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COKER'S LANDFILLS
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
WORK PLAN

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TASK 1

COKER'S LANDFILLS SITE BACKGROUND

1.A Site Background

The Coker Sanitation Service Landfills, known as Coker's Landfill No. 1 and Coker's Landfill No. 2 are closed former landfills each rectangularly shaped and approximately 10 and 15 acres, respectively, in size. The landfills are located 1.3 miles northwest of the town of Cheswold, Delaware and 5.7 miles northwest of the city of Dover, Delaware. A location map is presented in Figure 1.1. While these two landfills were in operation, they were used for the disposal of latex rubber waste sludges from what is now the Reichhold Chemicals, Inc., Cheswold Plant.

The Coker's Landfill No. 1 site was operated by Coker's Sanitation during a 14 year period from 1962 to 1976 under lease from the property owner, John Schmidt. During this time the Cheswold Plant was under the operation of four different owners including: International Latex and Chemical Corporation; Glen Alden, now part of Rapid American; Standard Brands Chemical Industries Inc.; and Reichhold Chemicals, Inc. A chronology of operation during the active life of Coker's Landfill No. 1 and No. 2 is presented in Figure 1.2.

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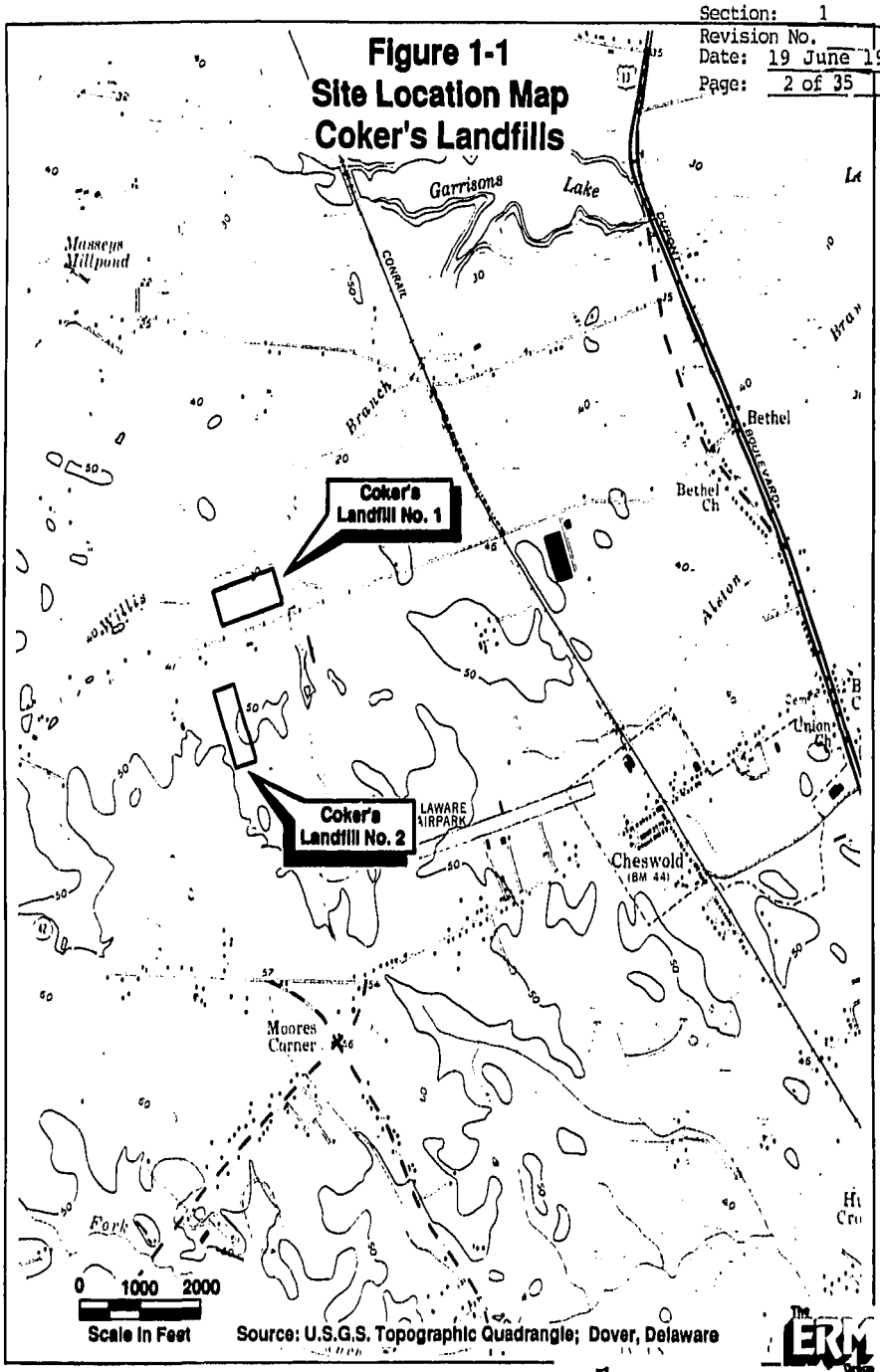
Figure 1-1
Site Location Map
Coker's Landfills



Source: U.S.G.S. Topographic Quadrangle; Dover, Delaware

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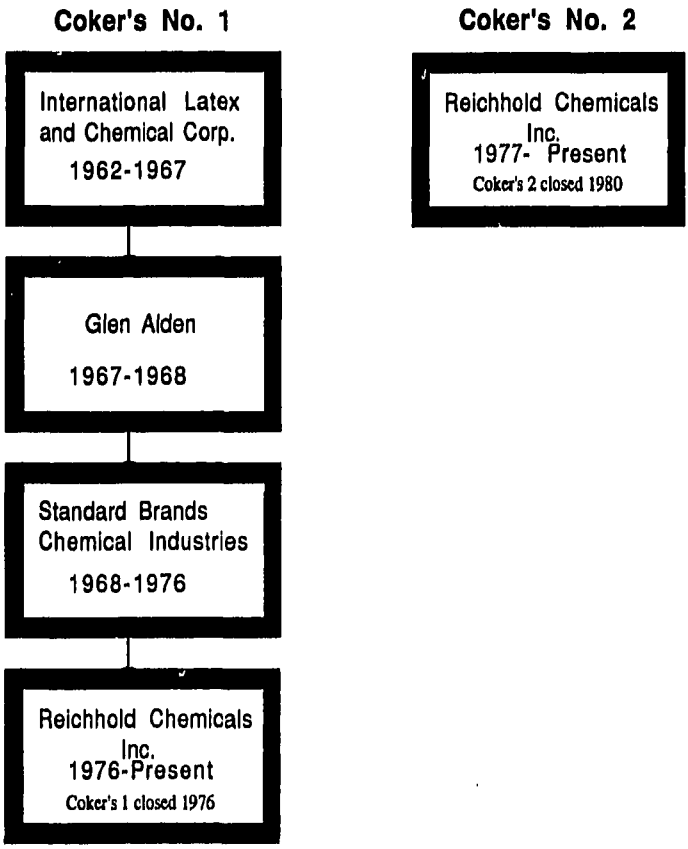
Figure 1-2

Site Chronology of Coker's Landfills No.1 and 2



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Coker's Landfill No. 1 was operated pursuant to general state permits with latex rubber production wastes being placed in 12 foot wide and 6 to 8 foot deep unlined trenches. The wastes were allowed to remain uncovered one to two weeks to solidify and then were covered with native soils. Documentation reviewed for this section indicated that some of the pits were later excavated and reused. The site was first permitted by the Delaware Water and Air Resources Commission in 1969. The landfill was later permitted by the Delaware Department of Natural Resources and Environmental Conservation(DNREC) in 1973 and renewed annually until 1976. Disposal activities at Coker's Landfill No.1 ended in 1976 shortly after Reichhold Chemicals assumed ownership of the Cheswold Plant.

The Coker's Landfill No.2 site is located approximately one-half mile to the southwest of Coker's Landfill No. 1 on property owned by Joseph Kowinsky. The site was operated from April 1977 to June 1980.

The Coker's Landfill No.2 was permitted under the DNREC solid waste regulations in 1976 (Permit SW 77/01), to construct and operate a landfill. Requirements of the permit included synthetic liners, a leachate collection system, installation of ground water monitoring wells, leachate treatment and monitoring, regularly scheduled inspections and ground water and leachate sampling. Approximately 150 tons per week of dewatered latex sludges were disposed of in Coker's Landfill No. 2 until it was closed in 1980.

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Several site investigations have been conducted by the EPA and it's subcontractors on Coker's Landfills No. 1 and No. 2.

These are as follows:

Date of Report	Title
September 9, 1980	Site Inspection/Sampling of Coker's Landfill #1 Cheswold, De. TDD No. F3-8007-57 DE-4 Ecology and Environment, Inc. Field Investigation Team Region III
September 9, 1980	Site Inspection/Sampling of Coker's Landfill #2 Cheswold, De. TDD No. F3-8007-56 DE-5 Ecology and Environment, Inc. Field Investigation Team Region III

September 28, 1984	Site Inspection of Coker's Landfill No. 1 prepared under TDD No. F3-8211-36B EPA NO. DE-04 Contract No. 68-01-6699 for Hazardous Site Control Division U.S. Environmental Protection Agency, NUS Corporation Superfund Division
October 1, 1984	Site Inspection of Coker's Landfill No. 2 prepared under TDD No. F3-8211-36B EPA No. DE-005 Contract No. 68-01-6699 for Hazardous Site Control Division U.S. Environmental Protection Agency, NUS Corporation Superfund Division
January 16, 1985	Hazardous Ranking System Score Sheets and References for Coker's Landfills Kent County Delaware Reviewed by Thomas Pearce NUS Corporation and Neil Swanson USEPA Region III

Site Impacts on the environment summarized in these reports include an observed leachate seep from Coker's Landfill No. 1 to an unnamed tributary of the Willis Branch. Compounds found downstream of the seep at Coker's Landfill No. 1 and in ground water samples collected from Monitoring Well 5 at Coker's

September 28, 1984	Site Inspection of Coker's Landfill No. 1 prepared under TDD No. F3-8211-36B EPA NO. DE-04 Contract No. 68-01-6699 for Hazardous Site Control Division U.S. Environmental Protection Agency, NUS Corporation Superfund Division
October 1, 1984	Site Inspection of Coker's Landfill No. 2 prepared under TDD No. F3-8211-36B EPA No. DE-005 Contract No. 68-01-6699 for Hazardous Site Control Division U.S. Environmental Protection Agency, NUS Corporation Superfund Division
January 16, 1985	Hazardous Ranking System Score Sheets and References for Coker's Landfills Kent County Delaware Reviewed by Thomas Pearce NUS Corporation and Neil Swanson USEPA Region III

Site Impacts on the environment summarized in these reports include an observed leachate seep from Coker's Landfill No. 1 to an unnamed tributary of the Willis Branch. Compounds found downstream of the seep at Coker's Landfill No. 1 and in ground water samples collected from Monitoring Well 5 at Coker's

Landfill No. 2 have included: acrolein, toluene, and ethyl benzene and iron. Samples collected from monitoring wells at Coker's Landfill No. 2 also indicate the presence of low levels of phthalates, chloroform, nitrophenols, arsenic, and lead. Confidence in the validity of these data is questionable in light of the Quality Control/Quality Assurance (QA/QC) deficiencies found in the analytical data base from the site investigations.

1.A.1 Site Location

The Coker's Landfills No. 1 and No. 2 are located 1.3 miles northwest of Cheswold, Delaware. A location map is presented in Figure 1-1. Coker's Landfill No. 1 is a 9 to 10 acre tract of land located several hundred feet north of County Route 152 (Figure 1-3). The site stopped receiving waste in 1976. Capping and grading of the site was completed in 1977 under DNREC direction. Currently, the site occupies a clearing in a wooded area that supports grassy vegetation. To the north, the landfill area drops off in a relatively steep slope, bordering Willis Branch, which flows from west to east less than 100 feet from the toe of the slope. Access to the site is via a dirt haul road secured by a chain at the site entrance. The immediate area surrounding the sites is rural with two farms on the adjacent Kowinsky and Schmidt properties.

The Coker's No. 2 Landfill consists of a 15 acre rectangular - shaped landfill, that has been inactive since 1980 (Figure 1-4). It is located on the south side of County Route 152, to the south-southwest of the Coker's No.1 Landfill. Several hundred feet of wooded area separate the grass covered site from the main

road to the north. There are also woods to the south of the site. A tree line separates the site from farmed fields to the east, and a ravine/swamp area borders the site to the west.

A total of fifty-one synthetically lined disposal pits lie on both sides of the dirt access road which bisects the Coker's No. 2 site from north to south. Six existing monitoring wells (5 shallow and 1 deep) are located on site (Figure 1-4). According to the NUS 1983 report on Coker's Landfill No. 2, six to eight leachate collection system withdrawal wells are installed east of and adjacent to the access road. A review of the Reichhold plant files indicated that each waste cell has a leachate collection pipe, which is pumped on a regular basis.

1.A.2 Physiography

The United States Geological Survey (USGS) Dover Quadrangle Topographic Map (Figure 1-1) indicates that the site is in flat lying area with elevations of 20 to 50 feet above mean sea level (MSL). Surface water drainage in the vicinity of Coker's Landfill No.1 is via Willis Branch of Leipsic River which flows to the east and drains the northwest and northern portions of the site. This flow is joined downstream by a north flowing, unnamed tributary which drains the west perimeter of the site. Willis Branch is a tributary of Leipsic River and discharges into the river via a man-made lake named Garrison's Lake. At Coker's Landfill No. 2 a drainage swale extends from an area of ponded water present during periods of high rainfall in the southeast corner of the site. This swale extends along the southern and western perimeter, and empties into a low wetland area west of

the pits. During periods of heavy rain, the wetland area apparently drains northward toward Willis Branch, intercepting the stream upstream of Coker's Landfill No. 1.

1.A.3 Hydrogeology

Ground water at the Coker's Site occurs in two major flow systems: a surficial water table aquifer and a deeper, artesian aquifer which underlies a silty clay confining layer. A municipal water supply study done for the town of Cheswold by O'Brien and Gere in 1982 identified these two aquifers in the vicinity of Cheswold as the Columbia and Cheswold Aquifers. The Columbia Aquifer is a water table aquifer composed of Pleistocene Age sediments and is the principal aquifer for domestic wells in the area. The unit is relatively permeable with an average hydraulic conductivity in the mid-Delaware area of 75 feet per day (Johnston, 1973). This aquifer commonly produces water containing high levels of iron. At Coker's Landfill No. 2, based on the well log for the only deep well, monitoring well 6 installed by A.W. Martin in 1975, the Columbia Formation is 15 to 20 feet thick with water levels 3 to 5 feet below ground surface.

Underlying this silty clay unit is the Cheswold Aquifer, which in the site area is composed of gray fine sands. Pump tests conducted by O'Brien and Gere for the municipal study determined that the silty clay confining unit had some permeability, therefore a potential exists for vertical movement of recharge water downward from the surficial to the underlying aquifer. Pump tests conducted for the Cheswold municipal study at the 60 to 100 feet screened interval of the Cheswold aquifer indicated a

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transmissivity of 17,000 gpd/ft and an average storage coefficient of 1.56×10^{-3}. Static water level was 10 feet below ground surface and 50 feet above the top of the aquifer.

On a regional scale, studies by the USGS indicate that the Coker's sites are located just north of an 83 Km^2 area identified by Johnston and Leahy (1977) as a major leakage/recharge area caused by the heavy pumping of the Cheswold Aquifer at Dover since the turn of the century.

A total of six monitoring wells were installed at Coker's Landfill No. 2 by A. W. Martin in 1975 prior to the initiation of disposal operations. Martin produced a ground water table map indicating a ground water flow direction of north to northwest and water table levels of less than 3 feet below ground surface. NUS, in their 1983 site investigation, mapped a ground water flow direction to the northeast with water levels averaging 6 feet below ground surface. Because only one deep well was installed by Martin, no ground water flow direction for the Cheswold Aquifer beneath the site can be determined, but flow is probably to the south because the southerly dip of the aquifer and the high pumping centers in Dover.

1.A.4 Geology

Based on the log for the 80 foot deep well installed at the site by A.W. Martin in 1975 (Monitoring Well 6), Coker's Landfill No. 2 is underlain by 15 to 22 feet of brown to brown-gray silt, sand, silty sand, and "minor" gravel above three to five feet of gray silty clay. These sediments comprise the Columbia Aquifer

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which is the Pleistocine Age Columbia Formation. Below the gray silty clay the remaining 50 to 55 feet consisted of a gray, fine sand which comprises the Cheswold Aquifer. The Cheswold is part of the Miocene Age Cheasapeake Group formally known as the Calvert Formation.

Stratigraphically, these units are uncomformably underlain by older Tertiary and Cretaceous Age sediments. The estimated depth to the basement complex in this area is approximately 3000 feet. Soils in the Coker's area as described by the Soil Conservation Service (1971) consist of Sassafras sandy loams in cultivated areas and Fallsington loams in woodlands.

1.A.5 Vegetation

Coker's Landfill No. 1 is on a 9 to 10 acre tract of land located several hundred feet north of County Route 152. The site is in a clearing in a wooded area which has grassy vegetation. Coker's Landfill No. 2 is on a 15 acre tract on the south side of County Route 152. Several hundred feet of wooded area separate the cleared site from the main road to the north. The site is covered with grass and is surrounded by trees except to the west where Coker's Landfill No. 2 site is bordered by a ravine/swamp area.

1.B Nature and Extent of Problem

As listed in Section 1.A, the initial response action to the Coker's Landfills No. 1 and No. 2 was an EPA site investigation

in 1980. Subsequent site investigations are also listed in Section 1.A.

The dates of sampling, list of parameters analyzed and EPA contractors conducting the site investigations has varied. In addition, a large amount of data generated by the potentially responsible parties (PRPs) during and after cessation of the landfills exists. ERM has prepared a comprehensive data summary of all the EPA sanctioned sampling events. Tables have been constructed (Table No.'s 1-1, 1-2, 1-3 and 1-4) which provide the historic monitoring record for each specific constituent. These tables are included in the following discussion.

Principal constituents that have been detected in these investigations include acrolein which was detected in both on-site waste samples and in Monitoring Well 5 of Coker's Landfill No.2. Ethylbenzene was detected in leachate samples from Coker's No. 1 and in a sample collected from Monitoring Well 5 at Coker's No. 2. High concentrations of iron were detected in ground water and leachate during the various samplings and have also been found in the waste sludge.

EPA waste characterization analyses performed in January 1981 on latex waste material similar to that landfilled at the Coker's Landfill No. 2 indicated that the wastes did not exhibit ignitability, corrosivity, reactivity or EP toxicity. Typical latex waste generated for landfill disposal after dewatering consisted of 70 percent water, 20 percent organics (latex rubber) and 10 percent inorganics (calcium carbonate). As specified in the DNREC permit for Coker's No. 2, the leachate from these

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TABLE 1-1
Coker's Landfill No. 1
Site Investigation Data - Organics
All Results ug/l (ppb) - blank = none detected

Location	Sample Type	Sample Date	Sampler	Laboratory	4 nitrophenol	bis-2-ethylhexyl phthalate	di-n-butyl phthalate	benzene
Willis Branch - Downstream	SW	3/27/80	EPA	WCTS				
	SW	3/4/83	NUS	WCTS		9B		
	SW	3/4/83	NUS	WCTS				
	SW	8/15/85	Weston	Anal Tech				
	SD	8/15/85	Weston	Anal Tech		1379D	780B	1032E
Unamed Willis Branch - Downstream	SW	3/3/83	NUS	WCTS				
	SD	3/3/83	NUS	WCTS				
Willis Branch - Upstream	SW	3/27/80	EPA	WCTS				
	SW	3/3/83	NUS	WCTS				
	SD	3/3/83	NUS	WCTS				
	SW	8/15/85	Weston	Anal Tech		9E		
	SD	8/15/85	Weston	Anal Tech			2550B	6900
Leachate Seep	LE	3/27/80	EPA	EPA	20			
	LE	3/4/83	NUS	WCTS		4B		
Willis Branch-West Side	SW	8/12/80	EE	Mead Tech				
Willis Branch - North Side	SW	8/12/80	EE	Mead Tech				
Willis Branch - East Side	SW	8/12/80	EE	Mead Tech				
A. Armstrong Well	GW	3/2/83	NUS	WCTS				
G. Kowinsky Well	GW	3/2/83	NUS	WCTS				
	GW	8/15/85	Weston	Anal Tech				
F. Kowinsky Well	GW	3/2/83	NUS	WCTS				
	GW	8/15/85	Weston	Anal Tech				
W. Lewis Well	GW	3/3/83	NUS	WCTS				
Lomax Well	GW	8/15/85	Weston	Anal Tech				
Coker 1A Soil	SL	8/15/85	Weston	Anal Tech		396D		
Coker 1B Soil	SL	8/15/85	Weston	Anal Tech		396B	1140B	
Coker 1C Soil	SL	8/15/85	Weston	Anal Tech		180B		

Abbreviations

EE - Ecology and Environment	SW-Surface Water
NUS - NUS Corporation	GW-Ground Water
Weston - Roy F. Weston Inc.	SD-Sediment
WCTS - West Coast Tech. Serv.	SL-Soil
Mead Tech - Mead Technology	LE-Leachate
Anal Tech - Analytical Technology	

Qualifiers

B - as compound found in blanks. Its presence in the sample is questionable.
E - compound is present in sample. Numerical value of result is an estimate.

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TABLE 1-1
(Continued)

Location	Sample Type	Sample Date	Sampler	Laboratory	1,1,1 trichloroethane	methylene chloride	toluene	alpha BHC	pentachlorophenol
Willis Branch - Downstream	SW	3/27/80	EPA	WCTS					
	SW	3/4/83	NUS	WCTS		10B			
	SW	3/4/83	NUS	WCTS	16B	68B			
	SW	8/15/85	Weston	Anal Tech		22B			
	SD	8/15/85	Weston	Anal Tech			204E		
Unamed Willis Branch - Downstream	SW	3/3/83	NUS	WCTS		15B			
	SD	3/3/83	NUS	WCTS	13B	39B			
Willis Branch - Upstream	SW	3/27/80	EPA	WCTS					
	SW	3/3/83	NUS	WCTS		15B			
	SD	3/3/83	NUS	WCTS	24B	63B			
	SW	8/15/85	Weston	Anal Tech		45B			
	SD	8/15/85	Weston	Anal Tech		5100B	2340D		
Leachate Seep	SW	3/27/80	EPA	EPA					
	SW	3/4/83	NUS	WCTS		9B		0.2B	10E
Willis Branch-West Side	SW	8/12/80	EE	Mead Tech					
Willis Branch - North Side	SW	8/12/80	EE	Mead Tech					
Willis Branch - East Side	SW	8/12/80	EE	Mead Tech					
A. Armstrong Well	GW	3/2/83	NUS	WCTS		13B			
G. Kowinsky Well	GW	3/2/83	NUS	WCTS		12B			
	GW	8/15/85	Weston	Anal Tech					
F. Kowinsky Well	GW	3/2/83	NUS	WCTS		12B			
	GW	8/15/85	Weston	Anal Tech					
W. Lewis Well	GW	3/3/83	NUS	WCTS		12B			
Lomax Well	GW	8/15/85	Weston	Anal Tech		72B			
Coker 1A Soil	SL	8/15/85	Weston	Anal Tech		9B			
Coker 1B Soil	SL	8/15/85	Weston	Anal Tech		11B			
Coker 1C Soil	SL	8/15/85	Weston	Anal Tech		29B			

Abbreviations

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WCTS - West Coast Tech. Serv.	SL-Soil
Mead Tech - Mead Technology	LE-Leachate
Anal Tech - Analytical Technology	

Qualifiers

B-This compound found in blanks. Its presence in the sample is questionable.
E-Compound is present in sample. Numerical value of result is an estimate.

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TABLE 1-1
(Continuted)

Location	Sample Type	Sample Date	Sampler	Laboratory	acetone	2 butanone	benzoic acid	ethyl benzene	butyl benzyl phthalate	xylenes
Willis Branch - Downstream	SW	3/27/80	EPA	WCTS						
	SW	3/4/83	NUS	WCTS						
	SW	3/4/83	NUS	WCTS		54B				
	SW	8/15/85	Weston	Anal Tech						
	SD	8/15/85	Weston	Anal Tech	775E			213E		671E
Unamed Willis Branch - Downstream	SW	3/3/83	NUS	WCTS		27B				
	SD	3/3/83	NUS	WCTS		54B				
Willis Branch - Upstream	SW	3/27/80	EPA	WCTS						
	SW	3/3/83	NUS	WCTS	16B	12B				
	SD	3/3/83	NUS	WCTS		54B				
	SW	8/15/85	Weston	Anal Tech					9B	
	SD	8/15/85	Weston	Anal Tech	996DB	5460D		3000		7000E
Leachate Seep	SW	3/27/80	EPA	EPA						
	SW	3/4/83	NUS	WCTS	19D					
Willis Branch-West Side	SW	8/12/80	EE	Mead Tech						
Willis Branch - North Side	SW	8/12/80	EE	Mead Tech						
Willis Branch - East Side	SW	8/12/80	EE	Mead Tech						
A. Armstrong Well	GW	3/2/83	NUS	WCTS	30B	8B				
G. Kowinsky Well	GW	3/2/83	NUS	WCTS		10B				
	GW	8/15/85	Weston	Anal Tech					6B	
F. Kowinsky Well	GW	3/2/83	NUS	WCTS	10B		3E			
	GW	8/15/85	Weston	Anal Tech						
W. Lewis Well	GW	3/3/83	NUS	WCTS						
Lomax Well	GW	8/15/85	Weston	Anal Tech						
Coker 1A Soil	SL	8/15/85	Weston	Anal Tech						
Coker 1B Soil	SL	8/15/85	Weston	Anal Tech						
Coker 1C Soil	SL	8/15/85	Weston	Anal Tech			2082E		180B	

Abbreviations

EE - Ecology and Environment	SW-Surface Water
NUS - NUS Corporation	GW-Ground Water
Weston - Roy F. Weston Inc.	SD-Sediment
WCTS - West Coast Tech. Serv.	SL-Soil
Mead Tech - Mead Technology	LE-Leachate
Anal Tech - Analytical Technology	

Qualifiers

B-This compound found in blanks. Its presence in the sample is questionable.
E-Compound is present in sample. Numerical value of result is an estimate.

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TABLE 1-1
(Continued)

Location	Sample Type	Sample Date	Sampler	Laboratory	trans-1,2-dichloroethene	trichloroethene	tetrachloroethene	benzyl alcohol
Willis Branch - Downstream	SW	3/27/80	EPA	WCTS				
	SW	3/4/83	NUS	WCTS				
	SW	3/4/83	NUS	WCTS				
	SW	8/15/85	Weston	Anal Tech				
	SD	8/15/85	Weston	Anal Tech				
Unamed Willis Branch - Downstream	SW	3/3/83	NUS	WCTS				
	SD	3/3/83	NUS	WCTS				
Willis Branch - Upstream	SW	3/27/80	EPA	WCTS				
	SW	3/3/83	NUS	WCTS				
	SD	3/3/83	NUS	WCTS				
	SW	8/15/85	Weston	Anal Tech				28E
	SD	8/15/85	Weston	Anal Tech	1200J	6600	6000	
Leachate Seep	SW	3/27/80	EPA	EPA				
	SW	3/4/83	NUS	WCTS				
Willis Branch-West Side	SW	8/12/80	EE	Mead Tech				
Willis Branch - North Side	SW	8/12/80	EE	Mead Tech				
Willis Branch - East Side	SW	8/12/80	EE	Mead Tech				
A. Armstrong Well	GW	3/2/83	NUS	WCTS				
G. Kowinsky Well	GW	3/2/83	NUS	WCTS				
	GW	8/15/85	Weston	Anal Tech				
F. Kowinsky Well	GW	3/2/83	NUS	WCTS				
	GW	8/15/85	Weston	Anal Tech				
W. Lewis Well	GW	3/3/83	NUS	WCTS				
Lomax Well	GW	8/15/85	Weston	Anal Tech				
Coker 1A Soil	SL	8/15/85	Weston	Anal Tech				
Coker 1B Soil	SL	8/15/85	Weston	Anal Tech				
Coker 1C Soil	SL	8/15/85	Weston	Anal Tech				

Abbreviations

EE - Ecology and Environment	SW-Surface Water
NUS - NUS Corporation	GW-Ground Water
Weston - Roy F. Weston Inc.	SD-Sediment
WCTS - West Coast Tech. Serv.	SL-Soil
Mead Tech - Mead Technology	LE-Leachate
Anal Tech - Analytical Technology	

Qualifiers

B-This compound found in blanks. Its presence in the sample is questionable.
E-Compound is present in sample. Numerical value of result is an estimate.

