	-
Cd	0.02	0.02	0.02	<0.010	0.2603	-	-
Co	<0.01	0.02	-	<0.050	<0.050	-	-
Cr	0.22	0.20	0.21	0.140	0.106	0.123	+71
Cu	0.10	0.11	0.11	0.182	0.174	0.178	-38
Fe	<0.10	<0.10	-	0.116	0.069	0.093	-
Hg	<0.010	<0.010	-	<0.0004	0.0015	-	-
Mn	0.12	0.08	0.10	<0.050	0.531	-	-
Ni	<0.01	<0.01	-	<0.050	0.103	-	-
Pb	<0.005	<0.005	-	0.005	0.005	0.005	-
Se	0.42	0.39	0.41	0.114	0.068	0.091	+351
Sn	0.01	0.01	-	<0.050	<0.050	-	-
Sr	6.97	6.99	6.98	6.43	6.35	6.39	+9
Zn	0.05	0.05	0.05	<0.050	0.723	-	-

$$\dagger\% \text{ Difference} = \frac{\text{EMSL Mean} - \text{WES Mean}}{\text{WES Mean}} \times 100$$

TABLE C-9. COMPARISON OF ANALYSES OF EP LEACHATE FROM DRIED GROUND WASTE FROM SAMPLE 10C.

Parameters	EMSL Results			WES Results			†% Difference
	10C1	10C2	Mean	10CA	10CB	Mean	
Ag	<0.01	<0.01	-	<0.050	<0.050	-	-
As	<0.010	<0.010	-	0.005	0.005	-	-
Ba	0.22	0.22	0.22	0.234	0.216	0.225	-2
Be	<0.01	<0.01	-	<0.005	<0.005	-	-
Cd	<0.01	<0.01	-	0.0263	0.010	-	-
Co	0.01	0.03	0.02	<0.058	<0.050	-	-
Cr	0.28	0.26	0.27	0.211	0.266	0.239	+13
Cu	0.07	0.07	0.07	0.132	0.130	0.131	-47
Fe	<0.10	<0.10	-	0.286	0.125	0.206	-
Hg	<0.010	<0.010	-	0.0007	<0.0004	-	-
Mn	0.01	<0.01	-	0.367	0.134	0.251	-
Ni	0.01	<0.01	-	0.092	0.059	0.076	-
Pb	0.005	<0.005	-	0.010	<0.001	-	-
Se	0.46	0.45	0.46	0.038	0.032	0.035	+1214
Sn	<0.01	<0.01	-	<0.050	<0.050	-	-
Sr	7.46	7.75	7.61	8.08	8.46	8.27	-8
Zn	0.04	0.02	0.03	0.241	0.098	0.170	-82

† % Difference = $\frac{\text{EMSL Mean - WES Mean}}{\text{WES Mean}} \times 100$

TABLE C-10. COMPARISON OF ANALYSES OF EP LEACHATE FROM DRIED GROUND WASTE FROM SAMPLE 12C.

Parameters	EMSL Results			WES Results			†% Difference
	12C1	12C2	Mean	12CA	12CB	Mean	
Ag	<0.01	<0.01	-	<0.050	<0.050	-	-
As	<0.010	<0.010	-	0.009	0.008	0.009	-
Ba	0.13	0.21	0.17	0.092	0.095	0.094	+81
Be	<0.01	<0.01	-	0.006	0.005	0.006	-
Cd	<0.01	<0.01	-	0.0238	0.010	-	-
Co	<0.01	<0.01	-	<0.050	<0.050	-	-
Cr	0.50	0.73	0.62	0.329	0.333	0.331	+87
Cu	0.08	0.08	0.08	0.133	0.125	0.129	-38
Fe	0.18	1.03	0.61	0.226	0.262	0.244	+150
Hg	<0.010	<0.010	-	0.0007	0.0005	0.0006	-
Mn	<0.01	0.02	-	0.245	<0.050	-	-
Ni	<0.01	<0.01	-	0.082	<0.050	-	-
Pb	<0.005	<0.005	-	<0.001	0.007	-	-
Se	0.74	0.77	0.76	0.223	0.275	0.249	+205
Sn	<0.01	<0.01	-	<0.050	<0.050	-	-
Sr	5.48	6.07	5.78	6.25	5.95	6.10	-5.2
Zn	0.03	0.09	0.06	0.086	<0.050	-	-

† % Difference = $\frac{\text{EMSL Mean - WES Mean}}{\text{WES Mean}} \times 100$

TABLE C-11. COMPARISON OF ANALYSES OF EP LEACHATE FROM DRIED GROUND WASTE FROM SAMPLE 13D.