300044

TABLE 1-1
(Continued)

Location	Sample Type	Sample Date	Sampler	Laboratory	di-n-octyl phthalate	bis-2-chloroethyl ether
Willis Branch - Downstream	SW	3/27/80	EPA	WCTS		
	SW	3/4/83	NUS	WCTS		
	SW	3/4/83	NUS	WCTS		
	SW	8/15/85	Weston	Anal Tech		
	SD	8/15/85	Weston	Anal Tech		
Unamed Willis Branch - Downstream	SW	3/3/83	NUS	WCTS		
	SD	3/3/83	NUS	WCTS		
Willis Branch - Upstream	SW	3/27/80	EPA	WCTS		
	SW	3/3/83	NUS	WCTS		
	SD	3/3/83	NUS	WCTS		
	SW	8/15/85	Weston	Anal Tech	5B	
	SD	8/15/85	Weston	Anal Tech		
Leachate Seep	SW	3/27/80	EPA	EPA		
	SW	3/4/83	NUS	WCTS		28
Willis Branch-West Side	SW	8/12/80	EE	Mead Tech		
Willis Branch - North Side	SW	8/12/80	EE	Mead Tech		
Willis Branch - East Side	SW	8/12/80	EE	Mead Tech		
A. Armstrong Well	GW	3/2/83	NUS	WCTS		
G. Kowinsky Well	GW	3/2/83	NUS	WCTS		
	GW	8/15/85	Weston	Anal Tech		
F. Kowinsky Well	GW	3/2/83	NUS	WCTS		
	GW	8/15/85	Weston	Anal Tech		
W. Lewis Well	GW	3/3/83	NUS	WCTS		
Lomax Well	GW	8/15/85	Weston	Anal Tech		
Coker 1A Soil	SL	8/15/85	Weston	Anal Tech		
Coker 1B Soil	SL	8/15/85	Weston	Anal Tech		
Coker 1C Soil	SL	8/15/85	Weston	Anal Tech		

Abbreviations

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Mead Tech - Mead Technology	LE-Leachate
Anal Tech - Analytical Technology	

Qualifiers

B-This compound found in blanks. Its presence in the sample is questionable.
E-Compound is present in sample. Numerical value of result is an estimate.

300045

TABLE 1-2
Coker's Landfill No. 2
Site Investigation Data - Organics
All Results ug/l (ppb) - blank = none detected

Section: 1
Revision No.: 2
Date: 19 June 1987
Page: 20 of 35

Location	Sample Type	Sample Date	Sampler	Laboratory	bis-2-ethylhexyl phthalate	di-n-butyl phthalate	benzene	1,1,1 trichloroethane
Monitoring Well 1	GW	3/27/80	EPA	WCTS				
	GW	3/3/83	NUS	WCTS				
	GW	8/14/85	Weston	Anal Tech	5B			
Monitoring Well 2	GW	3/3/83	NUS	WCTS				
	GW	8/14/85	Weston	Anal Tech	20B			
Monitoring Well 3	GW	8/14/85	Weston	Anal Tech				
Monitoring Well 4	GW	8/14/85	Weston	Anal Tech				
Monitoring Well 5	GW	3/27/80	EPA	EPA	10			
	GW	3/3/83	NUS	WCTS				
Monitoring Well 6	GW	8/15/85	Weston	Anal Tech	8B			
Leachate Pit 2	LE	3/27/80	EPA	EPA			14	
Trib. of Wills Br. N of Coker's 2	SW	3/27/80	EPA	Anal Tech	13			
	SW	8/12/80	EE	Mead Tech				
	SW	8/15/85	Weston	Anal Tech				
	SW	8/15/85	Weston	Anal Tech	620E	2840B		
Unnamed Wills Branch Upstream	SW	3/3/83	NUS	WCTS				
	SD	3/3/83	NUS	WCTS				17B
G. Carney Well	GW	8/12/80	EE	Mead Tech				
G. Kowinsky Well	GW	8/12/80	EE	Mead Tech				
J. Kowinsky Well	GW	8/12/80	EE	Mead Tech				
Coker 2A Soil	SL	8/15/85	Weston	Anal Tech	1360B	800B		
Coker 2B Soil	SL	8/15/85	Weston	Anal Tech	860B	770B		
Coker 2C Soil	SL	8/15/85	Weston	Anal Tech	1386D	462B		

Abbreviations
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Mead Tech - Mead Technology
Anal Tech - Analytical Technology

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SD-Sediment
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LE-Leachate

Qualifiers
B-This compound found in blanks. Its presence in the sample is questionable.
E-Compound is present in sample. Numerical value of result is an estimate.

300046

TABLE 1-2
(Continued)

Location	Sample Type	Sample Date	Sampler	Laboratory	methylene chloride	phenol	acetone	2 butanone	ethyl bazene	butyl benzyl phtalate
Monitoring Well 1	GW	3/27/80	EPA	WCTS	2146					
	GW	3/3/83	NUS	WCTS	770		200	12B		
	GW	8/14/85	Weston	Anal Tech						5B
Monitoring Well 2	GW	3/3/83	NUS	WCTS			1300			
	GW	8/14/85	Weston	Anal Tech	24B					
Monitoring Well 3	GW	8/14/85	Weston	Anal Tech	43B					18B
Monitoring Well 4	GW	8/14/85	Weston	Anal Tech	61B				1037	
Monitoring Well 5	GW	3/27/80	EPA	EPA	6543	52				
	GW	3/3/83	NUS	WCTS	20B		760	13B	17	
					36B				111	
Monitoring Well 6	GW	8/15/85	Weston	Anal Tech	122B		8B		391	7B
Leachate Pit 2	LE	3/27/80	EPA	EPA	1607	1088			3897	
Trib. of Wilis Br. N of Coker's 2	SW	3/27/80	EPA	Anal Tech	10				10	
	SW	8/12/80	EE	Mead Tech						
	SW	8/15/85	Weston	Anal Tech						
	SW	8/15/85	Weston	Anal Tech	3900B		25650B	71300		
Unnamed Wilis Branch Upstream	SW	3/3/83	NUS	WCTS	18B		35B	23B		
	SD	3/3/83	NUS	WCTS	52B			57B		
G. Carney Well	GW	8/12/80	EE	Mead Tech						
G. Kowinsky Well	GW	8/12/80	EE	Mead Tech				10B		
J. Kowinsky Well	GW	8/12/80	EE	Mead Tech						
Coker 2A Soil	SL	8/15/85	Weston	Anal Tech	14B		58B			
Coker 2B Soil	SL	8/15/85	Weston	Anal Tech	56B		123B			
Coker 2C Soil	SL	8/15/85	Weston	Anal Tech	300B		604			

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Mead Tech - Mead Technology	LE-Leachate
Anal Tech - Analytical Technology	

Qualifiers

B-This compound found in blanks. Its presence in the sample is questionable.
E-Compound is present in sample. Numerical value of result is an estimate.

30 00466

TABLE 1-2
(Continued)

Location	Sample Type	Sample Date	Sampler	Laboratory	acrolein	1,2 trans dichloro ethyl ether	trichlorofluoromethane	tetrachloroethane
Monitoring Well 1	GW	3/27/80	EPA	WCTS				
	GW	3/3/83	NUS	WCTS				
	GW	8/14/85	Weston	Anal Tech				
Monitoring Well 2	GW	3/3/83	NUS	WCTS				
	GW	8/14/85	Weston	Anal Tech				
Monitoring Well 3	GW	8/14/85	Weston	Anal Tech				
Monitoring Well 4	GW	8/14/85	Weston	Anal Tech				
Monitoring Well 5	GW	3/27/80	EPA	EPA	1278		399	
	GW	3/3/83	NUS	WCTS				
Monitoring Well 6	GW	8/15/85	Weston	Anal Tech				
Leachate Pit 2	LE	3/27/80	EPA	EPA	2128	14	10	10
Trib. of Wills Br. N. of Coker's 2	SW	3/27/80	EPA	Anal Tech	22			
	SW	8/12/80	EE	Mead Tech				
	SW	8/15/85	Weston	Anal Tech				
	SW	8/15/85	Weston	Anal Tech				
Unnamed Willis Branch Upstream	SW	3/3/83	NUS	WCTS				
	SD	3/3/83	NUS	WCTS				
G. Carney Well	GW	8/12/80	EE	Mead Tech				
G. Kowinsky Well	GW	8/12/80	EE	Mead Tech				
J. Kowinsky Well	GW	8/12/80	EE	Mead Tech				
Coker 2A Soil	SL	8/15/85	Weston	Anal Tech				
Coker 2B Soil	SL	8/15/85	Weston	Anal Tech				
Coker 2C Soil	SL	8/15/85	Weston	Anal Tech				

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Mead Tech - Mead Technology	LE-Leachate
Anal Tech - Analytical Technology	

Qualifiers

a This compound found in blanks. Its presence in the sample is questionable.
: Compound is present in sample. Numerical value of result is an estimate.

300047

Table 1-2
(Continued)

Location	Sample Type	Sample Date	Sampler	Laboratory	toluene
Monitoring Well 1	GW	3/27/80	EPA	WCTS	
	GW	3/3/83	NUS	WCTS	
	GW	8/14/85	Weston	Anal Tech	
Monitoring Well 2	GW	3/3/83	NUS	WCTS	
	GW	8/14/85	Weston	Anal Tech	
Monitoring Well 3	GW	8/14/85	Weston	Anal Tech	
Monitoring Well 4	GW	8/14/85	Weston	Anal Tech	
Monitoring Well 5	GW	3/27/80	EPA	EPA	
	GW	3/3/83	NUS	WCTS	
Monitoring Well 6	GW	8/15/85	Weston	Anal Tech	
Leachate Pit 2	LE	3/27/80	EPA	EPA	51
Trib. of Willis Br. N of Coker's 2	SW	3/27/80	EPA	Anal Tech	
	SW	8/12/80	EE	Mead Tech	
	SW	8/15/85	Weston	Anal Tech	
	SW	8/15/85	Weston	Anal Tech	
Unnamed Willis Branch Upstream	SW	3/3/83	NUS	WCTS	
	SD	3/3/83	NUS	WCTS	
G. Carney Well	GW	8/12/80	EE	Mead Tech	
G. Kowinsky Well	GW	8/12/80	EE	Mead Tech	
J. Kowinsky Well	GW	8/12/80	EE	Mead Tech	
Coker 2A Soil	SL	8/15/85	Weston	Anal Tech	
Coker 2B Soil	SL	8/15/85	Weston	Anal Tech	
Coker 2C Soil	SL	8/15/85	Weston	Anal Tech	

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Mead Tech - Mead Technology	LE-Leachate
Anal Tech - Analytical Technology	

Qualifiers

B-This compound found in blanks. Its presence in the sample is questionable.
E-Compound is present in sample. Numerical value of result is an estimate.

300048

TABLE 1-3
Coker's Landfill No.
Site Investigation Data - Inorganics
All Results ug/l (ppb) - blank = none detected

Section:
Revision No.: 1 2
Date: 19 June 198
Page: 24 of 35

Location	Sample Type	Sample Date	Sampler	Laboratory	Zn	Fe	Pb	Mn	As	Hg	Al	Cr	Ba	Cd	Cu	B	Se	An
Willis Branch - Downstream	SW	3/27/80	EPA	EPA								4	60					
	SW	8/12/80	EE	Versar		2300		120			2390		112			48		
	SW	3/4/83	NUS	Callabs	13	380B		56			280B					460B		
	SD	3/4/83	NUS	Callabs	3.3	720	0.8	54			330		7			18		1.7
	SW	8/15/85	Weston	RMA	15B	1550		136			291		60		13B			
	SD	8/15/85	Weston	RMA	15	5020	2.9	47			3110	6	23					
Unamed Willis Branch - Downstream	SW	3/3/83	NUS	Callabs		500		73			640B					440B		
	SD	3/3/83	NUS	Callabs	4.3	500	2.3	15			315			0.13B		20B		
Willis Branch - Upstream	SW	3/27/80	EPA	EPA								3						
	SW	3/3/83	NUS	Callabs		460		40			400B					430B		
	SD	3/3/83	NUS	Callabs	1.4	725	.32B	3.8			600	2.8			5	20B		
	SW	8/15/85	Weston	RMA	15B	1200	3.4B	73			587		68		5.8B			
	SD	8/15/85	Weston	RMA	6.7	1650		7.5			1370		10					
Leachate Seep	LE	3/27/80	EPA	EPA			16		5			4	600					
	LE	3/4/83	NUS	Callabs	150	102000		11000			460B		2100			760B		
Willis Branch - West Side	SW	8/12/80	EE	Versar		862		70			825							
Willis Branch - North Side	SW	8/12/80	EE	Versar		1010	54	83			898							
Willis Branch - East Side	SW	8/12/80	EE	Versar		1500	439	103			1220							
A. Armstrong Well	GW	3/2/83	NUS	Callabs		1300		98						2.5B	110	760B	2.3	
G. Kowinsky Well	GW	3/2/83	NUS	Callabs		1500		54							99	1200B	4.7	
	GW	8/15/85	Weston	RMA	35B	2950		61							5.3B			
F. Kowinsky Well	GW	3/2/83	NUS	Callabs	84	790		130			1900				120	620B		
	GW	8/15/85	Weston	RMA	13B	407		44							8.2B			
W. Lewis Well	GW	3/3/83	NUS	Callabs	25	2000		180								430B		
Lomex Well	GW	8/15/85	Weston	RMA	225	110B		72			779		5.3		24B			
Coker 1A Soil	SL	8/15/85	Weston	RMA	18	8430	5.9	42			10200	11	28		4.7			
Coker 1B Soil	SL	8/15/85	Weston	RMA	21	16000	6.7	38	3.8B		7970	17	19		4.9			
Coker 1C Soil	SL	8/15/85	Weston	RMA	24	9870	8	217		0.1	8620	9.1	14		5.2			

Abreviations
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NUS - NUS Corporation
Weston - Roy F. Weston Inc.
bs - Calif. Anal. Laboratories
- Versar Inc.
Rocky Mtn. Analytical

SW-Surface Water
GW-Ground Water
SD-Sediment
SL-Soil
LE-Leachate

ers
compound found in blanks. Its presence in the sample is questionable.
pound is present in sample. Numerical value of result is an estimate.

300049

Table 1-1
(Continued)

Location	Sample Type	Sample Date	Sampler	Laboratory	Ca	Ba	Co	Mg	K	Na	Ni	Vd	Ag
Willis Branch - Downstream	SW	3/27/80	EPA	EPA									
	SW	8/12/80	EE	Versar	9910							11	
	SW	3/4/83	NUS	Cal Labs									
	SD	3/4/83	NUS	Cal Labs									
	SW	8/15/85	Weston	RMA	25700			4820	2280	4780			
	SD	8/15/85	Weston	RMA	453	0.2	2.8	309			4.3	2.7	
Unamed Willis Branch - Downstream	SW	3/3/83	NUS	Cal Labs									
	SD	3/3/83	NUS	Cal Labs									
Willis Branch - Upstream	SW	3/27/80	EPA	EPA									
	SW	3/3/83	NUS	Cal Labs									
	SD	3/3/83	NUS	Cal Labs									
	SW	8/15/85	Weston	RMA	27500			2710	1640	5210		4.7	
	SD	8/15/85	Weston	RMA	326	3000						3.4	
													0.6
Leachate Seep	LE	3/27/80	EPA	EPA									
	LE	3/4/83	NUS	Cal Labs									
Willis Branch - West Side	SW	8/12/80	EE	Versar									
Willis Branch - North Side	SW	8/12/80	EE	Versar									
Willis Branch - East Side	SW	8/12/80	EE	Versar									
A. Armstrong Well	GW	3/2/83	NUS	Cal Labs									
G. Kowinsky Well	GW	3/2/83	NUS	Cal Labs									
	GW	8/15/85	Weston	RMA	18300J			1230	999	2860			
F. Kowinsky Well	GW	3/2/83	NUS	Cal Labs									
	GW	8/15/85	Weston	RMA	37300E			1050	1090	3180			
W. Lewis Well	GW	3/3/83	NUS	Cal Labs									
Lomax Well	GW	8/15/85	Weston	RMA	13400J	0.7	14	14000	3000	8510	19		
Coker 1A Soil	SL	8/15/85	Weston	RMA	612	0.29	2.9	713			5.3	18	1.6
Coker 1B Soil	SL	8/15/85	Weston	RMA	208	0.41	3.4	724			5.5	20	
Coker 1C Soil	SL	8/15/85	Weston	RMA	1260	0.37	4.1	648			7.1	14	

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Cal Labs - Calif. Anal. Laboratories	SL-Soil
Versar - Versar Inc.	LE-Leachate
RMA - Rocky Mtn. Analytical	

Qualifiers

B-This compound found in blanks. Its presence in the sample is questionable.
E-Compound is present in sample. Numerical value of result is an estimate.

300056

TABLE 1-4
Coker's Landfill No. 2
Site Investigation Data - Inorganics
All Results ug/l (ppb) - blank = none detected

Section: 1
Revision No.: 2
Date: 19 June 1987
Page: 26 of 35

Location	Sample Type	Sample Date	Sampler	Laboratory	Zn	Fe	Pb	Mn	As	Hg	Al	Cr	Ba	Cd	Co	Bo	Se
Monitoring Well 1	GW	3/27/80	EPA	EPA			31		4			15	160				
	GW	3/3/83	NUS	Cal Labs	17	5100		320			4100		170			500B	2.6
	GW	8/14/85	Weston	RMA	26B	11600	6.8B	203			2540	12	60		3.5B		
Monitoring Well 2	GW	3/3/83	NUS	Cal Labs	38	630		58			290B					490B	5.7
	GW	8/14/85	Weston	RMA	29B	2500		35			904	4.9			6.3B		
Monitoring Well 3	GW	8/14/85	Weston	RMA	275	241000	9B	472	155	0.84	83300	246	731	18	304		
Monitoring Well 4	GW	8/14/85	Weston	RMA	57	85700	10B	862			9200	20	236	10	101		
Monitoring Well 5	GW	3/27/80	EPA	EPA			1		3.5				111				
	GW	3/3/83	NUS	Cal Labs	22	41000		1800			3600					1000B	
	GW	8/14/85	Weston	RMA	108	116000	53	1160		0.23	38400	50	225	8.8	169		
Monitoring Well 6	GW	8/15/85	Weston	RMA	90	69900	18B	319		0.89	39400	51	301	6	125		
Leachate Pit 2	LE	3/27/80	EPA	EPA					30			10	65				
Trib. of Willis Br. N of Coker's 2	SW	3/27/80	EPA	RMA					3			3	64				
	SW	8/12/80	EE	Versar	10	2300	40	120	10		2390	10	112				
	SW	8/15/85	Weston	RMA	51	4350	5.5	1.75	4		1260		72		10B		
	SD	8/15/85	Weston	RMA	28	3190	38	24	6.7E		2730	3.3	23		2.4		
Unnamed Willis Branch Upstream	SW	3/3/83	NUS	Cal Labs		390B		47			430B					490B	
	SD	3/3/83	NUS	Cal Labs	1.7	550		3.3			450		7			20B	
G. Carney Well	GW	8/12/80	EE	Versar				22									
G. Kowinsky Well	GW	8/12/80	EE	Versar	17	1950		50								10	
J. Kowinsky Well	GW	8/12/80	EE	Versar		486		38	10							16	
Coker 2A Soil	SL	8/15/85	Weston	Cal Labs	18	11900	7.3	57			8160	8.4	31		4.5		
Coker 2B Soil	SL	8/15/85	Weston	Cal Labs	31	12900	8.2	54	2.1B		11500	14	47		6.7		
Coker 2C Soil	SL	8/15/85	Weston	Cal Labs	21	11500	6.3	112	2.1B		12400	11	53		6.2		

Abreviations

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Versar - Versar Inc.	LE-Leachate
RMA - Rocky Mtn. Analytical	

Qualifiers

B-This compound found in blanks. Its presence in the sample is questionable.
E-Compound is present in sample. Numerical value of result is an estimate.

3000 54

TABLE 1-4
(Continued)

Location	Sample Type	Sample Date	Sampler	Laboratory	An	Ca	Be	Co	Mg	K	Na	Ni	Vd	Ag
Monitoring Well 1	GW	3/27/80	EPA	EPA										
	GW	3/3/83	NUS	Cal Labs										
	GW	8/14/85	Weston	RMA		4520E	0.5	5.6	3180	1390	9820		6.5	
Monitoring Well 2	GW	3/3/83	NUS	Cal Labs										
	GW	8/14/85	Weston	RMA		36200			1140	1330	3350		4.8	
Monitoring Well 3	GW	8/14/85	Weston	RMA	35	5620	17	39	14400	6920	14800	47	200	20
Monitoring Well 4	GW	8/14/85	Weston	RMA		23600	1.3	18	15600	3000	19100	12	30	10
Monitoring Well 5	GW	3/27/80	EPA	EPA										0.5
	GW	3/3/83	NUS	Cal Labs										
	GW	8/14/85	Weston	RMA		31140	3.4	141	5160	2610	15500	29	83	11
Monitoring Well 6	GW	8/15/85	Weston	RMA		2140	3.4	24	3670	2120	14000	21	73	8.6
Leachate Pit 2	LE	3/27/80	EPA	EPA										
Trib. of Willis Br. N of Coker's 2	SW	3/27/80	EPA	RMA										
	SW	8/12/80	EE	Versar										
	SW	8/15/85	Weston	RMA		23800J	0.7	5.8	5788	1600	4050	12		
	SD	8/15/85	Weston	RMA		701	0.34						5.2	
Unnamed Willis Branch Upstream	SW	3/3/83	NUS	Cal Labs										
	SD	3/3/83	NUS	Cal Labs										
G. Carney Well	GW	8/12/80	EE	Versar		24300			1590					
G. Kowinsky Well	GW	8/12/80	EE	Versar		23600			1130					
J. Kowinsky Well	GW	8/12/80	EE	Versar		31500			1030					
Coker 2A Soil	SL	8/15/85	Weston	Cal Labs		1200	0.33	3.3	691			6.7	19	
Coker 2B Soil	SL	8/15/85	Weston	Cal Labs		1140	0.47	3.8	883			7.7	26	
Coker 2C Soil	SL	8/15/85	Weston	Cal Labs		1110	0.44	5.4	820			6.9	22	

Abreviations

EE - Ecology and Environment	SW-Surface Water
NUS - NUS Corporation	GW-Ground Water
Weston - Roy F. Weston Inc.	SD-Sediment
Cal Labs - Calif. Anal. Laboratories	SL-Soil
Versar - Versar Inc.	LE-Leachate
RMA - Rocky Mtn. Analytical	

Qualifiers

B-This compound found in blanks. Its presence in the sample is questionable.
E-Compound is present in sample. Numerical value of result is an estimate.

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wastes was sampled on a quarterly basis for total organic carbon (TOC), chemical oxygen demand (COD), total nitrogen, ammonia nitrogen, pH, total iron, specific conductivity, and albuminoid nitrogen (AN).

1.B.1 Major Constituents

This section presents a summary of the major constituents that were identified in previous EPA site investigation samplings. All the constituents identified have undergone a QA/QC review by the EPA or its respective contractors as being representative of the actual sample concentration.

Acrolein was detected in a Coker's No. 2 leachate sample taken in March of 1980 at 2128 ug/l and was also found in a sample taken from Coker's No. 2 Monitoring Well 5 in March of 1980 at 1278 ug/l. Subsequent samplings of these locations did not detect any measurable concentrations of acrolein. Ethylbenzene was detected in leachate samples taken at the Coker's No. 2 site in 1980 at 89 ug/l and was later detected in Coker's No. 2 Monitoring Well 4 at 1037 ug/l in 1985.

Bis-2-chloroethyl ether, mentioned as a site contaminant in the 1985 HRS score sheets, was detected at 28 ug/l in leachate emanating from Coker's 1 in 1983. It was not detected in any previous or subsequent leachate or ground water samplings.

Zinc was identified as a major inorganic contaminant in the 1985 HRS score sheet. From ERM's analysis of the historical monitoring data, zinc was found to be below the recommended

primary drinking water standard of 5.0 mg/l for all samplings from both landfills.

Iron was found to exceed the secondary drinking water standard of 0.3 mg/l (300 ug/l) in samplings of Monitoring Wells 4 and 5 at 85,700 and 116,000 ug/l respectively in 1985. It must be noted that the Columbia aquifer has been cited (O'Brien and Gere Engineers, 1982) as having a high iron content. An elevated iron content also was found in a 1980 sampling of leachate from the Coker's No.1 Landfill at 102,000 ug/l. Analysis of the latex wastes generated by the plant in 1972 showed elevated iron levels of 1500 to 2000 ppm. Plant correspondence reviewed for this report indicated that large amounts of ferric sulfate have been and are currently used as a coagulant for the plant's latex waste emulsions.

1.B.2 Other Constituents

A number of minor constituents that are chemicals of concern have been detected in the EPA samplings of the site. Many of the constituents cited in this section are suspect because of the laboratory quality control problems discussed in the site inspection QA/QC reports. These QA/QC problems make it difficult to assess which compounds are actually present at the Coker's Landfill. A brief summary of the constituents detected and the sampling locations are presented below.

Chloroform was detected in trace amounts in samples taken of the leachate and in Monitoring Well 5 at Coker's Landfill No. 2. Both of these samples had a chloroform content of 10 ug/l which

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is at the method detection limit for this constituent. Benzene and toluene were also found in the leachate sample taken from Coker's No.2 at levels of 14 and 51 ug/l respectively, but was not found in any monitoring well samples. Low amounts (10 ug/l) of carbon tetrachloride; 1,1 dichloroethylene; tetrachloroethylene and trichloroethylene were also detected in the Coker's No. 2 leachate. These compounds were all present at concentrations equal to their respective method detection limits.

A number of suspected common laboratory contaminants found in laboratory blanks are presented in the data tables. These contaminants include bis-2-ethyl hexyl phthalate, di-n-butyl phthalate, methylene chloride, acetone and 2-butanone.

1.B.3 Summary of Health and Environmental Effects

Based on the residential well analysis information provided in the EPA Region III June 27, 1980 Case Development Plan for Coker's Landfill No. 2 and an May 1986 memorandum from Jeffrey Lyberg, M.D., Acting Director, Office of Health Assessment for the State of Delaware to Charles J. Walters, Public Health Advisor for EPA Region III, no imminent health threat to the surrounding population is presented by the Coker's Landfill No. 1 and No. 2 sites. However, the reports cited a potential for site contaminants to migrate offsite to surface waters, to the water table aquifer (Columbia) and to the deeper regional aquifer (Cheswold) which supplies the City of Dover.

Environmental effects cited to date include leachate pools at Coker's Landfill No.1 and apparent ground water contamination in

the area of Monitoring Well 5 at Coker's Landfill No. 2, possibly because of a leaking liner in one of the disposal pits. The potential may exist for this contamination to migrate downward into the deeper regional aquifer.

1.C Site Visit

Following work plan approval by EPA, ERM personnel will conduct an initial site visit to become familiar with site topography, access routes, seep locations, existing well locations and proximity of receptors to possible contamination.

1.D Site Boundary Conditions

Tentative site boundaries have been defined on the basis of known waste disposal locations combined with disturbed area boundaries, surface water drainage areas, and shallow ground water drainage areas as evidenced by downgradient seeps. The extent of the site as defined by these boundaries may change depending on data gathered in the RI phase of work.

The boundary of the site in the area around Coker's Landfill No. 1 is shown on Figure 1-5. This boundary runs 50 feet to either side of the center of the access road from Route 152, runs 50 feet back and parallel to the treelines along the south and west sides of the cleared landfill area, and runs along the northern and eastern boundaries of the Schmidt property.

The boundary of the site in the area around Coker's Landfill No. 2 is shown on Figure 1-5. This boundary runs 50 feet back

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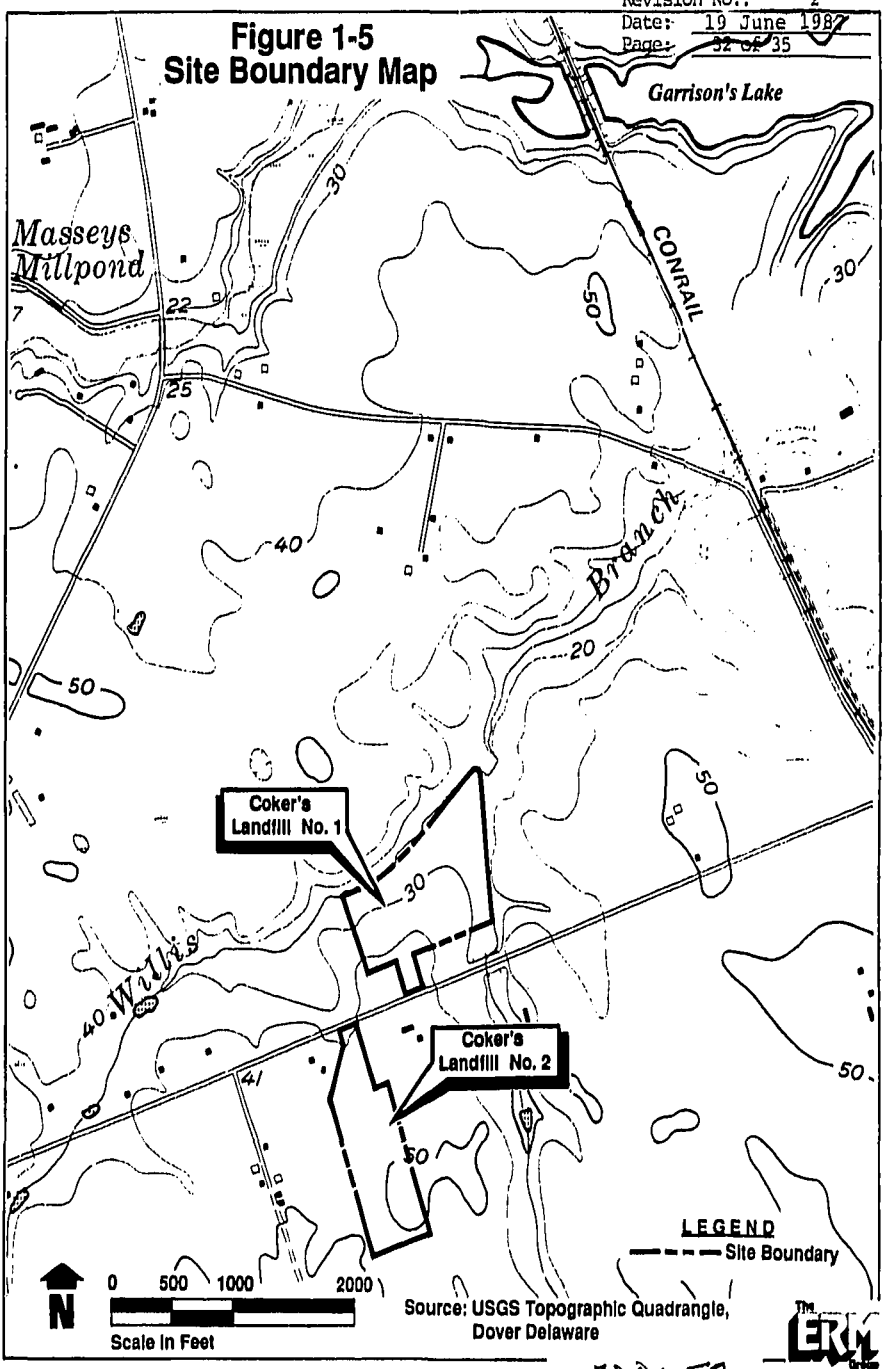
Figure 1-5
Site Boundary Map



Source: USGS Topographic Quadrangle, Dover Delaware

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and parallel to the property boundary of the area that was leased for the landfill on the east, west, and south sides, runs along the west bank of the drainage swale from the area's northwest corner out to Route 152 and runs parallel and 50 feet east form the center of the access road.

1.E Site Map

A base map will be prepared using aerial photographs obtained by flying the study area and a site survey to establish ground control for the aerial photos. All ground surveys will be conducted by professional surveyors. Bench marks will be selected in the site area to serve as control points for the establishment of locations and elevations of existing and new wells. The surveyors will produce a map of the site topography with a scale of 1 inch=100 feet and a contour interval of 1 foot. This map will also include the locations of wetlands, surface drainage, buildings, property lines, roadways, and the Conrail tracks.

Because the presence of foliage reduces the accuracy of topographic maps produced from an aerial survey, the aerial photography will be performed in late fall to early spring. If scheduling of the RI does not allow for this delay in preparation of the topographic base map, the map will be produced by a series of survey traverses over the sites.

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1.F Site Office

At present, there are no plans to establish a temporary site office. All operations will be performed from vehicles assigned to participating staff. An ERM van equipped with a mobile telephone, health and safety equipment, and other necessary items will serve as the field office. If additional equipment is needed, it can quickly be brought to the site from ERM's main office, which is located approximately 1.5 hours away in West Chester, Pennsylvania.

1.G Contractor Procurement

ERM will be responsible for the procurement of subcontractors necessary to provide certain of the services required for the remedial investigation and feasibility study.

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TASK 1
REFERENCES

Johnston, Richard H., 1973, Hydrology of the Columbia (Pleistocene) Deposits of Delaware: An Appraisal of a Regional Water Table Aquifer, Bull No. 14, Delaware Geological Survey, 79 p.

Johnston, R.H., and P.P. Leahy, 1977, Combined Use of Digital Aquifer Models and Field Base-Flow Data to Identify Recharge-Leakage Areas of Artesian Aquifers, Jour. Research U.S. Geol. Survey, Vol. 5, p. 491-496.

Letter from A.W. Martin Associates, Inc. to Carlton Coker, October 3, 1975.

Water System Feasibility Study for the town of Cheswold, Kent County, Delaware, O'Brien and Gere Engineers, Inc., September 1982. Report and Report Addendum.

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TASK 2

PLANS AND MANAGEMENT

2.A Objectives and Technical Approach

The objectives of the Remedial Investigation/Feasibility Study (RI/FS) are as follows:

- Determine the characteristics and locations of waste disposed on-site.

- Characterize and evaluate the soil, ground water, surface water, and stream sediment pathways for contaminant migration.

- Identify the impact on receptors and evaluate the available alternatives for remediation.

The data gathered during the remedial investigation will be used in the performance of both the endangerment assessment and the feasibility study. In order to achieve the objectives of the remedial investigation, a phased study will be performed. This approach will use data gathered in initial tasks to finalize the scope of later tasks. In addition, various screening techniques will be used as much as possible to help target problem areas

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early in the RI. This approach insures that the data required to perform the endangerment assessment and the feasibility study will be provided in a timely manner.

2.B Sampling Plan

This section presents the locations, types and numbers of samples to be taken, to be analyzed, and the rationale used in developing this sampling program. Sampling and investigatory procedures are discussed in Section 4 of the Quality Assurance Project Plan (QAPP) presented in Appendix A.

2.B.1 Review of Background Information

The background information collected during Task 1 will be examined to assist in placement of measurement points for the screening methods (i.e., soil gas and electromagnetic conductivity surveying). Special attention will be focused on anomalies observed during the site walkover and from the aerial photo chronology. The aerial photo chronology will also be used to help define the locations of the waste trenches in Landfill No. 1. Aerial photos for the aerial photo chronology will be supplied by EPA.

2.B.2 Electromagnetic Conductivity Surveying

An electromagnetic conductivity (EM) survey will be performed at both the Coker's Landfills No. 1 and No. 2. The EM survey will measure changes in the conductivity of subsurface materials in

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both the horizontal and vertical directions. The EM survey will be used as a screening method to achieve the following objectives:

- Identify the locations of the waste trenches in Landfill No. 1.

- Identify if any metallic objects are buried in Landfill No. 1.

- Identify any waste trenches or cells with abnormal conductivities which could signify a change in waste type.

- Identify any significant changes in ground water conductivity which may be indicative of a ground water contaminant plume.

- Confirm shallow site stratigraphy and water table configuration.

At Landfill No. 1, a grid of EM traverses with a spacing of 25 feet will be performed. The high density EM grid at Landfill No. 1 is necessary because the site history is less certain. Assuming a disposal area of about 50 feet by 25 feet, the statistical probability of detecting a disposal area with this grid size is 99 percent.

At Landfill No. 2, a minimum of four traverses will be made. Two of the traverses will be centered over the two rows of waste cells. The remaining two traverses will be oriented in an

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orthogonal direction to the first two traverses. Although Landfill No. 2 is very well documented, an EM survey is being conducted to confirm the absence of any metal objects. Additional traverses will be added as needed to fulfill the objectives stated in this subsection. The decision to perform additional traverses at Landfill No. 2 will be made in the field by the project geophysicist who will perform a preliminary analysis of the data collected from the initial four traverses.

At each landfill area, vertical EM measurements for determination of stratigraphy and water table depth will be made on a 200 foot grid. This initial spacing will be augmented by additional readings in areas where stratigraphy is determined to be different between measurement points.

A discussion of EM surveying procedures is included in the QAPP (Appendix A).

2.B.3 Soil Gas Surveying

Soil gas surveying to measure the total concentration of volatile organic compounds in the soil gas will be used as a second screening method for the RI. The objectives of the soil gas survey are as follows:

- Determine ambient air concentrations at the soil gas sampling locations to provide background levels of total volatile organic compounds (VOCs).

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- Determine the level of total VOCs in the soil gas immediately above waste cells or trenches and identify those waste cells or trenches with anomalously high total VOCs in the soil gas.

- Identify those areas away from waste cells or trenches which exhibit anomalously high levels of total VOCs in the soil gas.

As a secondary objective:

- Delineate any plumes in the water table aquifer from VOCs, if ground water concentrations are significant (ppm range) and if the soil is permeable enough to allow equilibration between any VOCs in the shallow ground water and soil gas above.

In Landfill No. 1, soil gas measurements will be obtained on a 50 foot grid. At Landfill No. 2 where there is good documentation of waste locations, soil gas measurements will be obtained on a 100 foot grid. An organic vapor analyzer (OVA) with a flame ionization detector (FID) will be used for measurements since an FID is more sensitive and can ionize a wider range of compounds as opposed to an OVA equipped with a photoionization detector (PID).

At all locations where a positive reading is obtained with the FID equipped OVA to be used for soil gas measurements, a second reading will be obtained with an OVA equipped with a PID. Because the FID detects methane and the PID doesn't, the

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difference in readings will provide a measurement of the amount of methane in the soil gas.

For positive readings of over 1 ppm for total VOCs minus methane, the distance between the grid point and the 4 surrounding grid points will be split and the split-spaced grid points sampled to determine the extent of the VOCs. Split spacing will be performed up to two times to provide sufficient definition of areas where VOCs are detected.

At both landfill areas, soil gas measurements will be obtained above the waste in each waste cell or trench. If a total VOC reading above the first standard deviation for cell readings for each landfill is obtained from above a cell, a second reading will be obtained from a point at least 2 feet from the first for repeatability and four additional readings will be obtained from soils adjacent to the four sides of the cell at distances of 5 feet from the edge to determine the lateral extent of the high VOC concentrations. Additional soil gas measurements will be obtained at any anomalies away from the waste cells or trenches identified from the electromagnetic conductivity survey and at any other points of concern identified during background data review.

A detailed discussion of soil gas procedures is presented in the QAPP (Appendix A).

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2.B.4 Waste Characterization

After delineation of waste trenches and cells at each landfill through examination of records, aerial photo chronology, and EM surveying, the waste at each landfill area will be sampled to achieve the following objectives:

- Confirm the physical nature of the waste at each landfill.

- Identify the compounds in the waste at each landfill area.

- Determine the leachability of the waste at each landfill area by EP toxicity analysis.

At a minimum, two randomly selected waste cells or trenches will be sampled at each landfill area. Sampling will be done by constructing test pits at each location. At Landfill No. 1, the test pits will extend from the top to the bottom of the waste and one or more composite samples will be obtained from each test pit by sampling every 2 feet. In Landfill No. 2, where existing waste characterization data are available, the test pits will be excavated to a maximum depth of 3 feet below the top of the waste to avoid perforating the lined cells. Less than 3 feet will be excavated if it is evident the liner's integrity may be breached because of the effect of such things as subsidence on cell dimensions, or for safety reasons. One or more composite samples will be obtained from each of the selected Landfill No. 2 test pits by sampling every 1.5 feet. Additional waste cells or

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trenches will be sampled for waste characterization if they are anomalous in terms of EM signature and/or total VOC readings from the soil gas above the waste location.

As part of waste characterization, leachate samples will be obtained from the waste in both landfill areas. Leachate will be obtained from the bottom of a test pit in Landfill No. 1 and leachate will be obtained from leachate removal pipes in Landfill No. 2, if sufficient sample is available. If leachate amounts are insufficient for analysis, sample results of the EP toxicity test will be used, although the test is designed for mixed wastes and not monofill as is the case at the Coker's site.

EPA and DNREC will be consulted for comment regarding any additional waste characterization sampling that may be determined to be necessary. A dicussion of waste sampling procedures is included in the QAPP (Appendix A).

2.B.5 Soil Sampling

The objectives of soil sampling are to:

- Determine background concentrations of organic and inorganic compounds being analyzed for in soils at the site.

- Identify and quantify any contaminants in the soils at targeted areas and anomalies

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- Determine the presence of any contaminants at random points away from waste trenches, cells and hot spots at the two landfill areas.

A minimum of six borings will be performed per landfill area on a grid layout to provide random sampling points at the perimeter of the landfill (Figures 2-1 and 2-2). A seventh boring will be performed by hand auger method at an upslope and upgradient location at each site to establish background soil conditions (See Figures 2-1 and 2-2). Additional borings will be performed at anomalies and other targets identified from background data and screening methods and which are located away from waste trenches and cells. Any strong EM anomalies which could indicate the presence of drums will be investigated by test pits rather than by borings.

Additional grid borings would be required if chemical compounds were detected in any grid boring at levels above those established in soil background sampling. The objective of any additional borings would be to establish the vertical and horizontal extent of the compounds in the soil above water table level. EPA and DNREC will be consulted regarding any additional soil sampling that may be determined to be necessary.

Borings will be drilled to the top of the water table. Below water table, ground water contamination becomes the primary concern because any ground water contamination would cause some amount of soil contamination. Characterization of ground water contamination will be accomplished through the network of monitoring wells and ground water sampling described in Section 2.B.6.

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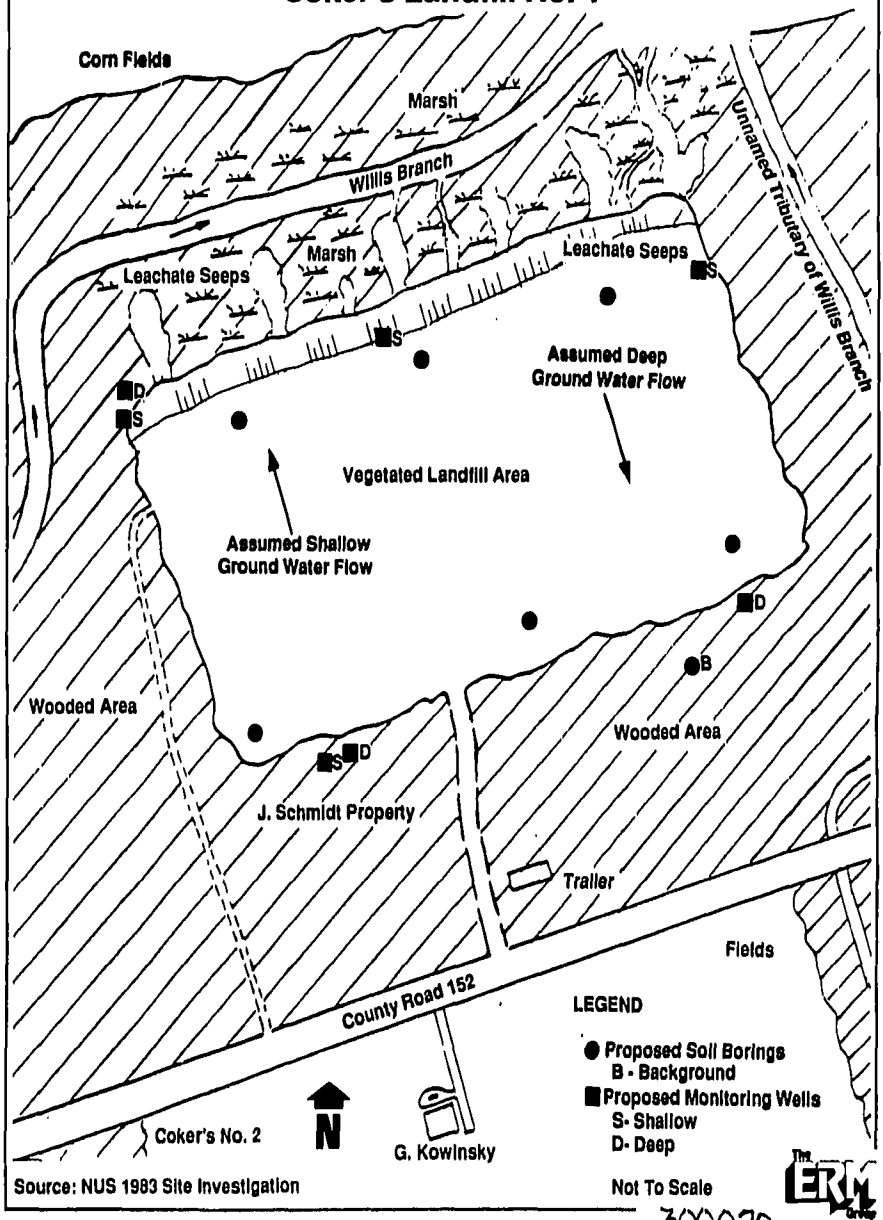
Figure 2-1
Monitoring Well and Soil Boring Locations
Coker's Landfill No. 1



Source: NUS 1983 Site Investigation

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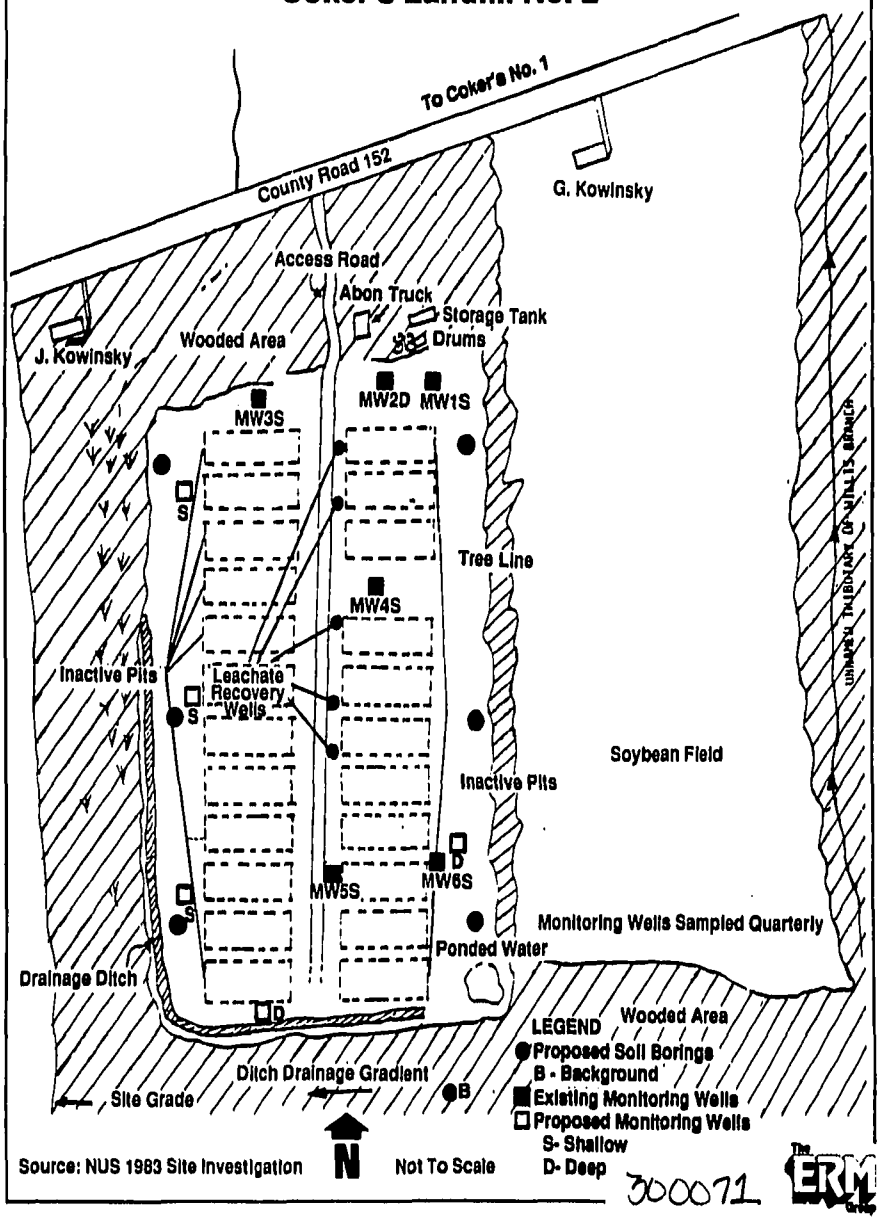
Figure 2-2
Monitoring Well and Soil Boring Locations
Coker's Landfill No. 2



Source: NUS 1983 Site Investigation

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Borings will be continuously sampled using the split spoon method (ASTM 1586). Duplicate samples will be obtained from each sampling interval. Samples will be screened for selection for laboratory analysis by measurement of the VOCs in the head gas of the duplicate combined with visual observation. In addition to samples selected for laboratory analysis on the basis of elevated VOC head space readings or discernable visual indications of contamination, a minimum of two samples will be submitted to the laboratory to establish vertical distribution of any contaminants present. Of these two samples, one will be taken from a depth of 3 feet and the other from a depth of 5 feet or one foot above the water table, whichever is deeper. If the water table is shallower than 5 feet, only the sample at a depth of 3 feet will be collected as a minimum. Above a depth of 3 feet, volatiles would be expected to be reduced by losses to the surface.

Boreholes will be grouted to surface upon completion. Cuttings from boreholes will be collected and containerized. Disposition of cuttings will be determined in consultation with DNREC on the basis of results from the samples collected from the borings. If soil is not classified as hazardous, it will be spread on site. The two background hand auger borings will be drilled to a depth of 3 feet or to water table, whichever is shallower. One sample will be obtained from each background boring by compositing soil from six-inch intervals starting at the surface. Background hand auger borings will be backfilled with cuttings from the hole.

A discussion of soil sampling procedures is included in the QAPP (Appendix A).

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2.B.6 Ground Water Sampling

The objectives of ground water sampling are as follows:

- Determine ground water background concentrations of organic and inorganic compounds being analyzed for at the site.

- Determine the hydraulic gradients and direction of ground water flow for both aquifers at each landfill area.

- Determine the vertical and horizontal extent of any contamination present in either the shallow or the deep aquifers at the site.

Before any new well installation or sampling, the five shallow and one deep existing wells at Landfill No. 2 will be evaluated as to their condition and usability during the RI/FS. The wells will be examined for any surface damage, depth to bottom, and possible clogging of the well screen. Those wells which are determined to be usable from the initial inspection will be redeveloped by pumping. A minimum of four shallow wells and three deep wells will be installed at Landfill No. 1. At Landfill No. 2, three shallow and two deep wells will be installed, assuming that the one existing deep well (Monitoring Well No. 2) and three existing shallow wells (Monitoring Well No. 1, 3 and 6) are usable. Replacement wells will be installed at Landfill No. 2 if the existing wells are found to be unusable.

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At each landfill, a minimum of three well locations in each of the two aquifers is required to determine the horizontal and vertical hydraulic gradient and the ground water flow direction. At least two pairs of shallow and deep wells will be nested at each site to provide an indication of the amount of vertical hydraulic communication between the two aquifers. It may be necessary to install additional wells at some later date to better delineate the areal extent of any contaminant migration. Permits will be acquired from the DNREC for all monitoring wells before initiation of well drilling.

The first new well installed at each site will be a deep well which will be drilled to the bottom of the second aquifer or to at least a depth of 150 feet, whichever is shallower. These wells will serve as pilot holes at each site and will be logged by split spoon samples obtained every 5 feet or at material changes to determine site stratigraphy and confirm final selection of the screened intervals for both shallow and deep wells. Shallow wells will extend to the base of the water table aquifer, estimated at a depth of 15 to 20 feet and will be screened from the base of the aquifer to 2 feet above water table level. This design conforms with DNREC monitoring well specifications and allows for fluctuation of the water table. Deep wells will extend 20 feet into the deeper aquifer (Cheswold) to an approximate depth of 45 feet and will be screened for 20 feet. This screened depth for deep wells was chosen because any leakage through the semi-confining layer from the water table aquifer would be expected to affect the upper bounding portion of the Cheswold aquifer.

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Because of the possible presence of phthalates reported in earlier analyses, the new wells will be constructed of 4-inch I.D. stainless steel 20 slot well screen with carbon steel riser. The annular space around the screens will be gravel packed a minimum of two feet above the top of the screen, a 2- to 3-foot thick bentonite pellet seal will be installed over the sand pack, followed by a cement/bentonite grout tremied to within three feet of ground surface. The cement/bentonite grout will consist of Portland cement and bentonite only. No Revert® or synthetic material will be substituted for the bentonite. The thickness of the gravel pack will be measured to within 0.5 feet. To prevent surface water infiltration and to provide security, a 6-inch steel protective casing with a hinged and locking cap will be cemented in place over each of the shallow wells. The cement seal will extend approximately three feet below land surface. Figure 2-3 is a well construction schematic of the surficial and deep aquifer wells.

During the installation of the deep aquifer wells, it will be necessary to seal off the overlying surficial aquifer to prevent possible contamination of the underlying zone. To prevent interconnection between the zones during drilling, an 8-inch I.D. carbon steel casing will be installed in a 12-inch I.D. borehole and driven a minimum distance of 3 feet into the confining layer.

The casing will then be pressure grouted into place. The outer casing will remain in place to prevent contamination between the zones. The monitoring well will then be completed the following day by drilling inside the casing to the desired depth. The deep well will be completed in the same manner as the shallow wells,

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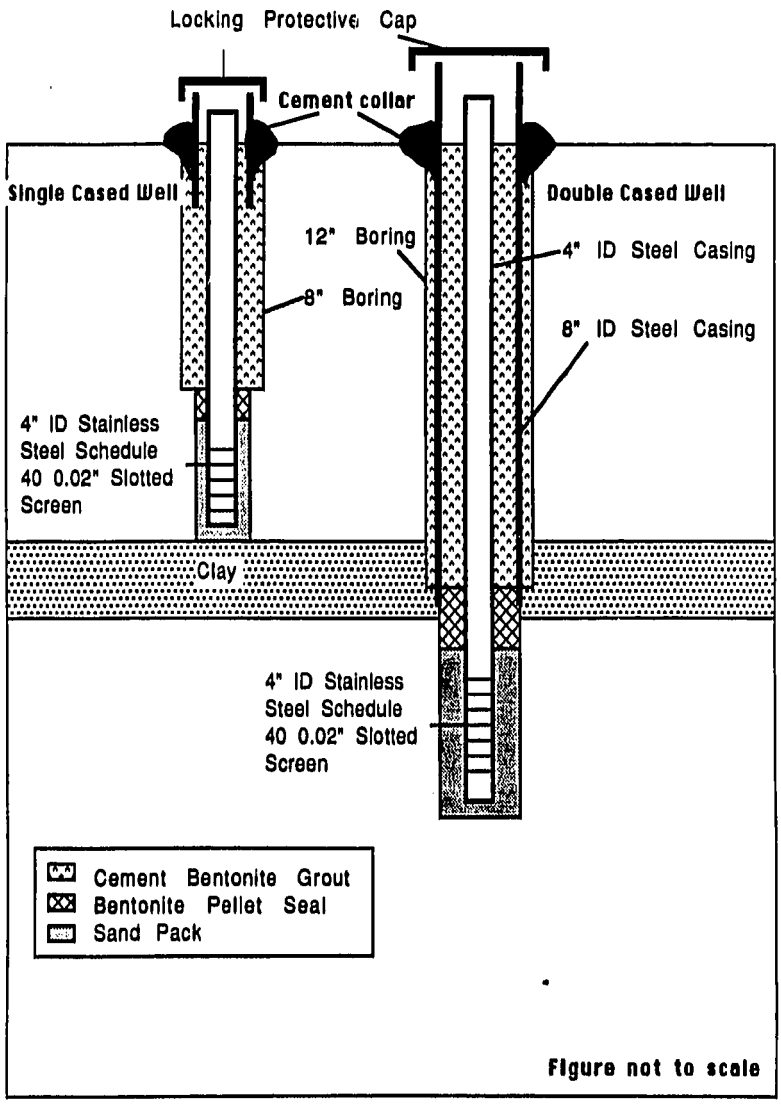
Figure 2-3

Monitoring Well Construction Schematic



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using 4-inch stainless steel 20 slot well screen with carbon steel riser. The grout will consist of a bentonite and portland cement mix installed to within 3-feet of the surface and will be followed by a three foot cement collar. Upon completion of the well, an additional segment of 8-inch steel casing will be welded onto the top to provide approximately 2-feet of stick up. A steel cap with padlock will be placed on the top of the well. The approximate depth of the deep wells will be 45 feet deep.

All wells will be installed under the continuous observation of an ERM hydrogeologist and will be constructed to meet DNREC standards. Should field conditions require changes to be made to the well design that would cause non-conformance to DNREC standards (e.g. water table of shallower than two feet causing shortening of screen to obtain surficial seal), EPA and DNREC will be consulted regarding the field change request. To minimize the potential for cross-contamination between borings, all drilling equipment will be steam cleaned between each boring. Additionally, all split-spoons will be decontaminated between uses in the same boring. Prior to installation, all of the casings and screens will be steam cleaned to remove any manufacturing-related contaminants.

Drill cuttings and fluids will be collected and containerized. Composite samples will be collected from each container and tested for EP toxicity and ignitability. Disposition of cuttings or drilling fluids will be discussed with DNREC and will be based on the test results. Unless determined to be hazardous, the cuttings will be spread on site.

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Upon completion, each of the wells will be developed by compressed air or pumping until pH and specific conductivity stabilize. Evacuated well water will be collected and disposed of in a DNREC approved manner upon ERM and DNREC joint review of the results from well sampling. The top of the well casing elevation and well location for each newly installed well and all existing wells sampled will be surveyed by a Delaware-licensed surveyor. The top of casing elevations will be keyed to a permanently marked reference point (i.e, a notch in casing top) which will be used for all measurements of depth to water.

After approval of the work plan, water level measurements will be conducted in existing wells to characterize seasonal ground water flow patterns during the dry season. Water level measurements will also be taken from each of the newly installed wells both immediately after well completion and after development. Depth to water measurements will be taken on a monthly basis from the entire monitoring well network, including existing wells, for a minimum of three months. Initial measurements from existing wells will be made at the beginning of the site investigation. This schedule should allow for detection of variations in water table elevations. The water levels will be measured to within 0.01 feet. To allow correlation between ground water levels and precipitation, daily precipitation data will be obtained from the closest Weather Bureau station or a nearby rain gauge established on site or at the Reichhold Cheswold facility.

One round of water samples will be obtained from three of the shallow and three of the deep wells at each landfill area with two of the samples from each aquifer being from downgradient wells. Off-site wells in the vicinity of the site may be sampled

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at the request of the local community. These samples will be obtained using appropriate EPA sampling and quality assurance/quality control (QA/QC) protocols discussed in the QAPP. The results of this community sampling effort would be included in the background data discussion (Task 1).

Upon completion of monitoring well installation, surveying, water level collection, and receipt of ground water analytical results a detailed review of the data will be performed. If no contamination is present in the ground water, shallow and deep aquifers, then additional investigations should not be required. However, if contamination is detected in site downgradient monitoring wells at levels above standards (ARARs) then additional investigations would be necessary to quantify the potential for contaminant migration off-site.