Parameters	EMSL Results			WES Results			†% Difference
	13D1	13D2	Mean	13DA	13DB	Mean	
Ag	<0.01	<0.01	-	<0.050	<0.050	-	-
As	<0.01	<0.01	-	0.005	0.012	0.009	-
Ba	0.22	0.15	0.19	0.205	0.180	0.193	-2
Be	<0.01	<0.01	-	<0.005	<0.005	-	-
Cd	0.01	0.01	0.01	0.0414	<0.010	-	-
Co	<0.01	<0.01	-	<0.050	<0.050	-	-
Cr	0.52	0.52	0.52	0.355	0.384	0.370	+41
Cu	0.18	0.18	0.18	0.163	0.145	0.154	+17
Fe	<0.10	<0.10	-	0.100	0.313	0.207	-
Hg	<0.010	<0.010	-	0.0015	0.0008	0.0012	-
Mn	0.02	0.02	-	0.207	0.050	-	-
Ni	<0.01	<0.01	-	0.098	0.050	-	-
Pb	<0.005	<0.005	-	0.020	0.012	0.016	-
Se	1.18	1.20	1.19	0.270	0.385	0.328	+263
Sn	<0.01	<0.01	-	<0.050	<0.050	-	-
Sr	6.01	5.93	5.97	6.32	6.21	6.27	-5
Zn	<0.01	<0.01	-	0.202	0.050	-	-

† % Difference = $\frac{\text{EMSL Mean - WES Mean}}{\text{WES Mean}} \times 100$

TABLE C-12. ANALYSES OF EP EXTRACTANT FROM TESTING OF MONOLITHIC SAMPLES OF TREATED WASTES FROM BORINGS 1 AND 2 TESTED AT EMSL

	Sample Designation				
Parameter	1C	2C	2D	2F	2G
Ag	<0.02	0.02	<0.02	<0.02	<0.02
As	<0.005	<0.005	<0.005	0.005	<0.005
Ba	<3.5	<3.5	<3.5	<3.5	<3.5
Be	<0.08	<0.08	<0.08	<0.08	0.08
Cd	<0.01	0.17	0.11	0.18	0.09
Co	<0.10	<0.10	<0.10	<0.10	<0.10
Cr	<0.05	<0.05	<0.05	<0.05	<0.05
Cu	0.03	0.35	0.18	0.32	<0.03
Fe	<0.05	<0.05	0.05	<0.05	<0.05
Hg	<0.001	<0.001	<0.001	<0.001	<0.001
Mn	<0.10	0.69	0.52	0.71	0.41
Ni	<0.25	<0.25	<0.25	<0.25	<0.25
Pb	<0.05	<0.05	<0.05	0.05	<0.05
Se	0.04	0.14	0.10	0.13	0.12
Sn	<0.01	<0.01	<0.01	<0.01	<0.01
Sr	0.16	1.64	1.08	1.38	0.81
Zn	0.10	3.41	2.49	3.71	1.95

TABLE C-13. COMPARISON OF ANALYSES OF PARTIAL DIGESTS OF SAMPLE 4J

Parameter	EMSL Results			WES Results			†% Difference
	4J1	4J2	Mean	4JA	4JB	Mean	
Ag	<0.75	<0.75	-	<6.0	<6.0	-	-
As	6.8	6.1	6.5	9.80	10.8	10.3	-37
Ba	130	156	143	35.8		35.8	+299
Be	1.7	1.9	1.8	1.70	2.20	1.95	-8
Cd	<0.75	<0.75	-	<1.5	<1.5	-	-
Co	16	18	17	<20	<20	-	-
Cr	33	42	38	66	80	73	-48
Cu	26	31	29	32	35	34	-15
Fe	28000	25900	27000	32900	36100	34500	-22
Hg	0.08	0.02	0.05	<0.1	<0.1	-	-
Mn	184	200	192	226	243	235	-18
Ni	40	46	43	48	52	50	-14
Pb	12.4	12.0	12.2	<20	<20	-	-
Se	0.5	0.6	0.6	0.80	0.80	0.8	-25
Sn	5	<5	-	<5.0		-	-
Sr	122	126	124	28.8		28.8	+331
Zn	96	94	95	97.3	103	100	-5