Additional investigations could involve:

1. Continuous monitoring of ground water levels for one week to determine if any off-site stresses on the aquifer (i.e., pumping) are observable on-site.

2. Slug and pump testing to determine aquifer permeability.

3. If head level measurements at the well nests indicate a downward vertical gradient then the permeability of the semi-confining layer would be determined to quantify vertical leakage.

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4. Analysis of potential contaminant migration based on collected water level and permeability data.

Additional monitoring wells would be required if one of the following conditions existed:

1. Hydraulic gradients and direction of ground water flow were not adequately defined by existing and proposed wells.

2. Vertical and horizontal extent of any contamination present in the ground water is not adequately defined (e.g. if concentrations of concern were present at farthest downgradient wells).

Additional rounds of ground water samples would be obtained from ground water monitoring wells if one of the following conditions existed:

1. Significant blank contamination, poor matrix spike recovery, or other data validation problems.

2. Installation of additional monitoring wells. Sampling results from new wells should only be used with concurrent sampling results from existing wells to meaningfully interpret any ground water contaminant plumes.

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EPA and DNREC will be consulted regarding additional testing, monitoring wells and/or ground water sampling that may be determined to be necessary.

A discussion of ground water sampling procedures is included in the QAPP (Appendix A).

2.B.7 Surface Water and Stream Sediment Sampling

The objectives of the surface water and stream sediment sampling program are in general to define the nature and extent of any site related inputs into Willis Branch. This will be done as follows:

- Determine the upstream or background surface water and stream sediment quality.

- Determine the types and amounts of contaminants which may be entering the streams from either of the landfill areas.

- Determine the gradient at which any surface water and stream sediment contaminants decrease downgradient from the site.

Samples of both surface water and stream sediment will be obtained from both Willis Branch and the unnamed tributary east of the two landfill areas which drains into Willis Branch. Sampling points will be located upstream, midstream adjacent to the sites, and downstream before the confluence of the two

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streams (Figure 2-4). In addition, two sample points for both surface water and stream sediment will be established below the confluence of the two streams: one approximately 1500 feet downstream of the confluence and the other just upstream of the mouth of the stream at Garrisons Lake. The station at Garrisons Lake is intended to determine if site related inputs are reaching the lake and may also provide information on other inputs to surface water and sediment quality that may be occurring downstream of the site. Sediment samples will be taken to the greatest extent possible in areas of deposition of fine particles.

Sediment samples for chemical analysis (see Section 2.B.9) will also be analyzed for grain size distribution. Grain size averages will be examined for all sediment samples and the effects on chemical analysis results will be determined (e.g. possible higher metals as grain size decreases).

As part of the surface water sampling program, a composite sample of the seepage from the bank below Landfill No. 1 and adjacent to Willis Branch will be collected from a minimum of 3 seepage points. If 3 seepage points do not exist, sampling will be delayed until a wetter season. A composite leachate sample will be collected for chemical analysis as well as for use in the leachate bioassay.

EPA and DNREC will be consulted for comment regarding any additional surface water or stream sediment sampling that may be determined to be necessary. A discussion of surface water and stream sediment sampling procedures is included in the QAPP (Appendix 1).

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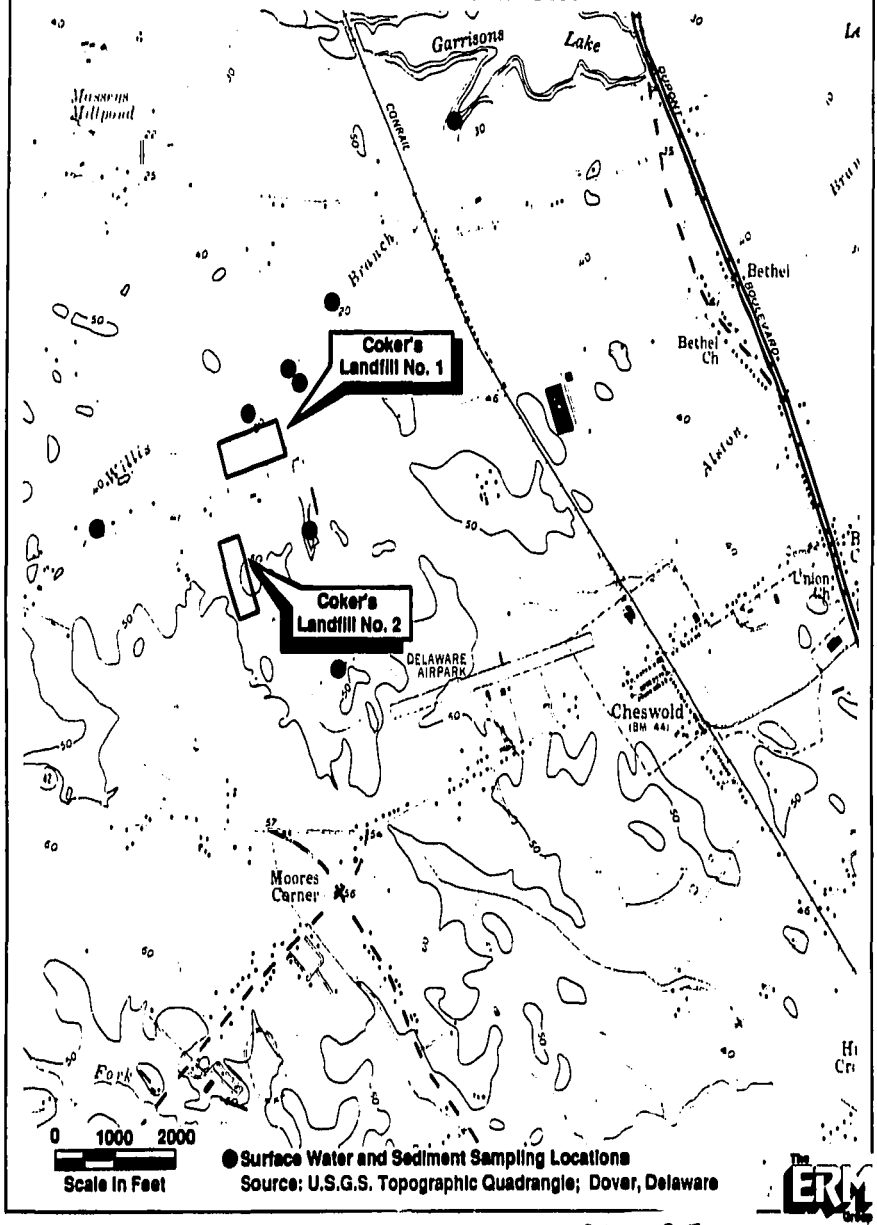
Figure 2-4
Surface Water and Sediment Sampling Locations
Coker's Landfill Site



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2.B.8 Environmental Assessment Methodology

The presence of any rare, threatened, or endangered species or species of special concern will be determined by contacting the Regional Director of the U.S. Fish and Wildlife Service, Newton Corner, Massachusetts; the Department of Natural Resources and Environmental Control (DNREC) Division of Fish and Wildlife and the Delaware Natural Heritage Program - Division of Parks and Recreation. Wetlands in the vicinity of the sites will be delineated using U.S. Fish and Wildlife Service National Wetland Inventory Maps (i.e. Cowardin System), DNREC Wetlands and Underwater Lands Branch Maps and Soil Conservation Service hydric soils information.

Macroinvertebrate populations in Willis Branch and any permanently flooded portion of the unnamed tributary to the east of site will be studied. Sampling locations will generally correspond to the surface water/sediment sampling points with the exception that no invertebrate samples will be collected downstream of the railroad in the vicinity of Garrison Lake. The macroinvertebrate survey will provide an indication of any cumulative effects of the site on the invertebrate population of Willis Branch.

The methodology used will be based on procedures outlined in USEPA. 1973. Biological Field And Laboratory Methods for Measuring the Quality of Surface Waters and Effluent. EPA 670/4-73-001. Station selection will be based on the natural environmental variables such as substrate type, current and depth.

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The best professional judgement of the Senior Biologist will be used to establish the station locations as a sampling procedure. It is anticipated that a measured area of stream bottom will be sampled to an approximate depth of 3 inches. The substrate will be field sieved using 0.5 mm mesh. Any organisms retained by the mesh will be captured, preserved and transported to the laboratory for identification and enumeration using appropriate keys or guides. A sample of the sediment will also be collected by ERM for particle size analyses. Field measurements of water temperature, conductivity and pH will be taken at each station.

EPA and DNREC will be consulted for comments regarding any additional Phase II sampling (e.g., tissues studies or sediment bioassays) that may be determined to be necessary. A discussion of sampling procedures is included in the QAPP (Appendix A).

An aliquot of the composite seepage sample will be used to conduct a leachate bioassay using Daphnia. The biossay will generally follow methods outlined in USEPA 1985: Methods For Measuring The Acute Toxicity of Effluent to Freshwater and Marine Organisms. EPA 600/4-85/013 as modified to follow the method of Nebeker et al, 1984. The modifications were agreed upon by EPA, NOAA, ERM, and CSI during the meeting of 15 June 1987. Previous discussions between Dr. Nebeker, the Academy of Natural Sciences (Dr. Goulden) and NOAA (Ms. Fritz) resulted in the consensus that the modified methodology would provide an indication of seepage toxicity. A static renewal test will be conducted by the Academy of Natural Sciences - Philadelphia, in which juvenile Daphnids will be exposed to a series of dilutions using the composite seepage and Willis Branch water collected above any site influence. The test will be run for a period of ten days with

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observations of the test organisms to assess acute toxicity (Days 1, 2, and 4) and chronic toxicity (Day 10). New dilutions will be made on Day 5 using the seepage composite for the assessment of chronic toxicity. The bioassay results will provide an indication of site impacts on the free swimming fauna of Willis Branch as well as an indication of potential effects on the downstream fauna such as that found in Garrison Lake.

Wetland areas in the vicinity of the site will be delineated by using published (USFWS) wetland inventory charts as well as by field reconnaissance. The field reconnaissance will also be utilized to assess non-wetland habitat in the vicinity of the site. In addition to observations made during the reconnaissance, any observations of wildlife made during field work at the site will also be recorded. The local waterways patrolman, local game protector and local residents will be contacted in relation to wildlife harvest/utilization in the area of the site. It is anticipated that USEPA Environmental Services Division representative will be part of the wetlands field reconnaissance team.

A meeting with USEPA Region III and DNREC representatives is planned to review the Phase I chemistry data, toxicity tests, and benthic survey data. At this time the need for Phase II studies will be evaluated.

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2.B.9 Parameters for Analysis

The parameters for analysis of the various samples (i.e., soil, ground water, surface water, waste, leachate) collected during the RI/FS investigation are presented on Table 7-1 in Appendix A (QAPP). The main parameter list will be the Target Compound List (TCL) including 30 additional tentatively identified compounds (TICs), Task 1 and 2 (metals) inorganic elements, and Task 3 (cyanide) inorganic elements. Task 1 and Task 2 metals analyses samples will be filtered to provide dissolved metals for ground water samples and unfiltered to provide total metals results for surface water samples. Exceptions to not analyzing for the complete TCL list or analyzing for additional parameters are as follows:

- It is proposed that pesticides and PCBs be eliminated from all samples taken at Landfill No. 2 with the exception of two selected waste characterization samples, because of good documentation which exists for the waste which went into Landfill No. 2.

- Stream sediment samples will be analyzed for the complete TCL list plus pH, total organic carbon (TOC), percent moisture, and grain size.

- Ground water and surface water samples will be analyzed for the complete TCL list plus hardness and sulfates and will be field analyzed for pH and specific conductance. In addition, surface water will be analyzed for total solids.

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- Shallow ground water and leachate samples will also be analyzed for acrolein and acrylonitrile.

2.C Health and Safety Plan

ERM's health and safety procedures for this study are presented in Appendix B.

2.D Data Management Plan

Data management considerations for the proposed RI/FS study are included in the Quality Assurance Plan, Appendix A.

2.E Community Relations Plan

EPA Region III personnel will take the lead role in providing information about the site to the community and orchestrating meaningful community involvement in response decisions. Clean Sites, Inc. and ERM will provide support to EPA on request.

2.F Schedule

The schedule for the proposed RI/FS study is presented in Figure 2-5, and illustrates the schedule for tasks and the time frames for coordination of document deliverables and milestones.

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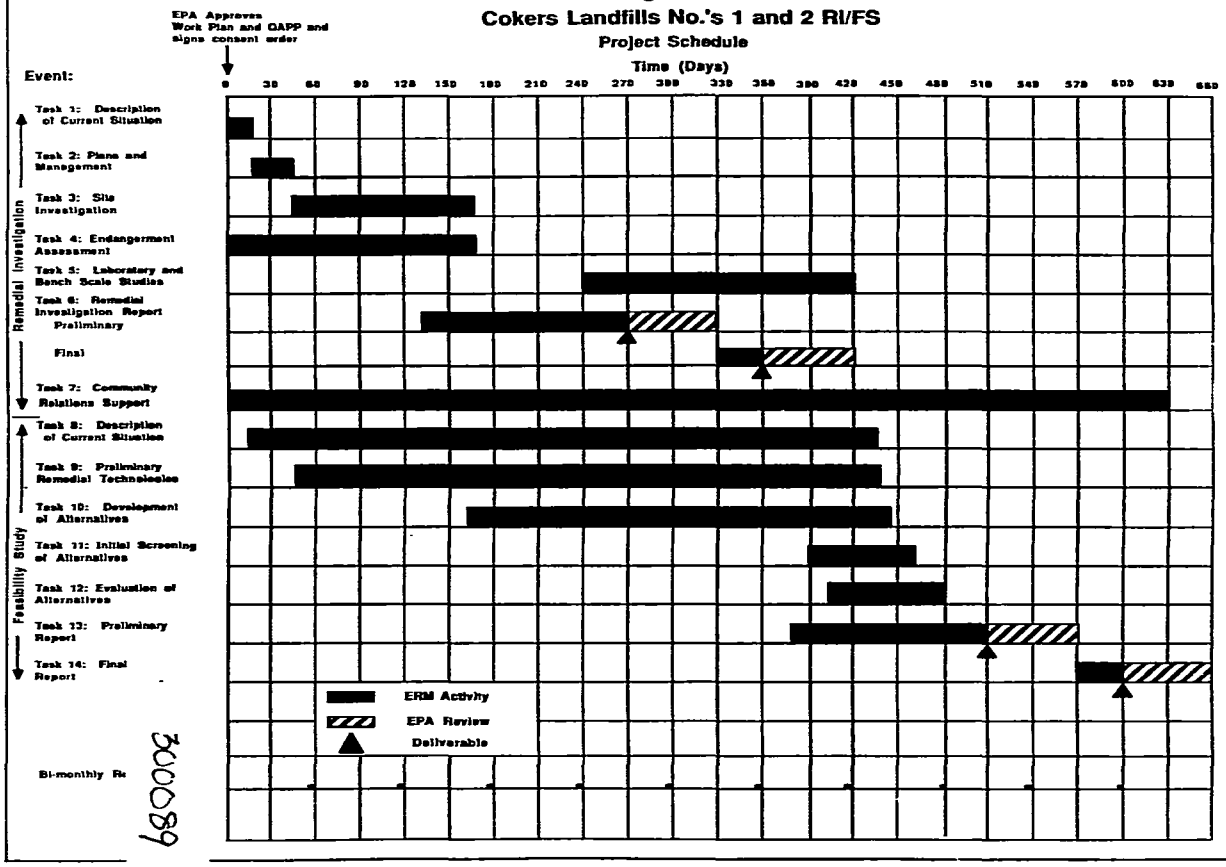
Figure 2-5
Cokers Landfills No.'s 1 and 2 RI/FS
Project Schedule



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The overall duration of the RI/FS project is approximately 98 weeks. The PRP's have projected the schedule based on 60 day review periods for EPA. If these review periods are exceeded, subsequent tasks will be extended by an equal amount of time. The schedule also assumes that only one set of bench scale and laboratory studies are required and that the studies will not exceed six months. The current schedule does not include time for Phase II activities and would need to be expanded to accommodate these activities.

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TASK 2

REFERENCES

Nebeker, A. V., M. A. Cairns, J. H. Gakstatter, K. W. Mallueg, G. G. S. Schuytema and D. F. Krawczyk, 1984, Biological Methods for Determining Toxicity of Contaminated Freshwater Sediments to Invertebrates, Environ. Toxicol. Chem., Vol. 3, p. 617-630.

USEPA, 1973, Biological Field and Laboratory Methods for Measuring the Quality of Surface Waters and Effluent. EPA 670/4-73-001.

USEPA, 1985, Methods For Measuring The Acute Toxicity of Effluent Freshwater and Marine Organisms, EPA 600/4-85/013.

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TASK 3

SITE INVESTIGATION

The investigation discussed in Task 2 has been designed to characterize the site and its actual or potential hazard to public health and the environment for soil, surface water, and ground water contamination. The investigations will be designed to provide data of adequate technical content to support the development and evaluation of remedial alternatives during the feasibility study. Investigation activities will focus on problem definition and data to support the screening of remedial technologies, alternative development and screening, and detailed evaluation of alternatives.

The site investigation activities will follow the plans set forth in Task 2. All sample analyses will be conducted at laboratories following procedures set forth in the Quality Assurance Project Plan (QAPP). Strict chain-of-custody procedures will be followed and the location of all samples will be shown on the site map (and grid system) established under Tasks 1 and 2.

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The criteria necessary to trigger additional investigations beyond those proposed are discussed in each sampling plan in Task 2. A summary of the proposed investigation is presented in Table 3-1.

As the results of the various components of the site investigation are generated, they will be included in the bi-monthly reports discussed in Section 6.A.

3.A Waste Characterization

A sampling and analysis program to characterize the waste materials in Coker Landfills No. 1 and No. 2 will be performed as discussed in Section 2.B.4. The constituents of the waste in Coker's No. 2 have been presented in Section 1.B and are well documented because disposal was conducted under a state solid waste disposal permit. Waste characteristics for Coker's No. 1 are expected to be consistent with the wastes in Coker's No. 2, which are well documented. Although Coker's No. 1 has not always been secure, there has been no confirmation of any wastes other than latex having been disposed at the site. Wastes will be analyzed as described in Section 2.B.9.

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TABLE 3-1
SUMMARY OF PROPOSED SAMPLING

Type of Sampling	Location	No. of Samples	Analyses	Objective
EM Conductivity Survey	Coker's No. 1	25 foot grid spacing 200 foot grid spacing (stratigraphy)	Horizontal and vertical conductivity of subsurface materials	Identify locations of waste trenches Identify metallic objects Identify changes in waste type
	Coker's No. 2	4 traverses 200 foot grid spacing (stratigraphy)	Horizontal and vertical conductivity of subsurface materials	Identify changes in ground water conductivity Confirm shallow stratigraphy and water table Configuration
Soil Gas Survey	Coker's No. 1	50 foot grid spacing	Total VOC's with OVA/FID Confirmation with OVA/PID	Determine background levels of VOC's Determine VOC levels in soils around waste area Identify high VOC areas away from waste cells
	Coker's No. 2	100 foot grid spacing	Total VOC's with OVA/FID Confirmation with OVA/PID	Delineate plumes in water table aquifer
Waste Characterization	Coker's No. 1 & 2	Test pits at 2 randomly chosen waste cells, 1 composite sample per pit plus leachate sample	EP Tox, TCL + 30 TIC's for waste TCL + 30 TIC's, Task 1,2,3 inorganics, and acrolein and acrylonitrile for leachate	Confirm physical nature of waste Identify constituents in wastes Determine leachability of wastes
Soil Sampling	Coker's No. 1	6 borings , 2 samples per boring 1 background boring, 1 sample	Total VOC head space TCL + 30 TIC's; Task 1,2,3 inorganics	Identify soil contaminants at targeted areas and anomalies Determine presence of contaminants at random points away from waste trenches, cells and hot spots
	Coker's No. 2	6 borings, 2 samples per boring 1 background boring,1 sample	Total VOC head space TCL + 30 TIC's; Task 1,2,3 inorganics	
Ground Water Sampling	Coker's No. 1	3 shallow monitoring wells 3 deep monitoring wells	TCL + 30 TIC's; Task 1,2,3 inorganics, hardness and sulfates, acrolein and acrylonitrile for shallow samples	Determine vertical and horizontal extent of contamination in shallow and deep aquifers
	Coker's No. 2	3 shallow monitoring wells 3 deep monitoring wells	TCL + 30 TIC's less PCB's and pesticides; Task 1,2,3 inorganics, hardness and sulfates, acrolein and acrylonitrile for shallow samples	
	#Off -Site	To be determined	To be determined	
Surface W Stream Se	Coker's No. 1 (Willis Branch)	8 surface water	TCL + 30 TIC's; Task 1,2,3 inorganics, hardness, sulfates and total solids	Determine the upstream or background stream sediment quality
	Coker's No. 2 (Unnamed tributary) (see figure 2-4)	8 sediment	TCL + 30 TIC's; Task 1,2,3 inorganics; pH; TOC; % moisture; grain size	Determine the types and amounts of contaminants from landfill area Gradient at which contaminants decrease downstream
Environmental Assessment	Coker's No. 1 (Willis Branch)	Benthic samples at 7 surface water/ sediment sampling points above lake	EPA 670/4-73-001	Determine impact of surface water and stream sediment contamination
	Coker's No. 2 (Unnamed tributary) (see figure 2-4)	Composite 3 leachate samples for bioassay for Cokers No. 1	EPA 600/4-85/013	Determine diversity and frequency

VOC - Volatile Organic Compounds
TCL - Target Compound List
TIC's - Tentatively Identified Compounds
Note: Sampling locations may change pending results of initial surveys

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3.B Hydrogeologic Investigation

A hydrogeologic investigation will be conducted to confirm and quantify the presence or absence of chemical constituents in ground water. The program is based on a survey of previous studies reviewed under Task 1. The drilling and sampling program discussed in Section 2.B.6 is designed to establish the horizontal and vertical distribution of chemical constituents in ground water. Data collected during the program will be used to define geologic conditions at the site (i.e., stratigraphy and lithology) and determine the ground water flow direction in both the surficial and deep (i.e., Cheswold) aquifers. The draft and final reports will contain maps depicting monitoring well locations and depths, location of geophysical anomalies, areal distribution of contaminants in soil and ground water, poteniometric surface of both aquifers, and the location of seeps. A predictive analysis of the long-term disposition (i.e., distribution and dispersion with time) of chemical constituents will be made, assuming no remedial action at the site.

3.C Soils, Sediment, and Surface Water Investigation

The investigation programs for soils, sediment, and surface water are based on a survey of previous studies reviewed under Task 1. The soils investigation will overlap with the hydrogeologic investigation because selected split spoon samples collected during monitoring well drilling will be collected and sent for laboratory analyses. The soil sampling program discussed in

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Section 2.B.5 is designed to establish the vertical and horizontal extent of any contaminants. The stream sediment sampling program discussed in Section 2.B.7 is designed to establish upstream, midstream, and downstream sediment conditions. The stream sediment parameter list has been expanded to include grain size, percent moisture, total organic carbon (TOC), and pH. The surface water and stream sediment investigations may overlap because the data from sediment samples may be relevant to surface water quality. The surface water and sediment sampling programs are designed to determine the absence or presence of contaminants in Willis Branch and in its unnamed tributary.

3.D Air Investigation

Collection of air samples to determine the extent of atmospheric contamination is not proposed because the compounds associated with the latex waste are not readily volatile. A review of previous data also does not indicate the presence of any readily volatile compounds. Air monitoring will be conducted during the site investigation as prescribed in the Health and Safety Plan (Appendix B).

3.E Site Investigation Analysis

A thorough analysis and summary of data obtained from all site investigations will be prepared to ensure that the data are sufficient in quality and quantity to determine the necessity for and to focus the thrust of any additional investigations. The

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summary will describe the quantities and concentrations of specific chemicals; and describe the numbers, locations, and types of nearby populations and pathways of exposure that may result in an actual or potential threat to human health and/or the environment.

Review of the results of all the site investigations as well as potential human and environmental exposure pathways will be used to address the need for any second phase investigations. This type of assessment basically is part of the Endangerment Assessment which will be a major input into the second phase assessment. Input/comment will be solicited from the appropriate agencies and parties including EPA, DNREC, NOAA, USFWS, and Clean Sites.

In general, any significantly impacted environmental compartment(s) identified in the site studies will be subject to additional investigation should the impact be judged to pose a significant threat to health or the environment. In all cases, background or control conditions as well as non-site related inputs will be considered in assessing any site related impacts.

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TASK 4

ENDANGERMENT ASSESSMENT

ERM will prepare an Endangerment Assessment (EA) following EPA's guidance documents to establish the degree of hazard posed by the site at various receptor points. This level of hazard will also serve as a benchmark (no action or existing site conditions) against which to measure the effectiveness of different remedial alternatives.

This task will run concurrently with the Remedial Investigation (RI). It will provide information to compare the 'No Action' and other alternatives in terms of environmental effectiveness. Appropriate remedial alternatives will satisfy Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) standards which will be established as part of this task.

ERM favors an integrated, phased approach to conducting the EA. Interaction between personnel engaged in the EA and Remedial Investigation/Feasibility Study (RI/FS) tasks will insure that

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the data required to conduct the EA will be gathered in a timely and cost effective manner (Figure 4-1). ERM's phased approach to conducting an EA includes:

1) Comparison of the concentration of contaminants at the site to Applicable or Relevant and Appropriate Standards (ARARs); and/or

2) Calculation of risk posed to human health and the environment by compounds for which ARARs do not exist.

A thorough quality assurance analysis and, summary of data including statistical interpretation obtained during ERM's investigations at the sites will be conducted. This analysis ensures that the data are sufficient in quality and quantity to accurately assess the risk to human health and the environment by compounds detected at the sites. The summary will include definition of the occurrence and extent of the chemical constituents of concern that were detected in the various environmental compartments, potential receptors including human, terrestrial and aquatic organisms, and the potential pathways of exposure that may result in an actual or potential threat to human health and/or the environment. In addition, the occurrence of any critical habitat or habitats of special concern that may be subject to impact will be identified.

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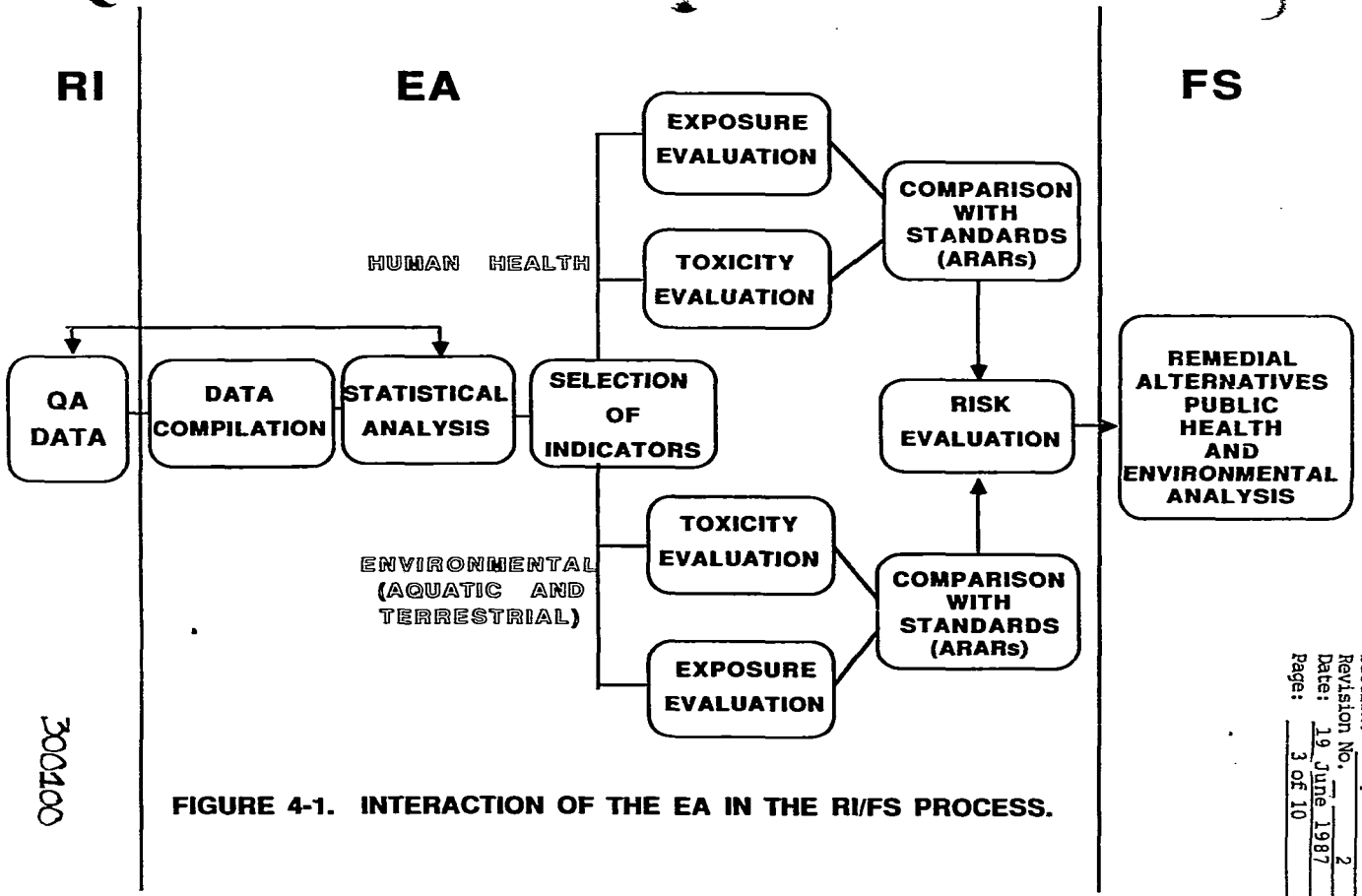

FIGURE 4-1. INTERACTION OF THE EA IN THE RI/FS PROCESS.

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The information collected will be an integral component of the human health endangerment assessment as well as providing input for the environmental assessment and for evaluation of impact to natural resources. The information collected will be reviewed by EPA and the trustees of natural resources including the National Oceanographic and Atmospheric Administration - Department of Commerce, Department of the Interior, and the State of Delaware. The purpose of the environmental assessment is to provide the necessary information to assure that proper mitigative measures and clean-up standards and levels are implemented to protect and restore the natural resources at the site.

The methodology used by ERM in conducting human health and environmental endangerment assessments is outlined in Sections 4A and 4B, respectively.

4.A. Human Health Assessment

4.A.1 EPA's Human Health Endangerment Assessment Process

This section provides a broad overview of the CERCLA Endangerment Assessment (EA) process. The discussion is not intended to be a comprehensive guide to preparing risk assessments. EPA has proposed guidelines for the preparation of EAs in the Endangerment Assessment Handbook (US EPA, 1985), Superfund Public Health Evaluation Manual (US EPA, 1986a), Exposure Assessment

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Handbook (US EPA, 1986b), and Toxicology Handbook (US EPA, 1986c).

An EA is normally conducted after the completion of a RI. The RI determines the nature and extent of contamination at a site, and its results form the data base on which potential exposures can be determined and risks assessed. In addition, the RI defines whether or not the present conditions at the site are at steady state.

There are five evaluations which must be completed in a CERCLA EA (Figure 4-2)

1. Identification of indicator chemicals, which are used to represent carcinogenic and noncarcinogenic risk at the site;

2. Exposure evaluation, which includes the calculation of doses to potentially exposed populations;

3. Toxicity evaluation of the potential carcinogenicity of site indicator chemicals, noncarcinogenic effects and development of environmental standards; and

4. Characterization of the risks to a population caused by exposure to each indicator chemical.

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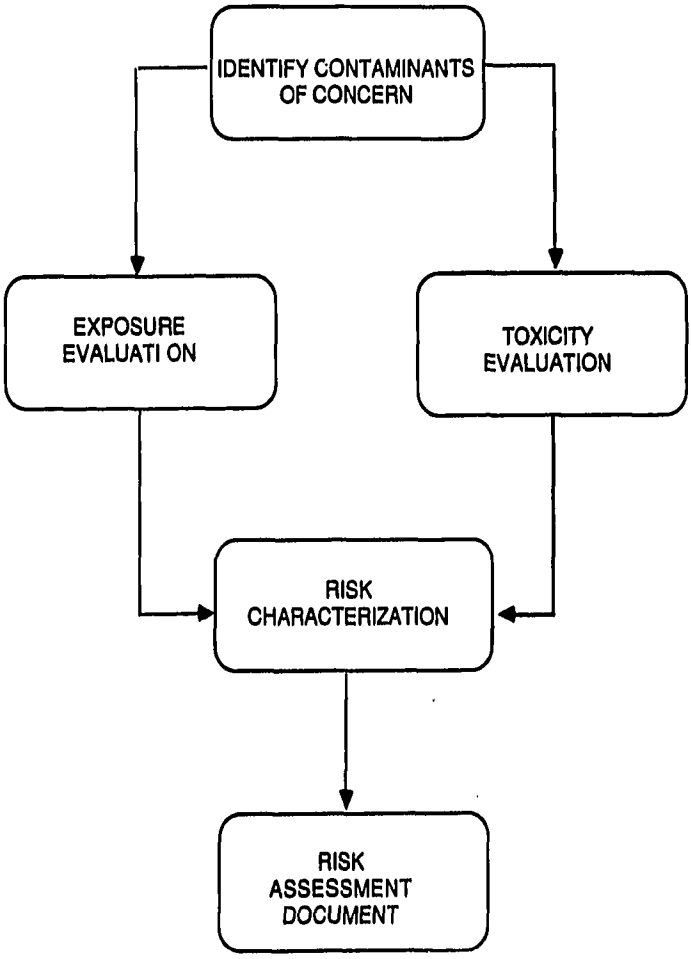
FIGURE 4-2. THE RISK ASSESSMENT PROCESS.



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SOURCE: US EPA August 1985
Draft Endangerment Assessment Handbook

5. Assessment of Remedial Alternatives (FS) compares the risk identified by the site under the no-action alternative (existing site conditions) to remedial alternatives proposed during the FS.

4.B Environmental Endangerment Assessments

Based upon results of ERM's phased approach to surface water, sediment, and possibly aquatic life, an environmental risk assessment may be required at the Coker's Landfill Sites. If no risks to the aquatic/terrestrial environments are identified during this phased approach, then the environmental assessment will consist of a comparison to ARARs. However, if the data show an impact on the aquatic/terrestrial environment, then an environmental endangerment assessment will be conducted as follows.

The NCP 300.72 Subpart G under Superfund Amendments and Reauthorization Act (SARA) authorized the Secretaries of the Department of Commerce (DOC) and Interior (DOI) to act as co-trustees for natural resources. The State of Delaware is also a trustee for the natural resources at the Coker's Sites.

Guidance documents for conducting environmental endangerment assessments are very limited in number and scope. ERM is developing internal guidance documents for conducting such

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assessments at CERCLA and RCRA sites. Development of these guidances is in conjunction with the trustee agencies for the specific site. Figure 4-3 outlines ERM's generic approach to environmental assessments. Indicator chemicals may be the same for human and environmental assessments. The environmental assessment examines all the compounds detected at a site for potential hazards to aquatic and terrestrial life. In particular, special attention is given to compounds which are bioaccumulated in aquatic/terrestrial life and which could potentially biomagnify and result in human exposure. Exposure analysis for aquatic life initially examines the concentrations of compounds in surface water and sediments and the effects on the aquatic life. For terrestrial life, soils and plants are similarly examined. Risks to aquatic and terrestrial life are independently determined and subsequent risk to humans from both exposures are calculated. A comparison with appropriate and relevant aquatic/terrestrial life standards are made.

The environmental endangerment assessment is a companion document to the human health risk assessment. The environmental assessment is interwoven into the human health assessment but each document may be reviewed by the appropriate agencies.

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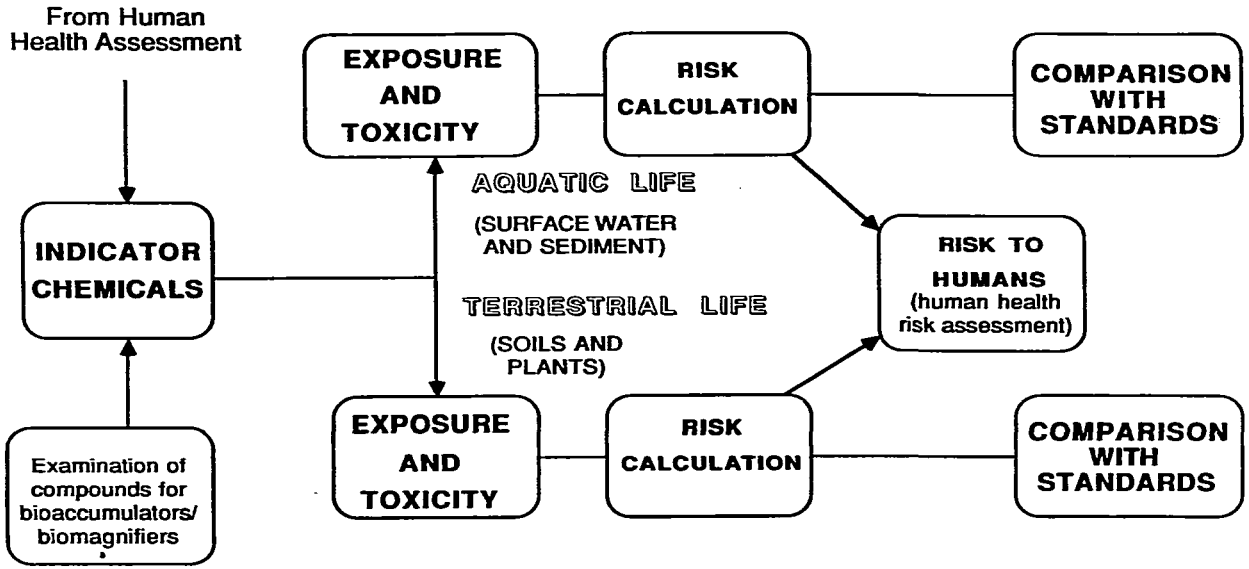

FIGURE 4-3. ENVIRONMENTAL RISK ASSESSMENT PROCESS.

SOURCE : ERM, INC

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TASK 4

REFERENCES

US EPA. 1985 U.S. Environmental Protection Agency. Office of Waste Programs Enforcement. Draft Endangerment Assessment Handbook. PRC, Environmental Management, Inc.

US EPA. 1986a. U.S. Environmental Protection Agency. Office of Waste Programs Enforcements. Superfund Public Health Manual. ICF Incorporated, October 1986.

US EPA. 1986b. U.S. Environmental Protection Agency. Office of Emergency and Remedial Response. Office of Solid Waste and Remedial Response. Draft Superfund Exposure Assessment Manual. Versar Inc., January 14, 1986.

US EPA. 1986c. U.S. Environmental Protection Agency. Office of Waste Programs Enforcement. Toxicology Handbook. ICAIR, Life Systems, Inc. September 1986

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TASK 5

LABORATORY AND BENCH-SCALE STUDIES

Consideration will be given to the necessity to conduct laboratory and/or bench-scale studies to determine the applicability of remedial technologies to site conditions and problems. If such a program is warranted, based on data gathered during the Remedial Investigation (RI), plans will be developed and submitted to the EPA for review and approval. Such plans will include:

- Analysis of the technologies based on literature review, vendor contracts, and past experience to determine the testing requirements;

- Development of a testing plan identifying the type(s) and goal(s) of the study(ies), the level of effort needed, and data management and interpretation guidelines;

- Evaluation of the testing results to assess the technologies with respect to the goals identified in the test plan; and

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- Plans to scale up those technologies selected based on testing results. Results, both positive and negative, will be summarized in a report of the testing program.

Laboratory and bench/scale studies that may be performed based on current information and results of the RI are described below.

1. Ground Water Studies to be considered will include, but may not be limited to:

   a. Carbon adsorption, isotherm development,
   b. Chemical oxidation bench-scale studies,
   c. Metals precipitation laboratory studies,
   d. Metals ion exchange bench-scale studies, and
   e. Absorbent resin bench scale studies.

2. Source studies to be considered will include, but may not be limited to:

   a. Dewaterability and thermal properties of latex waste solids for incineration, and
   b. Solidification/stabilization studies.

Results of any studies will be summarized in the FS report, but preliminary results of any studies will be included in the bimonthly status reports. Information from prior treatability studies conducted on the waste by Reichhold will be evaluted and discussed in the FS report.

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TASK 6

REPORTS

6.A Progress Reporting Requirements

Beginning 60 days after EPA approval of the complete Remedial Investigation/Feasibility Study (RI/FS) work plan, written progress reports for each 2 month period will be submitted to EPA. These reports will discuss the following items:

- Status of work at the site and progress to date.
- Results of sampling and tests.
- Data collection planned and the action planned for the next 2 months.
- Difficulties encountered during the reporting period.
- Any proposed expansions of scope of investigations which may be determined to be necessary during the course of the study and which have not been previously scoped in the work plan.

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6.B Remedial Investigation Report

The preliminary and final RI reports will be submitted for EPA and DNREC review. Within 30 days of receipt of EPA and/or DNREC comments on the preliminary or final report, the report will be amended and resubmitted. The report will include the result of Tasks 1 through 5, and will include additional information in the appendices. The report will be structured to enable the reader to cross-reference with ease.

Maps, cross-sections, tables, and other graphical presentations which will be incorporated in the draft and final RI reports include: site location maps, site topographic map, site geologic map, site geologic column, site soil map, site boundary maps, locations of waste cells and trenches, locations of electromagnetic survey anomalies, soil gas anomaly map, sample location map, boring logs, site cross-sections, well drilling logs and well as-built construction details, potentiometric surface maps for shallow and deep aquifers, location of surface seeps, delineation of wetlands, areal distribution of the most common contaminants detected in soil and in each aquifer, and summary tables of sampling results.

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TASK 7

COMMUNITY RELATIONS SUPPORT

The objective of the community relations program is to achieve community understanding of the actions taken and to obtain community input and support prior to the selection of remedial alternative(s). EPA Region III personnel will take the lead role in the community relations program. Clean Sites, Inc. (CSI) and ERM will provide continuing support to EPA on request throughout the project.

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TASK 8

DESCRIPTION OF CURRENT SITUATION

The remedial action Feasibility Study (FS) report will include a description of the current site situation, site background, and previous response activities to determine the nature and extent of the problem and develop and evaluate remedial action alternatives. Much of this information has already been described in this work plan under Task 1. The previously derived information and new information generated during the Remedial Investigation (RI) will be incorporated into the RI/FS Final Report.

If, during the course of the RI, any changes to the original project scope as described under Task 1 are required, these changes will be discussed and justified to the Environmental Protection Agency (EPA) based on observations made during the remedial investigation.

Included in the description of the current situation will be a statement of purpose for the remedial response, if such remedial action is required. This statement will be based on the results of the RI. The statement of purpose will identify the actual or

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potential ground water or other pathways to be addressed by the remedial alternatives, if applicable.

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TASK 9

PRELIMINARY REMEDIAL TECHNOLOGIES

9.A Scope of Task

Based on the current site conditions and the statement of purpose for any required remedial action response developed under Task 8, a master list of potentially feasible technologies will be developed. The remedial technologies will address surface water and/or ground water collection and treatment and the removal, containment, or treatment of contaminated soil or wastes as determined to be necessary during the Remedial Investigation (RI).

1. Ground water technologies to be considered will consist of, but may not be limited to:

    a. Ground Water Pumping
    b. Subsurface Drains
    c. Subsurface Barriers
    d. Metals Precipitation

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e. Chemical Oxidation
f. Ion Exchange for Metals
g. Activated Carbon or Absorbent Resins
h. Air of High Temperature Stripping
i. Biological Treatment
j. Discharge to POTW
k. Combinations of the Above and
l. No Action

2. Source control/contaminated soil technologies to be considered will consist of, but may not be limited to:

a. Surface Water Management
b. Site Grading
c. Cover Improvement
d. RCRA Type Cap
e. Excavation
f. Incineration
g. Solidification/Stabilization
h. Vacuum Extraction
i. Soil Stripping
j. Biological Degradation/Composting
k. Off-Site Disposal
l. Combinations of the Above and
m. No Action

Evaluation parameters will be based on literature values, past experience, and bench-scale studies, if appropriate.

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The technologies will include consideration of both on-site and off-site remedies, depending on site problems. The master list will be screened based on site conditions, waste characteristics, and technical requirements, to eliminate or modify those technologies that may prove extremely difficult to implement, will require unreasonable time periods to achieve remediation or will rely on insufficiently developed technology.

9.B Preliminary Review of Treatment Methods

Data from previous sampling efforts indicated that both volatile and semi-volatile organic compounds and metals were present at relatively low concentrations at the site.

Metals may be removed from ground water by two primary methods: chemical precipitation and ion exchange. Chemical precipitation involves the addition of a soluble hydroxide or sulfide salt to the liquid to be treated such that an insoluble metal precipitate is formed. Treatment efficiency is dependent on the concentration of reactants and the solubility limit of the metal salt formed. The ion exchange process causes smaller, less-strongly bound metals on a resin to be displaced by more readily bound metals in the liquid to be treated. Process efficiency depends on specific resin capacity for the metals being removed from solution.

Hazardous organic compounds may be removed from liquid streams via chemical oxidation, biological treatment, activated carbon or adsorbent resins, air stripping or high temperature stripping.

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Chemical oxidation employs such agents as hydrogen peroxide with iron catalyst (Fenton's reagent) or ozone to convert organics to simpler constituents. Complete conversion to carbon dioxide and water rarely occurs. Oxidation is most effective at degrading nonhalogenated compounds. Biological treatment, which for the Coker's site might consist of discharge to a POTW, could also be used to oxidize organics in ground water from the site.

Compounds most amenable to biodegradation include nonhalogenated, nonaromatic species, although halogenated and aromatic compounds can frequently be degraded by an acclimated bacteria. Biological treatment can effect complete conversion of complex organics to carbon dioxide and water. Activated carbon has been frequently used for removal of priority pollutants from water. In this process organics are adsorbed onto the surface of the carbon particles and so removed from the liquid stream. This process is most effective for large branched, non-polar compounds. Process effectiveness also depends on influent concentration and wastewater matrix characteristics.

Adsorbent resins are used in a similar manner, with the distinction that these resins can be designed to selectively adsorb certain classes of organic molecules. Operational efficiency is dependent on wastewater composition and concentration.

Air stripping is used to remove volatile organics from the liquid phase and to transfer these compounds to the air by passing air countercurrent to the liquid phase. Process efficiency is dependent on the system temperature, air-to-water ratio, air and

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liquid loading rates, and the compounds present in the ground water. The higher the Henry's constant (the equilibrium ratio of a compound's vapor pressure in air to its solubility in water), the more readily stripped the compound will be. High temperature air stripping is employed for the removal of less volatile compounds from aqueous streams. For constituents with a sufficiently low Henry's Constant, ambient temperature stripping is ineffective. However, by elevating the temperature of the stripping process, such compounds can be more readily removed.

The processes discussed above are potentially applicable to the treatment of contaminants in the ground water at the Coker's Site. A more detailed assessment of constituents of concern and subsequent treatability testing is necessary before further evaluation of the applicability of these technologies can be made.

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TASK 10

DEVELOPMENT OF ALTERNATIVES

Based on the results of the Remedial Investigation (RI) and consideration of preliminary remedial technologies (Task 9), remedial action alternatives will be developed on the basis of objectives established for the response. The No Action alternative will also be considered.

10.A Establishment of Remedial Response Objectives

Site-specific objectives for the remedial response will be established in the report of the Feasibility Study (FS). These objectives will be based on public health and environmental concerns, the description of the current situation (from Tasks 1 and 8), information gathered during the Remedial Investigation, section 300.68 of the National Contingency Plan (NCP), EPA's interim guidance, and the requirements of any other applicable EPA, Federal, and State environmental standards, guidance, and advisories as defined under EPA's Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) compliance policy. Objectives for source control measures will be developed to prevent or significantly minimize migration of harmful

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chemical constituents from the site. Objectives for management of migration measures will prevent or minimize impacts of the chemical constituents that have already migrated from the site. Preliminary cleaning objectives will be developed in consultation with Clean Sites, Inc. (CSI), EPA, and the State.

10.B Identification of Remedial Alternatives

Alternatives will be developed to incorporate remedial technologies (Task 9), response objectives, and other appropriate considerations into a comprehensive site-specific approach. Alternatives developed will include consideration of the following:

- Alternatives which attain applicable and/or relevant public health or environmental standards

- Alternatives which exceed applicable and/or relevant public health or environmental standards

- Alternatives which do not attain applicable and/or relevant public health or environmental standards but which will reduce the likelihood of present or future threat from site-derived contaminants. This will include an alternative which closely approaches the level of protection provided by the applicable or relevant standards

- No action

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There may be overlap among the alternatives developed. CSI, EPA, and the State will be consulted during alternatives development. Documentation of the rationale for excluding any technologies identified in Task 9 in the development of alternatives will be provided.

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TASK 11

INITIAL SCREENING OF ALTERNATIVES

Initially, the alternatives developed in Task 10 will be screened by ERM to eliminate those that are clearly infeasible or inappropriate. Three broad considerations will be used as a basis for the initial screening: public health, the environment, and cost.

11.A Environmental Protection

Only those alternatives that satisfy the response objectives and contribute substantially to the protection of public health, welfare, or the environment will be considered further. Source control alternatives will achieve adequate control of source materials. Management of migration alternatives will minimize or mitigate the threat of harm to public health, welfare or the environment.

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11.B Environmental Effects

Alternatives posing significant adverse environmental effects will be excluded.

11.C Technical Feasibility

Technologies that may prove extremely difficult to implement, will not achieve the remedial objectives in a reasonable time period, or will rely upon unproven technology will be modified or eliminated.

11.D Cost

An alternative whose cost far exceeds that of other alternatives will usually be eliminated unless other significant benefits may be realized. Total cost will include the cost of implementing the alternatives and the cost of operation and maintenance. The construction and operation and maintenance cost estimates will be developed for comparative purposes only; their accuracy is not suitable for planning capital budgets.

The cost screening will be conducted only after the environmental and public health screenings have been performed.

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TASK 12

EVALUATION OF THE ALTERNATIVES

The cost-effectiveness of remedial alternative that pass through the initial screening in Task 11 will be further evaluated. Alternative evaluation will be preceded by detailed development of the remaining alternatives.

12.A Technical Analysis

The technical analysis will, at a minimum:

12.A.1 Describe appropriate treatment, storage, and disposal alternatives.

12.A.2 Discuss how each alternative does (or does not) comply with specific requirements of other environmental programs. When an alternative does not comply, the discussion will include how the alternative prevents or minimizes the migration of chemical constituents and the associated public health or environmental impacts. Special design

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ATTACHMENT 2

STANDARD OPERATING PROCEDURES
FOR THE COLLECTION OF
ENVIRONMENTAL SAMPLES

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STANDARD OPERATING PROCEDURES FOR THE COLLECTION OF ENVIRONMENTAL SAMPLES

March 1986

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SECTION 1

INTRODUCTION

This document is Environmental Resources Management, Inc.'s (ERM) Standard Operating Procedures (SOPs) for the Collection of Environmental Samples, and includes procedures for collecting ground water, surface water, soil, sediment samples, and air samples. This document is intended to be an integral part of ERM's Quality Assurance/Quality Control project plans which also includes the following support documents: (1) the Site-Specific Project Work Plan, (2) Subcontract Laboratory Quality Control Plan, (3) Subcontract Laboratory Operations Manual, and (4) the Project Health and Safety Plan.

As much as possible, the procedures in this document have been standardized to make them applicable to all types of environmental investigations. It must be recognized, however, that under certain site specific conditions, all of the procedures discussed herein may not be appropriate. In such cases, it will be necessary to adapt the procedures given to the specific conditions of the investigation. To guarantee the timeliness of ERM's Standard Oerating Procedures, every six months this document will be reviewed and updated as necessary. Dates of review will be listed on the front cover and amendment on each individual page. All ERM employees are invited to comment on these Standard Operating Procedures and to submit their comments in writing to the company Quality Assurance Coordinator.

This document is divided into four major sections: (1) preparation of a project sampling plan; (2) procedures for the collection of environmental samples; (3) post-sampling procedures; and (4) sample packaging, shipping, chain-of-custody.

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SECTION 2

PREPARATION OF A PROJECT SAMPLING PLAN

Prior to the collection of environmental samples, it is necessary to prepare a project sampling plan which is site-specific. This will require determination of the following: (1) the objectives of the sampling program, (2) the media to be sampled, (3) the sampling locations, and (4) the analyses to be conducted. Predetermination of these items will result in the design and performance of a cost-effective and technically feasible sampling plan.

The three basic objectives of a sampling plan are the following: (1) determine the presence or absence of contamination, (2) determine the extent and magnitude of contamination, and (3) determine the contaminant pathways which may exist at a site. Each of these will greatly affect the sampling plan as each will subsequently affect the determination of the media to be sampled, the sampling locations, and the analyses to be conducted.

The second step in developing a sampling plan is the determination of the media to be sampled at a particular site. This may include the collection of surface and ground water samples, stream sediment samples, leachate springs or seeps, soil or rock samples, or air samples. Again, the materials to be sampled will be greatly affected by the objectives of the sampling.

The third step is to determine the sampling locations. In addition, it is necessary that the justifications for the selection of the sampling locations be detailed along with the intended use of the data.

The fourth step is to determine exactly what analysis will be conducted. The constituents analyzed are usually selected for several reasons. These are: (1) required by regulations; (2) considered to be toxic and present at the site or there is an indication of their presence at the site; (3) indicators of contamination which may not be toxic; and (4) site-specific constituents or those constituents known to be present at the site whether toxic or non-toxic.

All of the above factors will be dependent upon the work to be conducted at the site, whether it be a site investigation, feasibility study, and/or remedial design. In order to make informed decisions as to the above considerations, it is mandatory that all available background data on the site be collected

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and reviewed. Using this information, a detailed site-specific sampling plan for the investigation can be proposed. The plan must include a checklist of all equipment which will be needed during the sampling and a detailed discussion of all procedures to be used. As stated previously, the following sections will detail ERM's Standard Operating Procedures for the collection of environmental samples. These are to be used where applicable in the development and performance of the sampling plan.

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SECTION 3

PROCEDURES FOR THE COLLECTION OF ENVIRONMENTAL SAMPLES

The following discussion of sampling procedures for the collection of environmental samples is divided into five sections. These sections include procedures for the collection of (1) ground water, (2) surface water, (3) sediment, (4) soil samples, and (5) air samples.

3.1 Ground Water Sampling

There are two types of wells from which ground water samples may be obtained; monitoring wells or residential wells and municipal wells. Sampling from each of these will require the collection of different types of presampling information and sampling equipment, as well as different sampling procedures. Since sampling from monitoring wells is by far the most complex, it will be addressed first. The sampling of monitoring wells is further divided into three subsections: (1) preparation for sampling, (2) well evacuation, and (3) sample collection.

3.1.1 Monitoring Wells

3.1.1.1 Preparation for Sampling

Prior to going to a site, it is important to know the specifics of well construction, including: inside diameter of the well casing, total depth of the well, depth to the screened portion of the well, screen length, and the material used in the construction of the well and well screen. The diameter of the well casing is most important as it will directly affect the equipment and procedures to be used during well evacuation and sampling. The majority of the wells used only for monitoring have two-inch inside diameter casings, however, some older wells may have inside diameters of less than two inches. In many cases where ground water recovery may be a viable option for remediation of a contamination problem, wells with either four-, six-, or eight-inch inside diameter casings may have been installed. It is also important to know the accessibility of the wells. This may affect the selection of the sampling equipment to be used or, at a minimum, the procedure for getting the equipment to the well location. Prior to sampling, locate all the wells on a site map

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and determine the order in which each well will be sampled. If the water quality information is available, the order of well samples should be from least contaminated to most contaminated. Direction of anticipated or known ground water flow can be used to determine sampling order where no chemical data are available. Wells upgradient of the source area should be sampled first, then proceed from wells farthest downgradient and work towards the source area.

The following is a list of equipment which may be needed when evacuating and sampling monitoring wells:

- Material for sample preparation (see Section 4.2).
- Reagents for sample preservation (see Section 4.3).
- Appropriate sample containers (see Section 4.4).
- Meters, probes, and standards for field measurements (see Section 4.5).
- Appropriate field and transportation blanks. The type and number of blanks should be established with the laboratory conducting the analysis.
- Chain-of-custody labels, tags, and record forms (see Section 5.2).
- Keys. Many monitoring wells will have locking caps and keys will be necessary to gain access. In addition, some sites may be secured or may have a guard on duty, in which case keys and/or permission may be necessary.
- Tools to assist in well access. These may include screw drivers, hammers, chisels, pipe wrenches, or possibly a propane torch. All or any of these may be necessary for removing steel security caps on wells which have not been recently opened.
- Tape measure graduated in tenths and hundredths of feet. A tape measure may be useful for measuring the diameter of the well casing and the elevation of the well casing above ground level.
- Electronic water level indicator/graduated depth sounder. These may be necessary for determining the static water level and the total depth of the well if it is unknown.

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- Pocket calculator. This may be used for determining the volume of water within the well which, in turn, will be used for calculating the volume of water to be evacuated.

- Log book and indelible ink marker. This is for recording information pertinent to the sampling procedures used and observations on the environmental conditions at the time of sampling.

- Well evacuation equipment. In general a pump will be used to purge or evacuate stagnant water in the well prior to obtaining the sample (per Section 3.1.1.2). The size and capacity of the pump to be used will depend upon the inside diameter of the well casing, the depth to water, total depth of the well, well yield, and the volume of water to be removed. In some cases it may be necessary to use a bailer for well evacuation. ERM recommends that the following equipment be used for well evacuation when applicable.

  - For two-inch diameter wells where the depth to water is greater than 25 feet; an Isco Model No. 2600 diaphragm-type pump should be used for well evacuation.

  - For any well with an inside diameter of 2 inches or greater and where the water level in the well will remain above 25 feet; a self-priming centrifugal pump should be used. A gate value may be necessary to adjust the pumping rate so that the level of water in the well can be maintained above 25 feet. The ease of decontamination for this equipment makes it the first choice for evacuation.

  - A small-diameter bailer may be used to evacuate two-inch wells with a low volume of water needed to be purged from the well.

  - For large-diameter wells (4 inches or greater) where the depth to water is below 25 feet, a large-diameter, impellor-type, submersible pump will be required for evacuation. Great caution

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must be taken when using this pump as it can be very difficult to decontaminate compared to the other pumps used for evacuation.

- A dry inert gas or compressed air regulator. This is needed to activate the Isco 2600 pump. Nitrogen gas is recommended. Argon gas or compressed air can be used as an alternative.

- Bottom loading PVC, stainless steel, or Teflon bailer. The bailer will be used to obtain the ground water sample after the well has been evacuated. The choice of the material in bailer construction will depend on the site-specific characteristics.