† % Difference = $\frac{\text{EMSL Mean - WES Mean}}{\text{WES Mean}} \times 100$

TABLE C-14. COMPARISON OF ANALYSES OF PARTIAL DIGESTS OF SAMPLE 4K

Parameter	EMSL Results			WES Results			†% Difference
	4K1	4K2	Mean	4KA	4KB	Mean	
Ag	<0.75	<0.75	-	<6.0	<6.0	-	-
As	12.4	13.6	13.0	14.0	13.2	13.6	-4
Ba	108	112	110	47.5		47.5	+132
Be	1.5	1.3	1.4	1.90	1.90	1.90	-26
Cd	<0.75	<0.75	-	<1.5	<1.5	-	-
Co	18	18	18	20	20	20	-10
Cr	37	38	38	69	69	69	-45
Cu	26	25	26	28	32	30	-13
Fe	24350	30900	27600	34800	34900	34900	-21
Hg	<0.02	<0.02	-	<0.1	<0.1	-	-
Mn	194	191	193	222	223	223	-13
Ni	46	47	47	51	49	50	-6
Pb	12.4	12.6	12.5	<20	<20	-	-
Se	<0.1	<0.1	-	0.60	0.70	0.65	-
Sn	<5	<5	-	<5.0		-	-
Sr	94	90	92	110		110	-16
Zn	82	104	93	98.9	97.4	98.2	-5

† % Difference = $\frac{\text{EMSL Mean - WES Mean}}{\text{WES Mean}} \times 100$

TABLE C-15. COMPARISON OF ANALYSES OF PARTIAL DIGESTS OF SAMPLE 4L

Parameters	EMSL Results			WES Results			†% Difference
	4L1	4L2	Mean	4LA	4LB	Mean	
Ag	<0.75	0.75	-	<6.0	<6.0	-	-
As	11.8	13.0	12.6	13.6	11.9	12.8	-2
Ba	164	165	165	70.8		70.8	+133
Be	1.8	1.9	1.9	2.20	1.60	1.80	+6
Cd	<0.75	<0.75	-	<1.5	<1.5	-	-
Co	17	17	17	<20	<20	-	-
Cr	37	39	38	79	59	69	-45
Cu	29	28	29	31	32	32	-9
Fe	29150	33050	31100	36100	32100	34100	-9
Hg	<0.02	0.02	-	<0.1	<0.1	-	-
Mn	210	214	212	231	227	229	-7
Ni	44	44	44	48	42	45	-2
Pb	10.9	10.9	10.9	<20	<20	-	-
Se	<0.1	0.1	-	<0.50	0.50	-	-
Sn	<5	<5	-	-<5.0		-	-
Sr	135	135	135	154		154	-12
Zn	88	88	88	103	92.0	98.0	-10

$$\dagger\% \text{ Difference} = \frac{\text{EMSL Mean} - \text{WES Mean}}{\text{WES Mean}} \times 100$$

TABLE C-16. COMPARISON OF ANALYSES OF PARTIAL DIGESTS OF SAMPLE 5J

Parameters	EMSL Results			WES Results			†% Difference
	5J1	5J2	Mean	5JA	5JB	Mean	
Ag	<0.75	<0.75	-	<6.0	<6.0	-	-
As	13.2	8.4	10.8	10.6	9.60	10.1	+7
Ba	184	194	189	60.3		60.3	+213
Be	1.6	1.4	1.5	2.00	1.70	1.85	-19
Cd	<0.75	<0.75	-	<1.5	<1.5	-	-
Co	20	19	20	<20	<20	-	-
Cr	38	38	38	68	60	64	-41
Cu	28	29	29	32	32	32	-9
Fe	31200	33150	32200	37600	35000	36300	-11
Hg	<0.02	<0.02	-	<0.1	<0.1	-	-
Mn	208	206	207	231	227	229	-10
Ni	50	50	50	48	42	45	+11
Pb	12.6	13.1	12.9	<20	<20	-	-
Se	0.1	0.2	0.2	<0.50	0.50	-	-
Sn	<5	<5	-	<5.0		-	-
Sr	162	167	165	154		154	+7
Zn	96	96	96	103	92.0	98.0	-2