- Decontamination solutions/water. These will be used for decontaminating all equipment that comes into contact with the ground water or contaminated materials (see Section 5.1).

- Buckets, scrub brushes, and sponges will be needed during cleaning of all contaminated material (see Section 4.1).

- Buckets and/or graduated plastic pails. These will be used for measuring the flow rate and volume of water evacuated from the well prior to sampling and also for containment of potentially contaminated water until it can be properly disposed of if required by the investigation. A low-flow, totalizing meter can be used where necessary.

- Camera/film. These may be required for documenting sampling procedures and well locations.

After assembling all of the required sampling equipment, be sure that it is in working order, and has been decontaminated.

3.1.1.2 Well Evacuation

Prior to evacuating the well, it will be necessary to determine the volume of water being held in the well casing. The calculation of the well volume should be conducted as follows:

1. Measure well casing inside diameter.

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2. Determine the static water level. This should be measured to the nearest one-hundredth of a foot below the measuring point elevation. The top of the well casing should be used as the measuring point and marked to standardize its location. (Note: The water indicator must be cleaned before use in each well.)

3. Determine the total depth of the well from the measuring point.

4. Calculate the number of linear feet of static water (total depth of the well minus the static water level).

5. Calculate the static volume in gallons (πr^2 h x 7.48 gal/ft^3).

   where:

   π = 3.14
   r = radius of well in feet
   h = number of linear feet of static water

It is ERM's policy that three well volumes be removed prior to sample collection. In most cases, removal of three well volumes should insure the collection of a representative sample not influenced by stagnant water remaining in the well casing, and yet not result in overpumping of the well. The latter can result in pulling diluted or more concentrated ground water from another area within the aquifer. If the well goes dry, during evacuation allow it to recover and re-evacuate until at least one and one-half (1-1/2) volumes are purged.

Before evacuating the well, the depth at which to place the pump in the well must be determined. In high-yielding wells the pump should be placed near the top of the water column rather than in the screened area. This forces water to move up the well casing to the pump; otherwise, water may be removed from the formation only and water standing in the well above the screen may not be evacuated. This will not occur though if the pumping rate is high enough to cause significant well drawdown. Most diaphragm-type pumps for small-diameter wells are not capable of flows greater than one and one-half (1-1/2) gallons per minute. Therefore, this problem is greater in high-yielding, small-diameter wells. If well yield is low to moderate, the pumps should be placed at the bottom of the screened interval. The flow rate of the pumps may be measured using a graduated plastic bucket, or a totalizing flow meter in the case of submersible pumps.

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The sample must not be obtained from the pump or bailer used to purge the well. Furthermore, any hose coming in contact with the ground water must be decontaminated before use in the next well to avoid the possibility of cross-contamination. Cross-contamination can be avoided if the rope and the hose used during well evacuation is dedicated to each particular well and decontaminated between each use in that particular well. If this is not feasible, the rope and hose should be decontaminated between use in each well at the site.

3.1.1.3 Sample Acquisition

The following procedure is recommended for obtaining ground water samples from monitoring wells:

- If a pump has been used to purge the well, the hose, rope, and pump must be removed from the well and decontaminated and/or stored in an appropriately labeled container if each is to be dedicated to the particular well. The pump used for evacuation must be dismantled and cleaned, if necessary.

- If a bailer has been used to purge the well, a previously cleaned second bailer must be used to obtain the sample.

- The bailer used for collecting the sample should be lowered into the well, retrieved, and emptied to insure that the bailer is only in contact with water in the well.

- When collecting the ground water needed for filling the sample bottles, the bailer should be gently lowered sufficiently into the water column to collect or sample unaffected by equilibration with the atmosphere (approximately ten feet, if possible), jerked gently to insure the ball valve is closed, and retrieved at a steady rate to the surface.

- When transferring the water from the bailer to the sample containers, care must be taken to avoid agitation to the sample which will promote the loss of volatile constituents, and promote chemical oxidation.

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- If a bailer is not dedicated to a specific well, it must be cleaned between wells. Procedures for cleaning of equipment are given in Section 4.1. Again, all equipment and materials coming into contact with the inside casing of the wells or the ground water must be cleaned.

The geochemistry of ground water is such that exposure of ground water samples to atmospheric conditions can result in substantial loss of sample integrity. Therefore, it is necessary that immediately after collection, the samples are prepared, preserved, and stored in such a manner as to prevent any changes in sample chemistry. Refer to subsequent sections of this document for the procedures for sample preparation, preservation, storage, and in situ measurements.

3.1.2 Residential and Municipal Wells

Some precautions must be taken when collecting ground water samples from residential and municipal wells. Proper scheduling of sampling periods for residential and municipal wells is important. It is important that a municipal well be sampled while it is in a pumping cycle; thus insuring that you are taking a sample from water that has not been held stagnant in the well casing. Residential wells are continuously pumped, with the usage rate varying over the course of the day (heavy in the early morning hours for showers, etc.; moderate during the day; and heavy again at evening during cooking, dishwashing, and shower usage). This continuous usage creates an established homogeneity in the water entering the residential well. Therefore, the largest factor affecting sample integrity is the residence time water has spent in the pressure tank (holding tank). Also, when sampling a group of residential wells in a particular area, be sure to sample them over a relatively short period of time. When collecting more than one round of samples, make the sampling periods consistent with respect to the time of day the samples are taken.

When sampling residential and municipal wells, site accessibility is normally not a problem, since a limited amount of equipment is required. However, accessibility of the well can cause major problems. Before attempting to sample a residential well, determine if the well is physically accessible for sampling. For municipal wells, check to see if a spigot or valve is available from which a sample can be taken. Be sure that the sampling port or spigot is positioned as close to the well head as possible and prior to any type of treatment process, such as a water softener or carbon filtration unit. Residential wells generally have a spigot located at the base of the pressure tank. This is usually

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the closest tap to the actual well head. When collecting raw samples from the tap off the pressure tank, a cold water faucet should be turned on and run a minimum of five minutes and/or until temperature stabilization (two readings plus/minus ten percent). pH and/or conductivity may also be used to indicate fresh water is entering the pressure tank. After stabilization has been achieved, continue to run the cold water faucet and collect samples from the tap off the pressure tank. This will insure collection of a representative sample.

Contact the owner's or operator's of the wells to determine what tools, valves, hoses, etc., will be needed. Wrenches may be needed for opening and closing faucets or spigots. Often spigots on municipal wells may be too large, resulting in a high-volume flow which will make sampling difficult. In this case, it will be necessary to reduce the flow by using appropriate fittings. Obtain information from the operator on the size of the fittings required and on accessibility of the sampling spigot. It may be convenient to attach a section of hose to the line, especially under very cramped quarters.

Generally, all the equipment listed in the previous section on ground water sampling for monitoring wells should be used during the sampling of residential and municipal wells with the exception of the pumps and the bailer. Since municipal wells are high-volume water producers, there is no necessity for evacuating the well. However, the lines between the well and the spigot must be cleared. For most residential and municipal wells, the samples can be collected either directly into the sample bottles or, in cases where sample filtration is needed, samples can be placed directly into the filtration apparatus.

When collecting samples after residential or municipal systems with activated carbon treatment, a post-treatment tap simply needs to be cleared of stagnant water. Sample collection can then proceed, usually directly into the sample container. As with the ground water samples collected from monitoring wells, it will be necessary to prepare and preserve the samples prior to storage. Refer to the later sections of this document for the procedures for sample preparation, sample preservation, and sample storage in Sections 4.2, 4.3, and 4.4, respectively.

3.2 Surface Water Sampling

Surface water sampling may include the sampling of streams, rivers, ponds, or lakes. Prior to sampling, the surface water drainage in and around the area to be studied should be characterized using all available background information, including

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topographic maps and aerial photographs. As with all sampling procedures, an initial survey of the site should be conducted to verify sampling locations. This site survey will help to identify any special equipment, personnel safety requirements, or procedures which might be necessitated by terrain or other factors specific to the site. Needed background information includes: the depth of the surface water body, flow rate, and overall position of the sampling point and/or stream or tributary in the stream basin. Also, it is recommended that stream characteristics, such as stagnation zones or mixing zones which might affect the distribution or volatilization of constituents in the water, be noted.

The equipment needed for most surface water sampling is minimal. In fact, in many instances, the sample container will serve as the sampling device. The following is a recommended list of surface water sampling equipment and accessories:

- Materials for sample preparation (see Section 4.2).
- Reagents for sample preservation (see Section 4.3).
- Appropriate sample containers (see Section 4.4).
- Meters, probes, and standards for in situ measurements (see Section 4.5).
- Appropriate field and transportation blanks. The type and number of blanks should be established with the laboratory conducting the analysis.
- Chain-of-custody labels, tags, and record forms (see Section 5.2).
- Flow and velocity estimation devices.
- Sampling devices. These may include anything from use of the sample containers to use of a telescoping aluminum pole with an attached clamp and beaker known as a grab sampler. These can be bought from laboratory supply houses. Otherwise, a Kemmerer sampler can be used to collect samples from a particular depth in the water column. Due to problems which may result from the inaccessible nature of many surface sampling locations, it may be appropriate to use a boat to sample surface waters.

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- Decontamination solutions/water. These will be used for decontaminating all equipment that comes into contact with the sample (see Section 4.1).

- Buckets, plastic wash basins, scrub brushes, and sponges. These will be used for cleaning contaminated equipment and materials.

- Camera/film. For use in documenting sampling procedure and sample location.

Most surface water samples are taken as grab samples. Typically, surface water sampling involves immersing the sample container into the body of water. The following suggestions are made to help insure that the samples obtained are representative of the body of water being sampled:

- Generally, the most representative samples of streams or rivers are obtained at mid-channel, at one-half of the stream depth in a well mixed stream.

- Stagnated areas in streams or rivers might contain zones of contaminant concentration, depending upon the physical/chemical properties of the contaminants and the position of these stagnated waters relative to the source of contamination.

- When sampling a stream, proceed from downstream to upstream stations to avoid releasing contaminants into the water from bottom sediments.

- Though the containers used to obtain the samples are previously cleaned in the laboratory, it is recommended that the sample container be rinsed at least once, preferably three times, with the water to be sampled before the sample is taken.

- Sampling must begin at the suspected zones of lowest contamination and proceed towards to the zones of highest contamination.

- When sampling a pond or other large standing body of water, the surface area may be divided into grids. A series of samples may be taken from each grid and combined into one sample (a composite) or separate samples may be obtained from several grid locations at random. This will improve the representativeness of the sample and/or samples.

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- A discrete composite sampler may be used to collect a composite sample at a specific location over time or proportional to flow.

- Care should be taken to avoid excessive agitation of the water which can result in the loss of volatile constituents.

- Do not take a surface water sample at the surface/water interface unless sampling specifically for a known constituent which is immiscible with water (i.e., such as oil which floats on top of water). Instead, the sample container should be inverted, lowered to one-half the water depth, and held at about a 45° angle with the mouth of the bottle facing upstream.

Generally, surface water samples are more stable than ground water samples because these waters tend to be in equilibrium with atmospheric conditions. Therefore, samples from these streams will not undergo significant changes in water chemistry upon extraction from their environment. However, it is best not to assume that the surface water samples can be left unattended after collection. Hence, it is necessary to prepare, preserve, and store the samples appropriately as described in Sections 4.2, 4.3, and 4.4 of this document. Also, it is important that all the in-situ measurements described in Section 4.5 of this document be performed immediately after sample collection.

3.3 Sediment Sampling

The collection of sediment samples from ponds, lagoons, or streams is normally not a difficult task unless sampling is being conducted at great depth, in which case a boat and specialized equipment would be necessary. Caution must be taken to obtain samples which will be representative of the contaminants of interest versus the sediment materials present. For example, it is unlikely that absorbed organic constituents will be found in high concentrations in coarse-sized materials. However, the finer materials which are most likely to absorb organic contaminants from stream waters may not be located within the immediate flow areas of the stream transporting the contaminants, rather they would be located in less turbulent areas.

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A review of site background information may give an indication of the type of constituents present in the sediments and the type of sediments to be collected. It is important to consider the following:

- Constituents which may have affinities for particular sediment types.

- Hydrogeological information which may help establish a relationship between the contaminant source and the contaminants in the sediment.

- The pH of the surface water over the sediments. Unusual pH conditions may influence contaminant precipitation.

- Several sediment samples should be obtained from the area nearest the suspected contaminant point source. These samples should also be collected from various types of materials near the source (i.e., coarse gravels versus fine clays) to determine the relationship of the contaminants to the sediment material.

- Samples should be collected progressing from downstream to upstream to prevent the release of potentially contaminated sediments from one sampling station to another further downstream.

When developing a sampling plan for the collection of sediments from small streams or surface drainageways, it is important to address possible effects of runoff which may have occurred many years prior to the time of sampling. Consequently, it is often insufficient to test only the surface sediments because erosion and deposition of additional stream bed sediments in the intervening years could have formed a cover of uncontaminated surface sediments over potentially contaminated sediments. Therefore, the following procedures are recommended for the collection of samples from small streams:

- Assess which side of the stream received contaminated sediments from overland flow and collect samples on that side of the stream from mid-stream to the stream bank.

- Using a shovel, core or bucket sampler, collect a surface grab or composite sample of the top six inches of sediment.

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- At these same locations, collect another grab or composite sample at an approximate depth of six to twelve inches.

- The number of samples collected at each location should be proportionate to the stream width (i.e., three samples from a six-foot wide stream should sufficiently characterize sediment quality).

Comparatively, when sampling from large rivers, ponds or lakes, it may be necessary to lay out a visual or surveyed grid, if possible, and composite samples or collect grab samples from either random or regular locations within the grid.

After determining the relationship between the contaminant constituents and the sediments, a sampling plan can be prepared. The following is a list of recommended sediment sampling equipment:

- Materials for sample preparation (see Section 4.2).

- Appropriate sample containers (see Section 4.4).

- Chain-of-custody labels, tags, and record forms (see Section 5.2).

- Log book and indelible ink marker. This is for recording information pertinent to the sampling procedures used and observations on the environmental conditions at the time of sampling.

- Sampling devices. Sample devices may range from the sample container and a trowel, to more elaborate power-driven devices. See the discussion below on sediment sampling techniques.

- Decontamination solutions/water. These will be used for decontaminating all equipment that comes into contact with the sediment and the sampling devices (see Section 4.1).

- Buckets, wash basins, scrub brushes, and sponges. These will be used for cleaning of all contaminated materials.

- Camera/film. For use in documenting sampling procedures and sample locations.

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Very simple techniques can usually be employed in collecting sediment samples. Below are some suggested techniques for sediment sampling:

- As previously mentioned, in small, low-flowing streams or near the shore of a pond or lake, the sample container, a shovel, or hand-operated bucket auger may be used to scrape up sediments. The sediment must be dewatered as much as possible so as not to reflect soluble concentrations in the water.

- To obtain sediments from larger streams or further from the shore of a pond or lake, a beaker attached to a telescoping aluminum pole by means of a clamp may be used to dredge sediments.

- To obtain sediments from rivers or in deeper lakes and ponds, a spring-loaded sediment dredge (Eckman dredge) or benthic sampler may be used. Several types of sediment core samples exist for specialized sampling of sediments.

Lastly, all the equipment used should be decontaminated between the sampling stations using the procedures described in the following section.

3.4 Soil Sampling

There are two types of soil samples: surface (consisting of the top two feet) and subsurface (below two feet). In most cases, both types will be collected as grab samples. Although, in some cases composite sampling may be useful for obtaining data about contamination over a wide area. This provides a rough estimate of the overall extent and magnitude of contamination, while reducing the analytical costs. However, when composite sampling, it is important that extreme care be taken in documenting the location and depth of the composites.

3.4.1 Surface Soil

Listed below are three possible scenarios for the collection of surface soil samples over a large area:

- the total area may be divided by a grid system to identify specific sampling locations;

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- if the area is large and if complete characterization is required, a random sampling approach may be used to reduce the number of samples. In this instance, the area is laid out in a grid and sample locations determined randomly; and

- an extremely large study area can also be divided by grids with soil samples being composited from several locations within the grid.

The list of equipment necessary for the collection of surface soil samples may be minimal, depending upon the analytical parameters to be determined. As previously discussed in Section 2 of this document, the sampling devices may be constructed of either PVC, linear polyethylene, Teflon, or stainless steel, depending upon the parameters of interest. The following is a list of equipment necessary for the collection of surface soil samples:

- Materials for sample preparation (see Section 4.1).

- Appropriate sample containers (see Section 4.4).

- Chain-of-custody labels, tags, and record forms (see Section 5.2).

- Log book and indelible ink marker. This is for recording information pertinent to the sampling procedures used and information on environmental conditions at the time of sampling.

- Sampling devices. Generally, these include a scoop or hand trowel constructed of appropriate material. However, in some cases, shovels, picks, hoes, and/or hand augers may be necessary.

- Decontamination solutions/water. These will be used for decontaminating equipment (see Section 4.1).

- Buckets, plastic wash basins, scrub brushes, and sponges. These will be used in the cleaning of contaminated equipment.

- Camera/film. For use in documenting sampling procedures and sample location.

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Grab samples of surface soils are collected by placing the scooped or troweled sample into an appropriately sized bottle. However, composite soil sampling requires considerably more caution. Depending upon the number of samples to be collected and the area to be covered, the soil samples from various areas should be placed into an appropriately constructed pan, thoroughly mixed, and an appropriately sized aliquot taken. It is important that the volume of soil from each location be as identical as possible. When possible, it is recommended that composite soil sampling only be conducted when the soils are relatively dry. Wet soils are very difficult to work with thus making the collection of a representative composite sample difficult. Since it is necessary to split the samples and expose them to the atmosphere prior to storage, it is impossible to collect representative composite soil sample for volatile constituents.

3.4.2 Subsurface Soil

Subsurface soils can be collected either as grab or composite samples. The same precautions for composite sampling of surface soils apply to the compositing of subsurface soils. Although this document does not generally discuss safety factors involved in the collection of samples, it is important at this point to note that the collection of subsurface soil samples can constitute a substantial safety hazard. The most important safety factor involved is the avoidance of buried containers or pockets of highly contaminated material. A thorough background information search should be completed before obtaining subsurface samples. At a minimum, a metal detector survey should also be performed at sites where buried materials are suspected.

Generally, the problems encountered in the collection of subsurface soil samples are similar to those encountered in the collection of surface soil samples. Additionally, subsurface sampling must also address the depths from which the samples will be obtained. The overall approach is similar to that discussed previously for surface sampling, considering the aspects of grid systems and random versus specific sampling locations. The depths at which samples are to be taken will depend upon the suspected contaminants, their general mobilities, and the method by which they have entered the subsurface environment. Generally, subsurface samples can be obtained by three methods: shallow subsurface sampling by hand-operated equipment and deep subsurface samples by use of a drilling rig or a backhoe.

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The following is a list of recommended equipment for sampling subsurface soils:

- Materials for sample preparation (see Section 4.2).
- Appropriate sample containers (see Section 4.4).
- Chain-of-custody labels, tags, and record forms (see Section 5.2).
- Log book and indelible ink marker. This is for recording information petinent to the sampling procedures used and observations on the environmental conditions at the time of sampling and the location.
- Sampling devices (depending upon the sampling methods described in the following paragraph).
- Decontamination solutions/water. These will be used for decontaminating all equipment that comes into contact with the soils and the inside of the casing or auger flights (see Section 4.1).
- Buckets, wash basins, scrub brushes, and sponges. These will be used for equipment decontamination.
- Steam cleaner. A steam cleaner should be used when attempting to decontaminate large pieces of equipment such as auger flights.
- Camera/film. These are for use in documenting sampling procedures and sample locations.

Depending upon the depth and type of samples to be collected, a variety of methods are available for sampling subsurface soils. These include:

- A shovel which may be used to depths of several inches or several feet, depending on soil types.
- A slotted sampling trier which is limited to about two and one-half (2-1/2) to three feet.
- A hand auger may be used to collect subsurface samples at depths up to four to five feet; however, it mixes and thus destroys the cohesive structure and stratigraphic character of the soil preventing detailed soil description.

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- A hand-driven split-spoon sampler provides a means to obtain somewhat undisturbed core samples. The depth will again be limited by the soil type.

- Drill rig-operated sampling devices. These may be placed into two categories: (1) solid stem augers and (2) hollow stem augers. With solid stem augers, materials are mixed as brought to the surface, making representative samples from discreet depths impossible to obtain. With hollow stem augers, either a split-spoon or Shelby tube can be used for sample collection.

- Soil samples may be collected from a backhoe trench. It is emphasized that at no time should the sampler enter the backhoe trench. A contaminated air supply or possible caving makes this a dangerous situation. To collect samples from the pit, a long-handled bucket auger or the backhoe bucket may be used to collect the soil from the desired depth interval.

Lastly, proper decontamination procedures, discussed in Section 4.1, should be used in cleaning all the soil sampling equipment. Sample preservation for soils is not as imperative although volatile organic soils should be kept cool, and ERM recommends refrigeration of all soil samples.

3.5 Air Sampling

Air sampling of a hazardous waste site is useful in assessing potential adverse health effects caused by the inhalation of organics or inorganic constituents. Organic compounds volatizing into the air from surface streams, lagoons, open drums, or contaminated soils, as well as inorganic particulates, such as asbestos or lead, may be collected in sampling bags or tubes and analyzed to determine the specific constituents and their respective concentrations.

As previously discussed with the other types of environmental sampling, an initial survey of the site is necessary to provide background information needed for the design of an effective air sampling program. This background information includes: identification of personnel safety requirements, the locations of potential contaminant source areas, location of a background sampling station, and prevailing upwind and downwind directions. Also, if the types of constituents that are being monitored are known, then the sampling program should be designed to better

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detect these constituents. For example, heavy organic compounds will migrate along the ground surface and should be sampled at ground level.

The equipment needed for air sampling is minimal. Sampling for organic constituents will only be addressed in this section. Sampling air for organic vapor is performed by drawing air into a sample collection bag using an Analytical Instrument Development, Inc. Portable Organic Vapor Meter (OVM). Two design features of the Model 580 make this type of sample collection the preferred method. The first is that the detection system used in the Model 580 is the Photoionization Detector which is a non-destructive detector, making it possible to run the sample through the detector into the sample bag without changing the character of the sample. This makes it possible for the collection of the exact sample which may cause a high reading on the meter. The feature of the Model 580 that allows this sample collection is a positive displacement pumping system used to draw the sample into the Model 580. It is then a very simple procedure to attach the sample bag to the exit of this pump and trap the sample after it has passed through the detector.

Besides the OVM, the other necessary equipment needed for air sampling is as follows:

- Sample Collection Bag. The material and size of the sample bag is dependent upon the constituents which are to be analyzed. A one-liter size is an acceptable sample volume for most analysis. When analyzing for organic compounds, absorption of the organic molecules onto the surface of the bag becomes a serious problem. It is suggested that the bags be constructed or at least lined with Teflon or polyethylene to minimize the amount of absorption.

- Intake Collection Tube. This may be constructed of a relatively inert material, such as Tygon, which can be disposed of after the collection of each sample.

- Chain-of-custody labels, tags, and record forms (see Section 5.2).

- Log book and indelible ink marker. This is for recording information pertinent to the sampling.

- Camera/film. For use in documenting sampling procedures and sample locations.

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The actual collection of the sample is a relatively easy operation. The bag is attached to the OVM using the intake tubing. The OVM is switched on and air is pumped through the OVM, out the exit port, and into the sample bag until the bag is stiff but not bursting. The OVM Model 580 pumps at a rate of 500 ml per minute which will fill a one-liter bag in approximately two minutes. During filling, the OVM readings should be recorded for comparison to the final analysis. After the bag is filled, the valve on the bag is closed, and the bag is detached from the intake tubing.

It should be noted that air samples cannot be collected as composite samples since the bag may not be sealed and opened again before analysis. Also, analysis of the constituents in the bag should be conducted as soon as possible to prevent possible absorption of organics onto the surface of the bag. Background information on site conditions can be obtained by collecting an upwind sample at the site. During the sampling period, recording of the general weather conditions such as wind directions, wind speed, temperature, humidity, and degree of cloud cover may prove useful in the assessment of the results. Because high humidity and/or dampness interfere with the OVM intake system, air samples may not be collected during precipitation events.

Other than sample labeling, logging, and chain-of-custody, there is very little preparation needed for air samples. Organic samples should be kept cool (about 4°C) as prescribed in Section 4.3 of this document. The intake tubing should be discarded after each sample is collected. Most collection bags are reusable and should be properly purged according to the specifications of each individual manufacturer.

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SECTION 4

POST-SAMPLING PROCEDURES

Post sampling procedures include: (1) equipment decontamination, (2) sample preparation, (3) sample preservation, and (4) sample storage. Additionally, in many cases, in-field measurements of certain parameters may be required.

4.1 Equipment Decontamination

All non-disposable equipment used for the collection, preparation, preservation, and storage of the environmental samples must be cleaned prior to their use and after each subsequent use. Unless the equipment and materials being used are disposable or of sufficient number so as not to be reused during any one sampling period, decontamination will have to be conducted in the field. Field decontamination can be a tedious and expensive chore, as it can require taking into the field a sizable amount of equipment and reagents. If possible, attempts should be made to minimize field decontamination.

The materials needed for decontamination are dependent upon the equipment to be cleaned. The following is a very generalized list of equipment to be used during decontamination:

- Cleaning solutions. These will be dependent upon the items to be cleaned and the parameters which are being analyzed.

- Water. In some cases, tap water may be adequate for initial or intermediate rinses. The final rinses, however, must be with deionized/distilled water.

- Storage vessels. These will be used to transport large volumes of deionized/distilled water to the site. It is recommended that fifteen-gallon plastic carboys with a spigot positioned near the bottom of the tank be used.

- Buckets and wash basins. For use in the washing and rinsing of equipment.

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- A drying rack. All materials and equipment must be dried prior to additional use. Paper towels or Chemwipes should not be used for drying surfaces of equipment which come into contact with the samples.

- Paper towels and Chemwipes. For use in cleaning all outside surfaces or surfaces that do not come into contact with the sample.

Basically, there are two types of recommended field cleaning procedures. When collecting samples for inorganic constituents, the following procedures are recommended:

- Wash with a non-phosphate detergent (or steam clean).

- Rinse with tap water.

- Wash or rinse through the use of a squirt bottle with a dilute nitric acid. A one to five percent nitric acid solution is adequate.

- Rinse three times with deionized/distilled water.

When sampling for organic parameters, the following cleaning sequence is recommended:

- Wash with a non-phosphate detergent (or steam clean.
- Rinse with tap water.
- Rinse with reagent-grade acetone.
- Triple rinse with deionized water.

If analyses are to be conducted for ammonia or nitrogen compounds, it is necessary that a one to five percent solution of hydrochloric acid be used in place of the nitric acid bath. If it is found that persistent stains or water marks are present, it may be desirable to use a chromic acid solution as a further cleaning procedure. However, both hydrochloric acid and chromic acid are extremely corrosive and, if possible, their use should be avoided while in the field.

Larger pieces of equipment may require specialized decontamination procedures. The small-diameter bladder-type pump can be decontaminated with the use of two specially-designed decontamination tanks. These tanks can be constructed of a three-foot section of four-inch I.D. PVC pipe with an end cap placed on one end. The pump is set inside one tank along with three to five gallons of clean tap water. By pumping the clean tap water from

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the tanks, both the outside and inside of the pump can be decontaminated. After the tap water wash, the pump should be appropriately cleaned as per the above procedures using deionized water and the second tank.

The tubing used for a centrifugal pump can be decontaminated by pumping tap and then distilled water through the tubing. The outside of the tubing can be decontaminated by use of a pressure sprayer. To avoid cross-contamination, it is recommended that the PVC tubing be dedicated to each well and cleaned between uses.

Larger diameter submersible pumps are difficult to decontaminate and for this reason should be used only where absolutely necessary. These pumps have high flow rates and large volumes of clean water are needed to decontamiante the inside of the tubing. In most cases, the cost of the tubing for these pumps is prohibitive to dedication of tubing to each well. A pressure sprayer can be used to effectively decontaminate the outside of the pump and tubing. At sites where a clean tap water source is available, the submersible pump should also be decontaminated by pumping 75 to 100 gallons through it and the discharge tubing. A 45-gallon polyethylene drum has been dedicated for this use.

4.2 Sample Preparation

Immediately before sample collection, each sample bottle should have a label attached which includes the following information: sample identification, date, time, sampler's name, analysis requested, and the site name.

Whether or not a sample is to be prepared prior to preservation and storage depends upon the analyses to be conducted and the type of sample collected. If dissolved metal concentrations are desired, then the sample must be filtered in the field immediately after collection. Field filtration of surface water samples is not as critical as filtration of ground water samples. Surface water samples generally exist in equilibrium with atmospheric conditions and, as such, will not undergo rapid change after collection. However, ground waters tend to be more reducing and, precipitation will occur if the sample is not filtered immediately after withdrawal.

It is recommended that all surface and ground water samples be filtered using a Sartorious™, or Nalgene™ filtration apparatus or a Millipore™ pressure filter, depending on the quantity and turbidity of the samples (Figures 1, 2, and 3). The Sartorius™ and Nalgene™ apparatus is inert with respect to metals

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Figure 1
Sartorious Filtration Apparatus

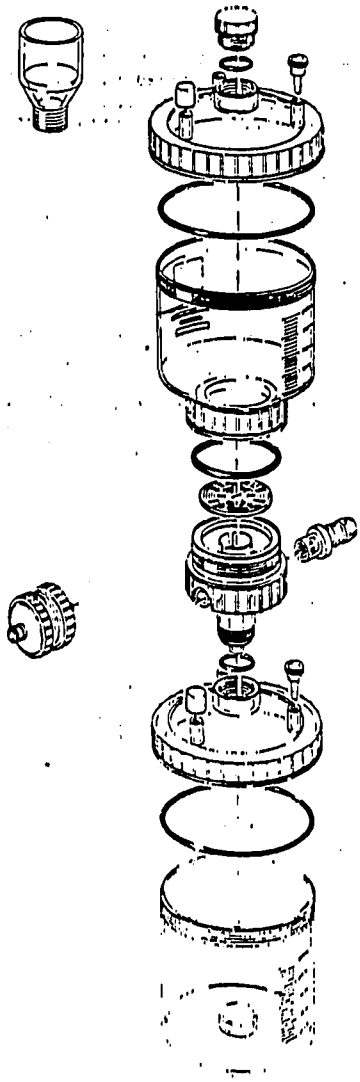

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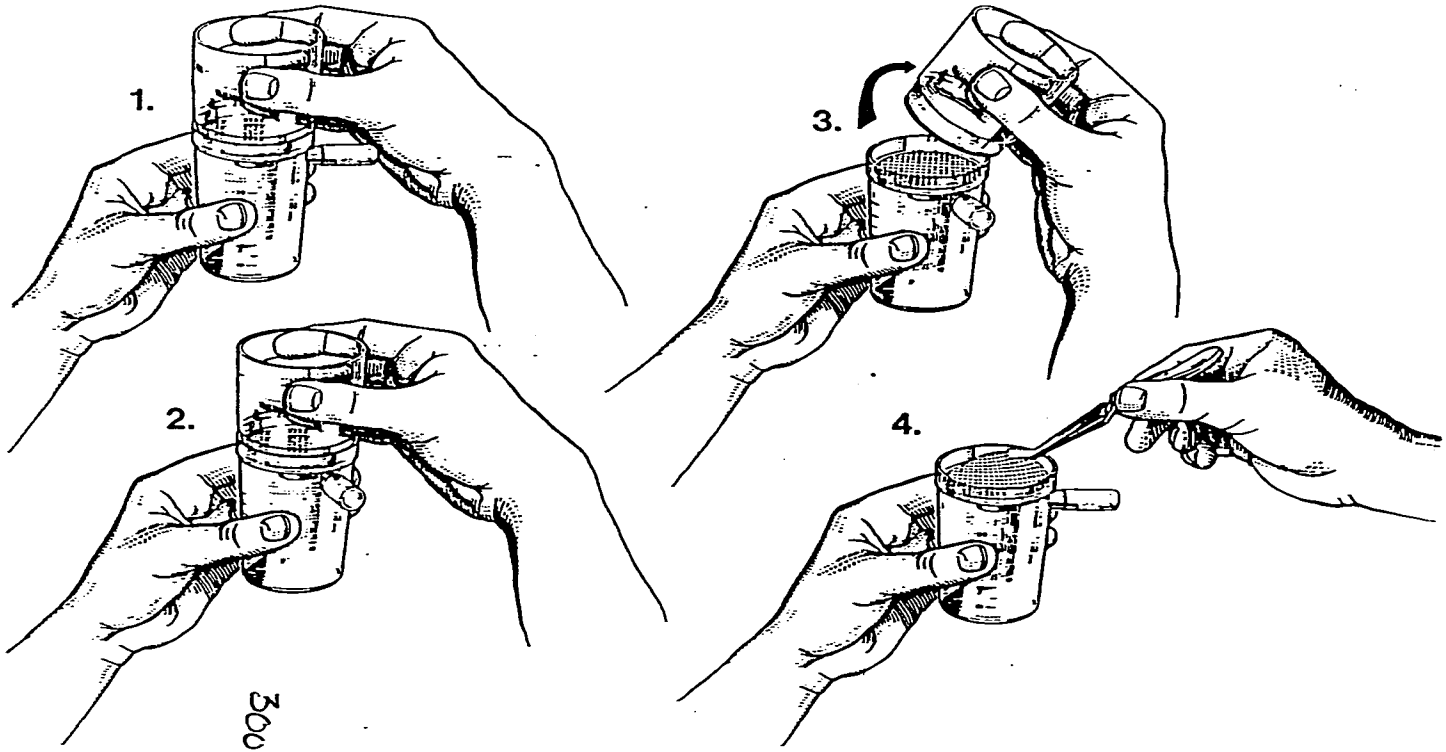
Figure 2 - Nalgene Disposable Filter Unit



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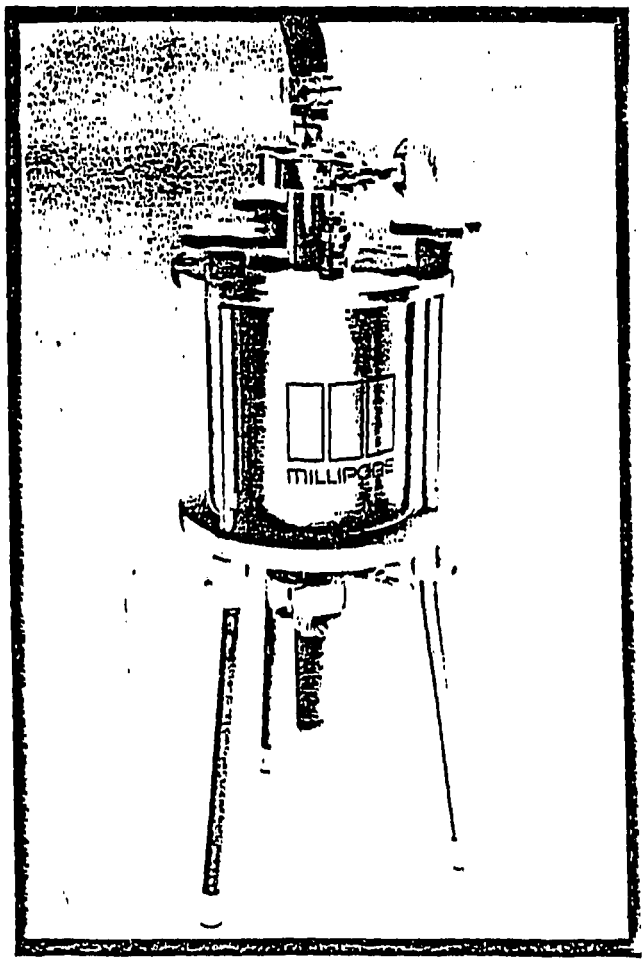
MILLIPORE®

Figure 3 - Millipore Pressure Filter

HAZARDOUS WASTE FILTRATION SYSTEM



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INSTALLATION, OPERATION AND MAINTENANCE MANUAL
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is a closed system which will prevent oxidation of the sample. A .45-micron pore sized membrane should be used for sample filtration. The sample may be pumped through the filter using a standard laboratory vacuum pump or a Nalgene hand vacuum pump. The Millipore™ pressure filter can be used where large volumes of sample need to be filtered, or the sample is extremely turbid. This pressure filter allows for rapid filtration and is constructed of all stainless steel and Teflon™ materials. A N_2 gas sample is needed to operate it. Samples being collected for organic contaminants need not be field filtered.

In general, soil and sediment samples are not prepared in the field. However, in cases where composite samples are being collected, it may sometimes be desirable to combine and split the samples in the field. In these cases, it will be necessary to sieve the samples to remove large, non-representative fractions and then to split the same using a soil sample splitter. This procedure, however, will be extremely difficult if the soils and sediments are damp or wet. In this case, it will be necessary to return the individual aliquots to the laboratory for preparation. As stated previously, samples collected for volatile constituents cannot be composited.

4.3 Sample Preservation

It is impossible to completely stabilize every constituent within a sample. At best, preservation techniques can only retard the chemical and biological changes that continue after the sample is removed from its environment. If the sample environment is significantly different from atmospheric conditions, the sample may undergo changes which will render it non-representative of its original environment. Methods of preservation are relatively limited and are intended to retard biological action, hydrolysis of chemical compounds and complexes, and volatility. Generally, preservation methods are limited to pH control, chemical addition, refrigeration, and freezing. Table 1 gives recommended volume sizes, container types, preservatives, and holding times for a variety of standard water quality parameters. Please be aware that preservative techniques are continuously changing, and these should be routinely checked.

Sample preservation should be performed in the field immediately after sample collection and preparation. In many cases where pH control or additions of reagents are required, separate bottles and preservatives may be supplied by the laboratory. In other cases, the preservatives may be placed directly in the sample bottle prior to collection.

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Table 1
Recommendation For Sampling And Preservation Of Samples According To Measurement

Measurement	Vol. Req. (ml)	Container[1]	Preservative	Holding Time[2]
100 Physical Properties				
Color	50	P,G	Cool, 4°C	24 Hrs.
Conductance	100	P,G	Cool, 4°C	24 Hrs.[3]
Hardness	100	P,G	Cool, 4°C HNO_3 to pH < 2	6 Mos.[3]
Odor	200	G only	Cool, 4°C	24 Hrs.
pH	25	P,G	Det. on site	6 Hrs.
Residue				
Filterable	100	P,G	Cool, 4°C	7 Days
Non-Filterable	100	P,G	Cool, 4°C	7 Days
Total	100	P,G	Cool, 4°C	7 Days
Volatile	100	P,G	Cool, 4°C	7 Days
Settleable Matter	1000	P,G	None Req.	24 Hrs.
Temperature	1000	P,G	Det. on site	No Holding
Turbidity	100	P,G	Cool, 4°C	7 Days
200 Metals				
Dissolved	200	P,G	Filter on site HNO_3 to pH < 2	6 Mos.[3]
Suspended	200		Filter on site	6 Mos.
Total	100	P,G	HNO_3 to pH < 2	6 Mos.[3]

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Table 1 (Cont)

Measurement	Vol. Req. (ml)	Container[1]	Preservative	Holding Time[1]
Mercury				
Dissolved	100	P,G	Filter on site HNO_3 to pH < 2	38 Days (Glass) 13 Days (Hard Plastic)
Total	100	P,G	HNO_3 to pH < 2	38 Days (Glass) 13 Days (Hard Plastic)
300 Inorganics, Non-Metallics				
Acidity	100	P,G	None Req	24 Hrs.
Alkalinity	100	P,G	Cool, 4°C	24 Hrs.
Bromide	100	P,G	Cool, 4°C	24 Hrs.
Chloride	50	P,G	None Req.	7 Days
Chlorine	200	P,G	Det. on site	No Holding
Cyanides	500	P,G	Cool, 4°C NaOH to pH 12	24 Hrs.
Fluoride	300	P,G	None Req.	7 Days
Iodide	100	P,G	Cool, 4°C	24 Hrs.
Nitrogen				
Ammonia	400.	P,G	Cool, 4°C H_2SO_4 to pH < 2	24 Hrs.
Kjeldahl, Total	500	P,G	Cool, 4°C H_2SO_4 to pH < 2	24 Hrs.[m]
Nitrate plus Nitrite	100	P,G	Cool, 4°C H_2SO_4 to pH < 2	24 Hrs.[m]
Nitrate	100	P,G	Cool, 4°C	24 Hrs.
Nitrite	50	P,G	Cool, 4°C	48 Hrs.

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Table 1 (Cont)

Measurement	Vol. Req. (ml)	Container[1]	Preservative	Holding Time[2]
Dissolved Oxygen Probe	300	G only	Det. on site	No Holding
Winkler	300	G only	Fix on site	4–8 Hours
Phosphorus Ortho-phosphate, Dissolved	50	P,G	Filter on site Cool, 4°C	24 Hrs.
Hydrolyzable	50	P,G	Cool, 4°C H_2SO_4 to pH < 2	24 Hrs.[4]
Total	50	P,G	Cool, 4°C H_2SO_4 to pH < 2	24 Hrs.[4]
Total, Dissolved	50	P,G	Filter on site Cool, 4°C H_2SO_4 to pH < 2	24 Hrs.[4]
Silica	50	P only	Cool, 4°C	7 Days
Sulfate	50	P,G	Cool, 4°C	7 Days
Sulfide	500	P,G	2 ml zinc acetate	24 Hrs.
Sulfite	50	P,G	Det. on site	No Holding
400 Organics				
BOD	1000	P,G	Cool, 4°C	24 Hrs.
COD	50	P,G	H_2SO_4 to pH < 2	7 Days[4]
Oil & Grease	1000	G only	Cool, 4°C H_2SO_4 or HCl to pH < 2	24 Hrs.
Organic carbon	25	P,G	Cool, 4°C H_2SO_4 or HCl to pH < 2	24 Hrs.
Phenolics	500	G only	Cool, 4°C H_3PO_4 to pH < 4 1.0 g $CuSO_4$/l	24 Hrs.
MBAS	250	P,G	Cool, 4°C	24 Hrs.

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Table 1 (Cont)

Measurement	Vol. Req. (ml)	Container[1]	Preservative	Holding Time[1]
N/A	50	P,G	Cool, 4°C	24 Hrs.

1. More specific instructions for preservation and sampling are found with each procedure as detailed in this manual. A general discussion on sampling water and industrial wastewater may be found in ASTM, Part 31, p. 72–82 (1976) Method D-3370.

2. Plastic (P) or Glass (G). For metals, polyethylene with a polypropylene cap (no liner) is preferred.

3. It should be pointed out that holding times listed above are recommended for properly preserved samples based on currently available data. It is recognized that for some sample types, extension of these times may be possible while for other types, these times may be too long. Where shipping regulations prevent the use of the proper preservation technique or the holding time is exceeded, such as the case of a 24-hour composite, the final reported data for these samples should indicate the specific variance.

4. If the sample is stabilized by cooling, it should be warmed to 25°C for reading, or temperature correction made and results reported at 25°C.

5. Where HNO_3 cannot be used because of shipping restrictions, the sample may be initially preserved by icing and immediately shipped to the laboratory. Upon receipt in the laboratory, the sample must be acidified to a pH <2 with HNO_3 (normally 3 ml 1:1 HNO_3/liter is sufficient). At the time of analysis, the sample container should be thoroughly rinsed with 1:1 HNO_3 and the washings added to the sample (volume correction may be required).

6. Data obtained from National Enforcement Investigations Center-Denver, Colorado, support a four-week holding time for this parameter in Sewerage Systems. (SIC 4952).

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4.4 Sample Storage

The ideal sample bottle must be constructed of a non-reactive material. In general, there are three types of material from which sample bottles are made. These are: plastic, glass, and Teflon. In general, samples collected for metals and general water quality parameters are stored in plastic bottles. Samples collected for organic analysis are routinely placed in glass bottles of various types and sizes, depending upon the particular analysis to be conducted. Table 1 gives a list of recommended sample containers and their volumes. In most cases, bottles will be supplied by the laboratory conducting the analysis.

4.5 In-Field Measurements

As discussed previously, determination of sample pH, Ec, Eh, and temperature on ground and surface waters require in field measurements taken immediately after sample collection. Although in-field measurements are more critical for ground water samples than samples from aerated surface waters, it is recommended that measurements be taken as soon as the sample is removed from its in-situ environment. When possible, measurements may be made directly in the well to avoid the loss of sample integrity.

An alternative method for in-situ measurements is through the use of a "closed cell". This is particularly applicable to ground water measurements where pumped water can be used to fill up a closed container in which measurement probes have been previously installed (closed cell). After removing all head space from the closed cell, the cell is closed to atmospheric conditions through the use of two stop cocks. This allows measurements on ground water samples to be made as close to its original, reducing environment as it were in the formation, and eliminates error due to atmospheric oxidation of the sample.

Prior to conducting the in-field measurement, the samplers or field team must review the operating manuals for the equipment to be employed and guarantee that all of the instruments and probes are properly standardized. All measurements should then be conducted according to the procedures outlined in the appropriate operating manuals.

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SECTION 5

SAMPLE PACKAGING, SHIPPING, AND CHAIN-OF-CUSTODY PROCEDURES

Once the samples have been collected, prepared, preserved, and appropriately stored, they must be packaged for shipment and/or delivery to the laboratory. In addition, from the time of sample collection until the analyses have been completed, chain-of-custody procedures must be followed to insure the proper handling and possession of the samples. This section outlines procedures for the packing and shipping of environmental samples, and general chain-of-custody procedures.

5.1 Packaging and Shipping Procedures for Environmental Samples

All individual sample containers must be placed in a strong outside shipping container. It is recommended that for this purpose a metal or styrofoam insulated cooler be used. The following is an outline of the procedures to be followed:

- Using fiberglass tape, secure the drain plug at the bottom of the cooler to insure that water from sample container breakage or ice melting does not leak from the outside container.

- Line the bottom of the cooler with a layer of absorbent material such as vermiculite.

- Place all sample containers in the cooler. Check screw caps for tightness and mark sample volume level on the outside of large containers.

- For large glass containers, packing peanuts may be used to keep containers in place and to prevent breakage.

- Small containers such as forty-milliliter vials may be placed in small plastic sandwich bags. When shipping these with large containers, steps should be taken to prevent shifting of the larger containers which might break the smaller ones.

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- Cushioning material is not necessary when shipping only plastic sample containers. However, some absorbent should be included in case of breakage or leaks.

- Ice sealed in plastic bags or cool paks should be placed in the cooler when samples must be kept at 4°C.

- Documents accompanying the samples should be sealed in a ziplock plastic bag attached to the inside of the cooler lid.

- The lid of the cooler must be closed and fastened.

- Fiberglass tape should be used to seal the space between the lid and the cooler. The tape should be wrapped around the cooler several times to insure that the lid does not open if the latch becomes unfastened.

- The following information must be attached to the outside of the cooler: name and address of receiving laboratory with return address, arrows indicating "This End Up" on all four sides, and "This End Up" label on the top of the lid.

- Additional labels such as "Liquid in Glass" are optional. If the bottles have been carefully packaged, additional warnings should not be needed.

- If the cooler is not equipped with a padlock, a custody seal should be affixed and signed across the lid of the cooler.

Samples packaged in this way may be shipped by commercial air. Personnel should be prepared to open and reseal the cooler for inspection if it is required. Be aware that some commercial carriers have limits as to the number of pounds per item that can be shipped.

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5.2 Chain-of-Custody Procedures

As in any other activity that may be used to support litigation, ERM must be able to provide the chain-of-possession and custody of any samples which are offered to evidence or which form the basis of analytical test results introduced as evidence. Written procedures must be available and followed whenever samples are collected, transferred, stored, analyzed, or destroyed. The primary objective of these procedures is to create an accurate written record which can be used to trace the possession and handling of the sample from the moment of its collection through analysis and its introduction as evidence.

A sample is defined as being in someone's custody if:

- it is in one's actual possession, or
- it is in one's view, after being in one's physical possession, or
- it is in one's physical possession and then stored in a secure facility or location so that no one can tamper with it, or
- it is kept in a secured area, restricted to authorized personnel only.

The number of persons involved in collecting and handling samples should be kept to a minimum. Detailed field records should be kept in a bound log book and should contain the following information:

- Unique sample identification or log number
- Date and time
- Source of sample (including name, location, and sample type)
- Preservative used
- Analysis required
- Name of collector(s)
- Pertinent field data (pH, DO, residual chlorine, specific conductance, temperature, redox potential, etc.)
- Serial numbers on seals and transportation cases

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To help eliminate possible problems in the chain-of-custody protocol, one person will be appointed Field Custodian for each investigation. For investigations where large sampling teams are used, all samples are to be turned over to the Field Custodian by the team members who collected the samples. The Field Custodian will then document each transaction and the sample will remain in his/her custody until it is shipped to the laboratory.

Each sample must be labeled using waterproof ink and sealed immediately after it is collected. Labels should be filled out before collection to minimize handling of the sample container.

Labels and tags must be firmly affixed to the sample containers. Be sure that the container is dry enough for a gummed label to be securely attached. Tags attached by string are acceptable when gummed labels are not applicable.

The sample container should then be placed in a transportation case, along with the chain-of-custody record form, pertinent field record, and analysis request form as needed. The transportation case should be sealed or locked. However, on those occasions when the use of a chest is inconvenient, the collector should seal the cap of the individual sample container with tape in a way that tampering would be easy to detect.

When samples are composited over a time period, unsealed samples can be transferred from one field crew to the next. The transferring crew lists the samples and a member of the receiving crew signs the list. The receiving crew either transfers the samples to another crew or delivers them to the laboratory.

When transferring the samples, the transferee must sign and record the date and time on the chain-of-custody record (Figure 2). Custody transfers made to a sample custodian in the field should account for each sample, although samples may be transferred as a group. Every person who takes custody must fill in the appropriate section of the chain-of-custody record form. To minimize custody records, the number of custodians in the chain-of-possession should be minimized.

The Field Custodian is responsible for properly packaging and dispatching samples to the appropriate laboratory. This responsibility includes filling out, dating, and signing the appropriate portion of the chain-of-custody record.

All packages sent to the laboratory should be accompanied by the chain-of-custody record and other pertinent forms. A copy of these forms should be retained by the originating office (either carbon or photo copy). Mailed packages can be registered with

300168

Figure 2
Chain Of Custody Record Form
Environmental Resources Management

Chain Of Custody Record

Environmental Resources Management, Inc.
999 West Chester Pike • P.O. Box 357 • West Chester, Pennsylvania 19381 ☎ (215) 696-9110

Project No. / I.D. _____ Sheet No. _____

Sampler(s) _____ Bottles Supplied By _____

Date Sampled _____ Bottle Batch No. _____

Sample I.D.	Sample Description	Sample Type	Sampling Method	Time	No. Of Contain-ers	Analysis Requested	Remarks

Relinquished By (Signature)	Received By (Signature)	Date/Time	Reason For Transfer

Copies: white - Sampler, Yellow - Lab, Pink - Client, Gold - File

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return receipt requested. For packages sent by common carrier, receipts should be retained as part of the permanent chain-of-custody documentation.

Writing chain-of-custody procedures, as well as the various promulgated laboratory analytical procedures, facilitates the admission of evidence under Rule 803(6) of the Federal Rules of Evidence (P.L. 93-575). Under this statute, written records of regularly conducted business activities may be introduced into evidence as an exception to the "hearsay rule" without the testimony of the person(s) who made the record. Although it is preferable, it is not always possible for the individuals who collected, kept, and analyzed samples to testify in court. In addition, if the opposing party does not intend to contest the integrity of the sample or testing evidence, admission under Rule 803(6) can save a great deal of trial time. For these reasons, it is important to standardize the procedures followed in collection and analysis of evidentiary samples.

In criminal cases, however, records and reports of matters observed by police officers and other law enforcement personnel are not included under the business record exceptions to the "hearsay rule" according to Rule 803(8), P.L. 93-595. It is arguable that those portions of the compliance inspection report dealing with matters other than sampling and analysis results come within this exception. For this reason, in criminal cases, records and reports of response team members may not be admissible. The evidence may still have to be presented in the form of oral testimony by the person(s) who made the record or report, even though the materials come within the definition of business records.

In a criminal case, the defense counsel may be able to obtain copies of reports prepared by a witness, even if the witness does not refer to the records while testifying. If obtained, the records may be used in cross-examination.

Records are not automatically admitted in either of these actions. The business records section authorizes admission "unless the source of information or the method of circumstance of preparation indicates lack of trustworthiness". The caveat under the public records reads "unless the sources of information or other circumstances indicate lack of trustworthiness".

Thus, whether or not the team members anticipate that various records will be introduced as evidence, they should make certain that all reports are as accurate and objective as possible.

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ATTACHMENT 3

INSTRUCTION MANUALS FOR PH
AND CONDUCTIVITY METERS

300172

The ERM Group

ACEMENT PARTS & ACCESSORIES

placement pH Probe Unit, 30" lead	$ 27.50
gh Temperature Probe Unit, 30" lead	33.00
ear Type Probe Unit, 30" lead	33.00
gh pH Probe Unit, 30" lead	33.00
Probe Unit with 10 ft. lead in 3/4" nipple	33.00
rrying Case	30.00
ffer Kit, 500 ml	9.00
ffer Salts, 6 env. per pkg. of one pH value	6.00
ffer Solution, per pint	3.30
Volt Battery	1.10

Guarantee

s instrument is unconditionally guaranteed for one ar from date of purchase except for broken or ensitized Probe Units. The guarantee is void if instrument has been dropped, severely jarred, or en apart.

the instrument requires service, we recommend that be floated in crushed newspaper and shipped prepaid to:

Analytical Measurements, Inc.
31 Willow Street
Chatham, New Jersey 07928

Prices subject to change without notice.

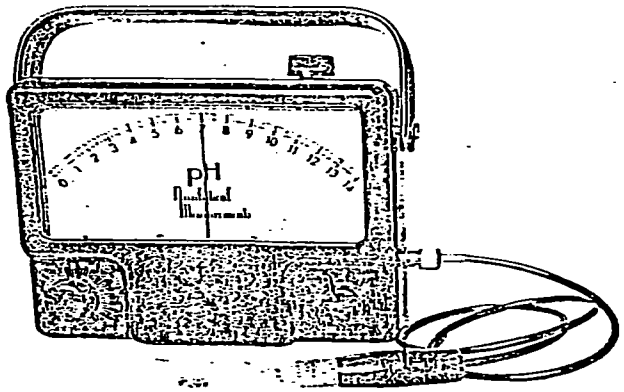
A2-1

200173

ANALYTICAL

BIG SCALE pH Meter

Model 707-B



Operating Instructions

Analytical Measurements
Telephone: (201) 223-7508
31 WILLOW STREET, CHATHAM, NEW JERSEY 07928

ANA ICAL BIG SCALE pH METER, MODEL 707-B

Operating Instructions

1. Set "Selector" Switch to "0" position. Rotate "Calibrate" knob clockwise and counterclockwise and observe pointer movement. Pointer should move freely up and down scale as knob is rotated. Then set pointer to 7 pH with "Calibrate" knob.

2. Remove sample cup from Probe and rinse Probe in distilled or deionized water. (If neither is available then rinse with tap water.)

3. Immerse Probe Unit in a beaker of 7 pH buffer solution. Turn Selector Switch to pH. Rotate Calibrate knob until pointer reads 7 pH.

4. Rinse Probe Unit under tap water or in a vessel of clean water, and immerse into a beaker of 4 pH buffer solution. The meter should now read 4 pH.

5. Rinse Probe Unit and instrument is now ready to test required samples.

6. Turn Selector Switch to 0 position and note reading. This is important. (If Calibrate knob is inadvertently tated during later testing, it would not be necessary go through Steps 3 and 4 again.) Reset pointer by ans of Calibrate knob to value noted above with lector Switch in 0 position.

   rn Selector Switch to pH. Set Temperature dial to mperature of sample under test.

   en finished with samples, rinse Probe, replace mple cup and fill sample cup with water to keep lb moist.

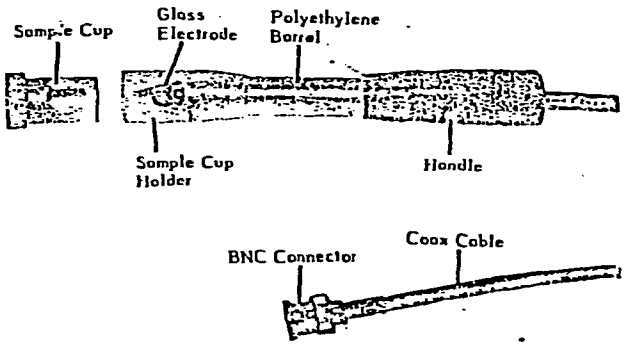
9. Turn Selector Switch to "Off".

0. To replace battery, remove back of meter (4 corner screws). Remove old battery, snap on new battery, place in clip and replace back. Use a standard 9 volt Transistor Radio battery available locally.

A2-2

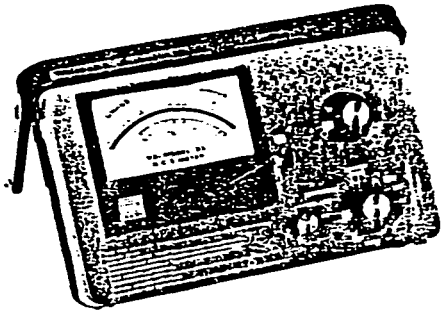
ANALYTICAL pH PROBE UNIT

This Probe Unit is of a new type requiring no refilling with KCl solution. This is accomplished with gel filling and a ceramic junction. The Probe Unit must be immersed above the top of the cup holder in order to make connection with the ceramic junction in the body of the electrode.



GEORGE T. FOTERA

INSTRUCTIONS FOR YSI MODEL 33 AND 33M S-C-T METERS



Scientific Division
Yellow Springs Instrument Co., Inc.
Yellow Springs, Ohio 45387 • Phone 513-767-7241

PRICE INCLUDING HANDLING $5.00

A2-3

54075

A2-4

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GENERAL DESCRIPTION

The YSI Model 33 and 33M S-C-T Meters are portable, battery powered, transistorized instruments designed to accurately measure salinity, conductivity and temperature. They use a probe consisting of a rugged plastic conductivity cell and a precision YSI thermistor temperature sensor combined in a single unit.

Conductivity with the Model 33 is expressed as micromhos/centimeter (µmhos/cm), with the 33M, it's millisiemens/meter (mS/m). These are measurements of the electrical conductance the sample would show if measured between opposite faces of a 1cm cube. (Conversion information: 1 µmho/cm = 0.1 mS/m.) Salinity is the number of grams of salt/kilogram of sample (‰ = parts per thousand). This measurement assumes the sample contains a "standard" sea water salt mixture. The sample temperature is measured in degrees Celsius.

Salinity measurements are manually temperature compensated by direct dial. Conductivity measurements are not temperature compensated, however, a temperature function is provided on the instrument to aid with calculation of corrections. Also, when just temperature and conductivity are known it is possible to calculate salinity, and when only temperature and salinity are known it is possible to calculate conductivity.