† % Difference = $\frac{\text{EMSL Mean - WES Mean}}{\text{WES Mean}} \times 100$

TABLE C-17. COMPARISON OF ANALYSES OF PARTIAL DIGESTS OF SAMPLE 5K

Parameter	EMSL Results			WES Results			†% Difference
	5K1	5K2	Mean	5KA	5KB	Mean	
Ag	<0.75	<0.75	-	<6.0	<6.0	-	-
As	0.8	5.0	2.9	6.80	6.80	6.80	-57
Ba	158	27	93	50.8		50.8	+83
Be	1.5	1.6	1.6	1.90	2.40	2.20	-27
Cd	<0.75	<0.75	-	<1.5	<1.5	-	-
Co	15	15	15	<20	<20	-	-
Cr	33	32	33	78	85	82	-60
Cu	25	25	25	35	37	36	-31
Fe	12500	24400	18500	34900	34200	34600	-47
Hg	<0.02	<0.02	-	<0.1	<0.1	-	-
Mn	180	178	179	219	212	216	-17
Ni	37	35	36	45	43	44	-18
Pb	3.8	10.7	7.3	45	35	40	-82
Se	<0.1	0.2	-	0.60	0.60	0.60	-
Sn	<5	<5	-	7.5		7.5	-
Sr	115	113	114	117		117	-3
Zn	82	82	82	102	99.3	102	-20

† % Difference = $\frac{\text{EMSL Mean - WES Mean}}{\text{WES Mean}} \times 100$

TABLE C-18. COMPARISON OF ANALYSES OF PARTIAL DIGESTS OF SAMPLE 5L

Parameter	EMSL Results			WES Results			†% Difference
	5L1	5L2	Mean	5LA	5LB	Mean	
Ag	<0.75	<0.75	-	<6.0	<6.0	-	-
As	7.5	6.7	5.1	8.20	6.40	7.30	-30
Ba	34	29	32	65.8		65.8	-51
Be	1.8	1.8	1.8	1.60	1.50	1.55	+16
Cd	<0.75	<0.75	-	<1.5	<1.5	-	-
Co	18	17	18	<20	<20	-	-
Cr	40	38	39	63	59	61	-36
Cu	29	31	30	34	26	30	0
Fe	31900	28850	30400	33200	24800	29300	+4
Hg	<0.02	<0.02	-	<0.1	<0.1	-	-
Mn	208	206	207	228	188	208	0
Ni	42	42	42	44	35	40	5
Pb	12.0	12.3	12.2	20	20	-	-
Se	0.1	0.2	-	0.50	0.50	-	-
Sn	5	5	-	5.0		-	-
Sr	134	125	130	174		174	-25
Zn	90	97	94	93.3	76.4	84.9	+11

$$\dagger \% \text{ Difference} = \frac{\text{EMSL Mean} - \text{WES Mean}}{\text{WES Mean}} \times 100$$

TABLE C-19. COMPARISON OF ANALYSES OF PARTIAL DIGESTS OF SAMPLE 6J

Parameter	EMSL Results			WES Results			†% Difference
	6J1	6J2	Mean	6JA	6JB	Mean	
Ag	0.75	0.75	-	<6.0	6.0	-	-
As	12.7	13.3	13.0	13.6	14.0	13.8	-6
Ba	44	46	45	95.5		95.5	-53
Be	1.5	1.5	1.5	1.80	1.20	1.50	0
Cd	0.75	0.75	-	<1.5	1.5	-	-
Co	26	26	26	26	26	26	0
Cr	36	34	35	56	68	62	-44
Cu	34	40	37	33	35	34	+9
Fe	25500	25200	25350	29500	32100	30800	-18
Hg	0.08	0.08	0.08	0.4	0.4	0.4	-80
Mn	165	157	161	175	190	183	-12
Ni	54	52	53	53	57	55	-4
Pb	14.1	15.0	14.6	20	20	-	-
Se	0.	0.4	0.4	0.50	0.50	-	-
Sn	5	5	-	5.0		-	-
Sr	150	150	150	174		174	-4
Zn	86	88	87	83.6	89.0	86.3	+1

† % Difference = $\frac{\text{EMSL Mean - WES Mean}}{\text{WES Mean}} \times 100$

TABLE C-20. COMPARISON OF ANALYSES OF PARTIAL DIGESTS OF SAMPLE 6K

Parameter	EMSL Results			WES Results			†% Difference
	6K1	6K2	Mean	6KA	6KB	Mean	
Ag	0.75	0.75	-	6.0	6.0	-	-
As	9.2	10.6	9.9	14.6	17.0	15.8	-37
Ba	26	20	23	79.0	72.5	75.8	-70
Be	1.5	1.8	1.7	1.70	1.50	1.60	+6
Cd	0.75	0.75	-	1.5	1.5	-	-
Co	18	16	17	20	20	-	-
Cr	35	35	35	73	72	73	-52
Cu	28	25	27	32	32	32	-16
Fe	24900	25200	25050	33500	36000	34750	-30
Hg	0.07	0.05	0.06	0.5	0.5	0.5	-88
Mn	165	154	160	188	190	189	-15
Ni	39	36	38	41	41	41	-7
Pb	12.5	10.0	11.3	20	20	-	-
Se	0.2	0.2	0.2	0.50	0.50	0.50	-60
Sn	5	5	-	7.6	5.0	-	-
Sr	108	97	103	125	134	130	-21
Zn	86	79	73	92.9	93.0	93.0	-22

† % Difference = $\frac{\text{EMSL Mean} - \text{WES Mean}}{\text{WES Mean}} \times 100$

TABLE C-21. COMPARISON OF ANALYSES OF PARTIAL DIGESTS OF SAMPLE 6L

Parameter	EMSL Results			WES Results			†% Difference
	6L1	6L2	Mean	6LA	6LB	Mean	
Ag	0.75	0.75	-	6.0	6.0	-	-
As	5.8	4.4	5.1	9.00	8.00	8.50	-4
Ba	43	44	44	111		111	-60
Be	1.7	1.6	1.7	1.50	1.70	1.60	+6
Cd	0.75	0.75	-	1.5	1.5	-	-
Co	14	13	14	20	20	-	-
Cr	32	32	32	64	61	63	-49
Cu	28	33	31	32	31	32	-3
Fe	24600	24300	24450	32000	31500	31750	-23
Hg	0.05	0.05	0.05	0.5	0.5	0.5	-90
Mn	162	162	162	182	191	187	-13
Ni	36	36	36	38	37	38	-5
Pb	11.6	11.6	11.6	20	20	-	-
Se	0.1	0.1	-	0.50	0.50	-	-
Sn	5	5	-	5.0		-	-
Sr	138	136	137	194		194	-29
Zn	82	99	91	90.0	87.6	88.8	+2

† % Difference = $\frac{\text{EMSL Mean - WES Mean}}{\text{WES Mean}} \times 100$

APPENDIX D

MULTIPLE EXTRACTION PROCEDURE

1) Grind sample to particle size capable of passing through 100 mesh screen.

2) Run the EP toxicity test on this sample (sample size 100 grams) as described in Test Methods for Evaluating Solid Waste U.S. EPA Publication SW 846.

3) Analyze the extract for those listed in Table 2 using DC Plasma for screening and the analytical methods indicated in Test Methods for Evaluating Solid Waste (SW-846) for final quantification.

4) Prepare a synthetic acid rain extraction fluid by adding a 60/40 weight percent mixture of sulfuric and nitric acids to distilled deionized water until the pH is 3.0 ± 0.2.

5) Weight the solid phase of the waste sample remaining after step 2 and place it in the extractor with 20 times its weight of the synthetic acid rain extraction fluid. Do not allow the material to dry before weighing. Use the same extractor as used in the EP.

6) The pH should be recorded between 5 and 10 minutes after the solid material and the synthetic acid rain are placed in the extractor and agitation has been started.

7) Agitate the mixture for 24 hours. Maintain the temperature at 20-40°C (68-104°F) during this time. The pH should again be recorded at the end of the 24 hour extraction period.

8) Separate the material in the extractor into its component liquid and solid phase as described in the Separation Procedure of the EP.

9) Analyze the extract as in step 3.

10) Repeat steps 5-9 eight (8) additional times. Use the same procedure for these additional extractions and analyses as used in the initial synthetic acid rain extraction.

11) If after completing the 9th synthetic rain extraction the concentration of any of the analyses is increasing over that found in the 7th and 8th extractions, then, continue extracting with synthetic acid rain until the concentration in the extract ceases to increase.

12) Report the initial and final pH of each extraction and the concentration of each listed constituent of concern in each extract.