SPECIFICATIONS

Model 33 Conductivity

Ranges	0-500, 0-5,000, 0-50,000 µmhos/cm with YSI 3300 Series Probes (Note: The "µmho" designations on the meter are a shorthand form for "µmho/cm".)
Accuracy	±2.5% max. error at 500, 5,000 and 50,000 plus probe ±3.0% max. error at 250, 2,500 and 25,000 plus probe. See Error Section.

Readability	2.5 µmhos/cm on 500 µmho/cm range 25 µmhos/cm on 5,000 µmho/cm range 250 µmhos/cm on 50,000 µmho/cm range
Temperature Compensation	None

Model 33M Conductivity

Ranges	0-50, 0-500, 0-5,000 mS/m with YSI 3300 Series Probes
Accuracy	±2.5% max. error at 50, 500 and 5,000 plus probe ±3.0% max. error at 25, 250 and 2,500 plus probe See Error Section
Readability	0.25 mS/m on 50 mS/m range 2.5 mS/m on 500 mS/m range 25.0 mS/m on 5,000 mS/m range
Temperature Compensation	None

Salinity

Range	0-40 ‰ in temperature range of -2 to +45°C
Accuracy	Above 4°C, ±0.9 ‰ at 40 ‰ and ±0.7 ‰ at 20 ‰ plus conductivity probe Below 4°C, ±1.1 ‰ at 40 ‰ and ±0.9 ‰ at 20 ‰ plus conductivity probe See Error Section
Readability	0.2 ‰ on 0-40 ‰ range
Temperature Compensation	Manual by direct dial from -2 to +45°C

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Temperature	
Range	-2 to +50°C
Accuracy	±0.1°C at -2°C, ±0.6°C at 45°C plus probe See Error Section
Readability	±0.15°C at -2°C to ±0.37°C at 45°C
Power Supply	Two D-size alkaline batteries Eveready E95 or equivalent provide approximately 200 hrs of operation
Probe	YSI 3300 Series Conductivity/Temperature Probe Nominal Probe Constant, K=5/cm
Accuracy	±2% of reading for conductivity and salinity Error of ±0.1°C at 0°C and ±0.3°C at 40°C
Instrument	
Ambient Range	Satisfactory operation -5 to +45°C. A maximum error of ±0.1% of the reading per °C change in instrument temperature can occur This error is negligible if the instrument is readjusted to redline for each reading.

OPERATION PROCEDURE

1. Setup
   (a) Adjust meter zero (if necessary) by turning the bakelite screw on the meter face so that the meter needle coincides with the zero on the conductivity scale
   (b) Calibrate the meter by turning the MODE control to REDLINE and adjusting the REDLINE control so the meter needle lines up with the redline on the meter face If this cannot be accomplished, replace the batteries
   (c) Plug the probe into the probe jack on the side of the instrument
   (d) Put the probe in the solution to be measured (See Probe Use)
2. Temperature
   Set the MODE control to TEMPERATURE Read the temperature on the bottom scale of the meter in degrees Celsius Allow time for the probe temperature to come to equilibrium with that of the water before reading
3. Salinity
   (a) Transfer the temperature reading from Step 2 to the °C scale on the instrument
   (b) Switch the MODE control to the SALINITY position and read salinity on the red 0 40 ‰ meter range
   (c) Depress the CELL TEST button The meter reading should fall less than 2%, if greater, the probe is fouled and the measurement is in error Clean the probe and re-measure
4. Conductivity on Model 33 (Model 33M data are in parentheses.)
   (a) Switch the MODE control to the X100 scale If the reading is below 50 on the 0 500 range (5 0 on the 0 50 range), switch to the X10 scale If the reading is still below 50 (5 0) switch to the X1 scale Read the meter scale and multiply the reading appropriately The answer is expressed in µmhos/cm (mS/m) Measurements are not temperature compensated

Example:	Meter Reading	247 (24 7)
	Scale	X10
	Answer	2470 µmhos/cm (247 0 mS/m)

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(b) When measuring on the X100 and X10 scales, depress the CELL TEST button The meter reading should fall less than 2%. If greater, the probe is fouled and the measurement is in error Clean the probe and re-measure

NOTE: The CELL TEST does not function on the X1 scale.

5. *Error*

The maximum error in a reading can be calculated by using the graphs in the following sections

(1) Temperature

The temperature scale is designed to give the minimum salinity error when the temperature readings are used to compensate salinity measurements

Figure 1 shows total error for probe and instrument versus °C meter reading

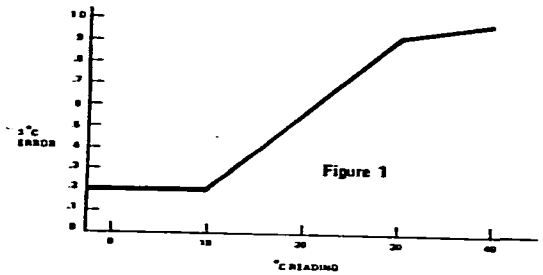

Figure 1

Example: Meter Reading 15°C

Total Error 0 4°C

Accuracy. 15°C ± 0 4°C for probe and instrument combined

(2) Conductivity on Model 33 (Model 33M data are in parentheses)

Figure 2 shows the worst-case conductivity error as a function of the conductivity reading for the probe and instrument combined

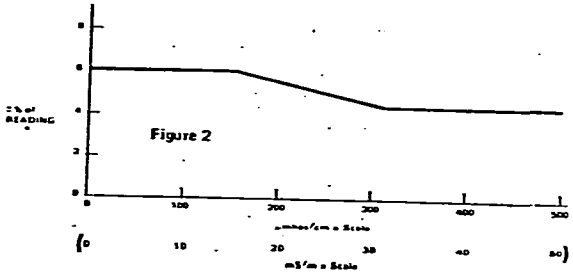

Figure 2

Example: Meter Reading 360 µmhos/cm (36 mS/m)

Scale X10

% Reading Error: ± 4 5%

Accuracy: 3600 ± 162 µmhos/cm (360 ± 16 2 mS/m) for probe and instrument

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(3) Salinity

The salinity readings are a function of temperature and conductivity, therefore the accuracy is a function of both. The temperature scale and temperature control have been designed to minimize the temperature error contribution to the salinity error. The error shown in Figure 3 is the total of the temperature and conductivity probe, the temperature scale and the salinity scale error.

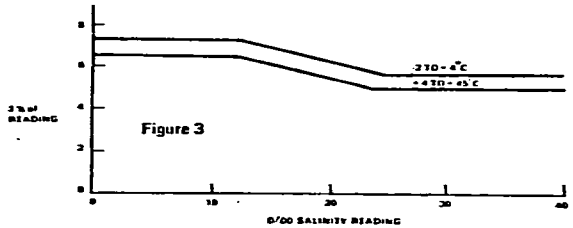


Figure 3

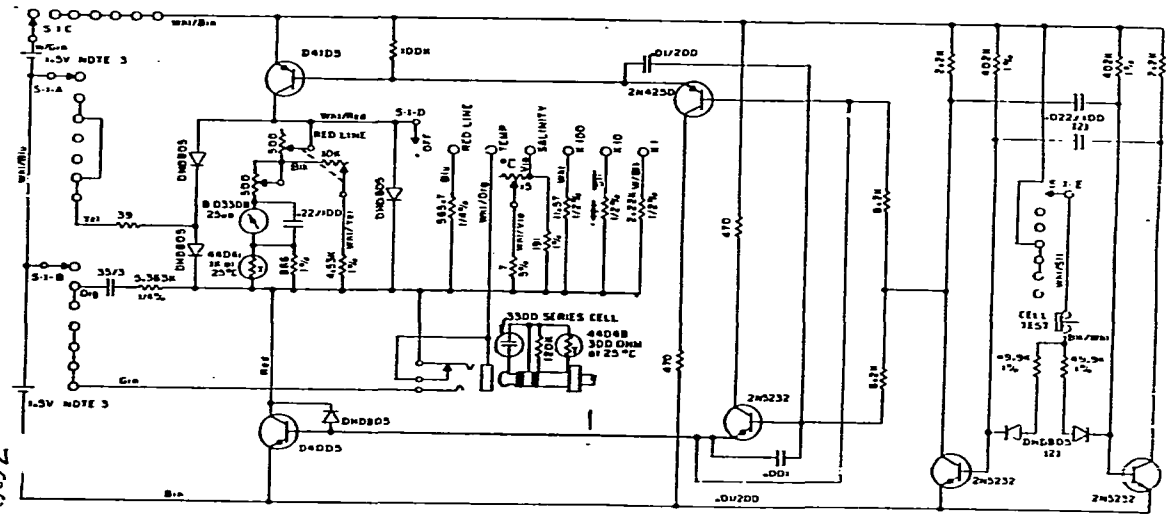
Example: Meter Reading: 10 0/00 @ 10°C

% of Reading Error: 6.5%

Accuracy: 10 ‰ ± 0.65 ‰ for all errors, combined worst case.

A2-8

081 0.03



YSI MODEL 33 AND 33M B-03321-F

A2-9

181 009

CIRCUIT DESCRIPTION, MAINTENANCE AND CALIBRATION

1. Description

The circuit is composed of two parts: a multivibrator and switching transistors. The multivibrator produces a square waveform voltage. The square wave is applied to two switching transistors. They alternately apply two batteries of opposite polarity to the probe thus providing AC power which minimizes polarization effects. The meter is in series with one battery and measures the current from it. The current from the battery is proportional to the conductance of the cell. Salinity is measured in a special range conductivity circuit which includes a user-adjusted temperature compensator. In the temperature, redline and X1 positions the multivibrator operates at 100 Hz. In the salinity, X100 and X10 positions the multivibrator operates at 600 Hz and in these ranges pushing the CELL TEST button drops the frequency to 100 Hz allowing the operator to judge the degree of probe polarization.

2. Maintenance

The only maintenance required is battery replacement. Two "D" size alkaline flashlight cells, such as Eveready E95 or equivalent, will provide 200 hrs. of operation. Accuracy will not be maintained if zinc-carbon "D" cells are used. Battery replacement is indicated when the redline adjustment cannot be accomplished.

Replace batteries every six months to reduce the danger of corrosion due to leaky batteries. To replace batteries, remove the six screws from the rear plate. The battery holders are color coded. The Positive (+ button) end must go on red.

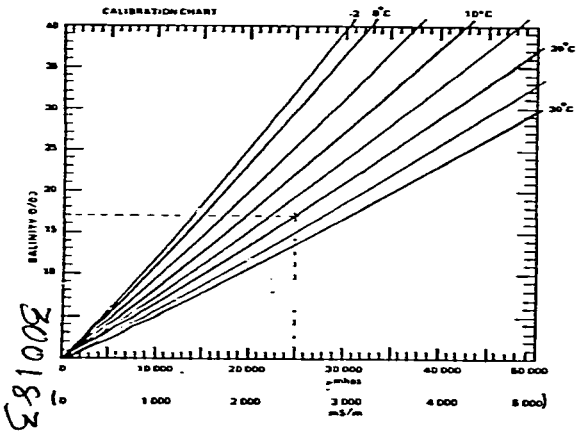
3. Calibration of Model 33 (Model 33M data are in parentheses.)

It is possible for the temperature knob to become loose or slip from its normal position. In an emergency the dial can be re-positioned. It must be emphasized that this is an emergency procedure only, and that the instrument should be returned to the factory for proper recalibration at the earliest opportunity.

A2-10

300182

(a) Read the temperature and conductivity of the solution. Determine the salinity of the solution by running a line vertically on the graph from this conductance value until it intersects the appropriate °C line (interpolate as required for temperature between the given °C lines). From this intersection extend a



line horizontally to the edge of the graph. This determines the salinity for this sample.

Example: 25 000 μmhos/cm and 20°C gives a salinity of 17 (Example: 2 500 mS/m and 20°C gives a salinity of 17.)

(b) Remove the °C knob, switch to SALINITY, and turn the control shaft until the meter needle indicates the salinity value determined in Step (a). In the example given, the value is 17.

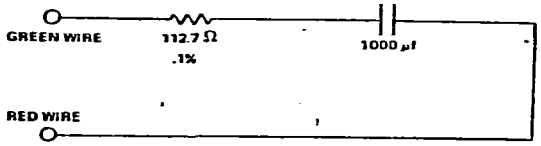
(c) Switch to TEMPERATURE. (Note: This temperature reading must be the same as Step (a), if not, begin again at Step (a).) Place the knob on the control shaft (without turning the control shaft) with the knob pointer at the same temperature as the meter reading and tighten both set screws securely.

At earliest opportunity recalibrate using the following procedure or return the instrument to factory for service.

(a) Set the instrument for a salinity measurement as normal.

(b) Substitute a 1000 μf capacitor and 112.7 ohm 0.1% tolerance resistor for the probe.

Connect the resistor and capacitor between the green wire and red wire on the jack connections inside the instrument.



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38183

(c) Turn the temperature dial until the meter reads redline

Now install the temperature knob with the arrow at 25°C This is a temporary calibration only Return the instrument to the factory for proper recalibration

PROBE

1. Description of YSI 3300 Series Conductivity/Temperature Probe

The YSI 3300 Series Conductivity Probes are designed for field use, embodying construction and design for rugged accurate service

Each probe features a built-in cell constant of 5 0 (500 0/M) ±2%, a precision YSI thermistor temperature sensor of ±0 1°C accuracy at 0°C and ±0 3°C at 40°C and a low capacitance cable assembly terminating in a three therminal 0 25" dia phone type connector

The 3310 has a 10 ft cable and the 3311 is a 50 ft version Other lengths are available on special order

The probe has a rigid P V C body platinized pure nickel electrodes, and a durable cable providing resistance to a wide range of water-borne substances

2. Maintenance

(a) Cleaning

When the cell test indicates low readings the probable cause is dirty electrodes Hard water deposits oils and organic matter are the most likely contaminants

For convenient normal cleaning soak the electrodes for 5 minutes with a locally available bathroom tile cleaning preparation such as Dow Chemical Bathroom Cleaner, Horizon Industries "Rally, Tile, Porcelain, and Chrome Cleaner", Johnson Wax "Envy, Instant Cleaner" or Lysol Brand "Basin Tub Tile Cleaner"

For stronger cleaning a 5 minute soak in a solution made of 10 parts distilled water, 10 parts isopropyl alcohol and 1 part HCl can be used

Always rinse the probe after cleaning and before storage

CAUTION Do not touch the electrodes inside the probe
Platinum black is soft and can be scraped off

If cleaning does not restore the probe performance, re-platinizing is required

(b) Re-Platinizing

Equipment Required —

(1) YSI #3140 Platinizing Solution, 2 fl oz (3% platinum chloride dissolved in 0 025% lead acetate solution)
(2) YSI Model 33 or 33M S-C-T Meter
(3) 50 ml glass breaker or equivalent bottle
(4) Distilled water

Procedure —

(1) Clean the probe as in Section (a) — either method
(2) Place the cell in the beaker and add sufficient YSI #3140 solution to cover the electrodes Do not cover the top of the probe
(3) Plug the probe into the Model 33 or 33M switch to the X100 scale to platinize the electrode Move the probe slightly to obtain the highest meter reading and continue platinizing for the approximate time shown below

Meter Reading		Time
µmhos/cm	mS/m	(minutes)
30 000	3 000	5
25 000	2 500	6
20 000	2 000	8
15 000	1 500	11
10 000	1 000	16

300184

(4) After the elapsed time remove the probe and rinse in fresh water

(5) Return the solution to its container 2 oz of solution should be sufficient for 50 treatments

(c) Storage

It is best to store conductivity cells in deionized water. Cells stored in water require less frequent platinization. Any cell that has been stored dry should be soaked in deionized water for 24 hours before use.

3. Probe Use

(a) Obstructions near the probe can disturb readings. At least two inches of clearance must be allowed from non-metallic underwater objects. Metallic objects such as piers or weights should be kept at least 6 inches from the probe.

(b) Weights are attached to the cable of the YSI 3310 and 3311 Probes. The YSI 3327 Weights are supplied in pairs with a total weight of 4 ounces per pair. Should it become necessary to add more weight to overcome water currents, we suggest limiting the total weight to two pounds (8 pairs). For weights in excess of two pounds use an independent suspension cable. In either case, weights must be kept at least 6 inches away from the probe.

(c) Gentle agitation by raising and lowering the probe several times during a measurement insures flow of specimen solution through the probe and improves the time response of the temperature sensor.

. Cell Calibration & Standard Solutions

he YSI #3300 Series Cells are calibrated to absolute accuracy of ±1.5% based on a standard solution. Since the literature on conductivity does not indicate a consistently accepted standardization method, we have chosen the 0.01 demal KCl solution method as determined by Jones and Bradshaw in 1937 as our standard. Recent textbooks, as well as the ASTM standards, concur with this choice.

The solution is prepared by diluting 0.745 grams of pure dry KCl with distilled water until the solution is 1 kilogram. The table below shows the values of conductivity this solution would have if the distilled water were non-conductive. However, since even high purity distilled water is slightly conductive, the measured conductivity will be higher by an amount equal to the water's conductivity.

Temperature °C	Conductivity µmhos/cm	mS/m
15	1141.5	114.2
16	1167.5	116.8
17	1193.6	119.4
18	1219.9	122.0
19	1246.4	124.6
20	1273.0	127.3
21	1299.7	130.0
22	1326.6	132.7
23	1353.6	135.4
24	1380.8	138.1
25	1408.1	140.8
26	1436.5	143.7
27	1463.2	146.3
28	1490.9	149.1
29	1518.7	151.9
30	1546.7	154.7

The operator may use the standard solution and the table to check accuracy of a cell's constant or to determine an unknown constant. The formula is shown below.

$$K = \frac{R(C_1 + C_2)}{10^5} \quad \text{or} \quad \frac{R(S_1 + S_2)}{10^5}$$

where K = Cell constant

R = Measured resistance in Ω

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C_1 = Conductivity in µmhos/cm
C_2 = Conductivity in µmhos/cm of the distilled water used to make solution
S_1 = Conductivity in mS/m
S_2 = Conductivity in mS/m of the distilled water used to make the solution

B. C_1 and C_2, or S_1 and S_2 must either be determined at the same temperature or corrected to the same temperature to make the equation valid

Note: For further information on conductivity and the above standard information, refer to ASTM Standards Part 23 — Standard Methods of Test for Electrical Conductivity of Water and Industrial Waste Water — ASTM Designation D1125-64

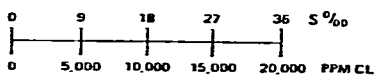
YSI MODEL 33 AND 33M USED WITH YSI 51A, 54 and 57 OXYGEN METERS

If the salinity measurement is to be used for salinity correction on the 51A the reading should be converted to Chlorosity The formula is

$$\text{PPM Chlorosity} = \frac{\text{Salinity } ‰ - 0.03}{1.8} \times 10^3$$

For these instruments the 0.03 can be neglected so the equation simplifies to

$$\text{PPM Cl} = \frac{\text{SS} \cdots \times 10^3}{1.8}$$



For salinity correction when using the Model 57 use the salinity reading direct from the Model 33 or 33M No conversion is necessary

Model 33 and 33M salinity readings taken in conjunction with Model 54 dissolved oxygen readings can be used to correct the Model 54 for salinity and to make post-measurement salinity corrections to dissolved oxygen data Correction tables are available from the factory

WARRANTY

All YSI products carry a one-year warranty on workmanship and parts, exclusive of batteries Damage through accident, misuse, or tampering will be repaired at a nominal charge

If you are experiencing difficulty with any YSI product, it may be returned to an authorized YSI dealer for repair even if the warranty has expired If you need factory assistance for any reason, contact

Service Department
Yellow Springs Instrument Co., Inc
P O Box 279
Yellow Springs, Ohio U S A
Phone (513) 767-7241

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APPENDIX B

HEALTH AND SAFETY PLAN

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The ERM Group

APPENDIX B
Revison No.: 1
Date: May 29, 1987

File No.: 484-02

RECOMMENDED HEALTH AND SAFETY PLAN FOR THE COKER'S LANDFILL SITE INVESTIGATION CHESWOLD, DELAWARE

June 1987

Prepared by:

Environmental Resources Management, Inc.
999 West Chester Pike
West Chester, PA 19380

Prepared for:

Clean Sites, Inc.
1199 N. Fairfax Street
Alexandria, VA 22314

ERM H&S Coordinator

Approved and adopted by
Clean Sites, Inc.
Designated Representative

ERM Designated Representative

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EXECUTIVE SUMMARY

Environmental Resources Management, Inc., (ERM) has developed the following Health and Safety Plan for the Coker's Landfill Site Investigation in Cheswold, Delaware. The intent of this plan is to recommend appropriate Health and Safety procedures to be followed by site personnel during the field operations of this Project. Environmental Resources Management, Inc., will provide consulting assistance to Clean Sites, Inc., in implementing, as a minimum, protocols established herein throughout those applicable activities associated with the Landfill Investigation.

Clean Sites, Inc., may adopt health and safety policies and procedures set forth in this Plan; however, ERM assumes no liability regarding its implementation unless specifically agreed upon in writing by a Principal of ERM. This plan has been developed on the basis of the information found in reports prepared by the NUS Corporation (TDD No. F3-8211-36B).

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SECTION 1

INTRODUCTION

This Health and Safety Plan has been developed by Environmental Resources Management, Inc., for the Clean Sites, Inc. Coker's Landfill Site Investigation in Cheswold, Delaware. This plan will serve to provide recommended health and safety procedures for those employees who may be exposed to any hazardous metals and conditions that may be present during the Investigation. The procedures set forth in this plan are designed to reduce the risk of exposure to chemical substances and physical or other hazards which may be present in the soil, water and air associated with the Coker's Landfill Site. The procedures set forth herein are developed in accordance with the provisions of 29 CFR 1910:120 (Interim Final OSHA Rule and in accordance with ERM experience in similar field investigations). ERM shall be responsible solely for compliance with the provisions of the present Health and Safety Plan by ERM employees unless otherwise specified and agreed to in writing by a Principal of ERM, Inc.

For the purpose of this Plan, Coker's Landfill Site Investigation is meant to include Coker's Landfills No. 1 and No. 2. Both landfills were used as dump sites for latex rubber sludges. Sludge wastes were disposed of in 6 foot deep trenches over a total of approximately 25 acres. Landfill No. 2 trenches were, for the most part, synthetically lined to contain fugitive leachate. Landfill No. 1 trenches were not lined with any protective barrier, resulting in the presence of leachate seeps along the landfill periphery. A more detailed site history can be found in Section 1 of the Work Plan.

1.1 Risk Assessment - Potential Chemical Exposure

Key compounds associated with the Coker's Landfill Site investigation have been identified and are listed in Table 1-1 along with a concise summary of the hazards involved with exposure to each component. A more detailed risk assessment has been developed to support this Plan and can be found in Section 4 of the Work Plan.

Other contaminants have been identified in the information and reports available to ERM. Laboratory qualitative analysis, however, indicated the confidence interval is significant enough

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TABLE 1-1

IDENTIFICATION AND ASSESSMENT OF KEY CHEMICAL HAZARDS

COMPOUND	REL, TLV, OR PEL*	ODOR THRESHOLD	ROUTE OF EXPOSURE	SYMPTOMS OF ACUTE EXPOSURE
Ethylbenzene	100 ppm	0.25-200 ppm	Inhalation, Ingestion Direct Contact	(1), (2)
Acrolein	0.1 ppm	.01-16.6 ppm	Inhalation, Ingestion Direct Contact	(1)
Pentachlorophenol	0.5 mg/m^3	9.3 mg/m^3	Inhalation, Absorption, Ingestion, Direct Contact	(1), (2), (3) (4), (6)
bis(2-chloroethyl)ether	5 ppm	1-35 ppm	Inhalation, Absorption Ingestion, Direct Contact	(1), (2), (5)

(1) Eye, Nose, Throat, Skin Irritation
(2) Headache, Fatigue, Nausea
(3) Lightheaded, Some Nausea, Dull Visual and Audio Response
(4) Central Nervous System Disorder, Convulsions, Sweating
(5) Potential Carcinogen
(6) Inadequate Evidence of Carcinogenicity

* REL – Recommended Exposure Limit (NIOSH)
PEL – Permissible Exposure Limit (OSHA – US or California)
TLV – Threshold Limit Value (ACGIH)
NOTE: Lowest established value is listed.

TABLE 1-2

POTENTIAL COMPONENTS - COKER'S LANDFILL

Compound	TLV, PEL, or REL*
1,1,1-Trichloroethane	350 ppm
Acetone	250 ppm
2-Butanone	200 ppm
Aluminum	2 mg/m^3
Barium	0.5 mg/m^3
Cadmium	0.05 mg/m^3
Copper	0.1 mg/m^3
Iron (oxide fume)	5 mg/m^3
Lead	0.05 mg/m^3
Manganese	1 mg/m^3
Zinc (Zinc Oxide)	5 mg/m^3
Selenium	0.2 mg/m^3
Arsenic	2 ug/m^3 (15 min ceiling)
Chromium	0.5 mg/m^3
Phenol	5 ppm (skin)
Mercury	0.05 mg/m^3
Trichlorofluoromethane	1000 ppm (ceiling)
Hexachlorocyclohexane (as Lindane)	0.5 mg/m^3
Methylene chloride	75 ppm
Bis(2-ethyhexyl) phthalate	5 mg/m^3
Toluene	100 ppm
Benzene	1 ppm

* Lowest established value is listed

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TABLE 1-3

APPLICABLE STANDARDS

AGENCY	STANDARD REFERENCE	SUBJECT OF REGULATION
U.S. Dept. of OSHA	1910.20	Recordkeeping
U.S. Dept. of OSHA	1910.134	Respiratory Protection
U.S. Dept. of OSHA	1910.151	Medical Facilities
U.S. Dept. of OSHA	1910.120	Worker Protection at Hazardous Waste Sites
U.S. Dept. of OSHA	1926	Construction Activities

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to exclude these compounds from the initial risk assessment. The level of personal protection has been established on a conservative basis to allow for the potential presence of these components. Table 1-2 lists the potential compounds and corresponding exposure limits.

1.1 Risk Assessment - Physical Hazards

The Coker's Landfill Site Investigation poses several physical hazards to those workers directly involved with the site activities. Implementation of feasible engineering controls and safe work practices will greatly reduce the threat of physical injury due to the inherent hazards present at the site.

Physical hazards associated with the site include the presence of heavy machinery, backhoe pits, working along active thoroughfares, and the presence of construction materials and refuse e.g., care must be taken to insure compliance with 1926 Shoring requirements. Such inherent hazards pose the threat of physical injury to site personnel and must be considered in the Health and Safety Plan.

1.2 Applicable Regulations

Federal and state agencies have established standards and guidelines addressing worker protection and safe work practices.

These regulations may or will impact the manner in which the Coker's Landfill Site operations are conducted. Table 1-3 summarizes key regulations that must be considered and/or followed during the Coker's Landfill Site Investigation.

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SECTION 2

PROJECT ORGANIZATION AND RESPONSIBILITIES

The following responsibilities and authorities have been or will be assigned to designated personnel for the duration of the Coker's Landfill Site Investigation pursuant to Contract (No. CSI-SA-87.01) between Clean Sites, Inc. (CSI) and Environmental Resources Management, Inc. (ERM, Inc.).

2.1 ERM, Inc. Designated Representative and ERM Project Manager

Person designated by contract and duly appointed by ERM to act in a supervisory capacity over all ERM employees and ERM activities with respect to ERM's contractual obligations for Clean Sites, Inc. during the Coker's Landfill Site Investigation. The ERM, Inc. Site Manager for this investigation will be Mr. Alan Funk. Mr. Funk is responsible for assuring that ERM Health and Safety responsibilities are carried out in conjunction with this site investigation.

2.2 ERM Inc. Site Manager

Person duly appointed by ERM and under the supervision of ERM's Project Manager to conduct field and related activities specific to the Coker's Landfill Site Investigation. The ERM Site Manager for this Project will be Mr. Frank Smith. Mr. Smith is responsible for carrying out ERM Health and Safety responsibilities on the site.

2.3 CSI Designated Representative and CSI Project Manager

Person designated by contract and duly appointed by Clean Sites, Inc., to monitor all services performed by ERM or its designated subcontractor. This person is Richard Sobel.

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2.4 Site Safety Officer

Person duly appointed by ERM, Inc., and having:

- responsibility for the field implementation, evaluation, and any necessary field modifications of this Health and Safety Plan;

- responsibility for maintaining adequate supplies of all personal protective equipment as well as calibration and maintenance of all monitoring instruments.

- authority to suspend work during the Coker's Landfill Site Investigation due to any ineffectiveness of this Health and Safety Plan.

Clean Sites, Inc., hereby grants to the ERM, Inc. Designated Representative authority to designate a Site Safety Officer(s) to carry out the health and safety responsibilities described above at the site. Clean Sites, Inc., agrees to give reasonable notice to ERM, Inc., prior to authorizing any person, including individuals, sub-contractors of Clean Sites, Inc., vendors, visitors or the like, to enter on the Coker's landfill site such that ERM, Inc. will be able to observe, advise and otherwise carry out its responsibilities of health and safety on site. It is understood that the ERM, Inc. responsibility in the case of individuals, subcontractors and, vendors and visitors who are not employees or subcontractors of ERM, Inc., is limited to advising such persons and CSI, if necessary, of any ineffectiveness or nonconformance with the Health and Safety Plan.

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SECTION 3

MEDICAL MONITORING AND PERSONNEL TRAINING REQUIREMENTS

3.0 Medical Monitoring

The U.S. Department of OSHA has established requirements for a medical surveillance program designed to monitor and reduce health risks for employees potentially exposed to hazardous materials. This program has been designed to provide baseline medical data for each employee involved in hazardous waste operations including field activities and to determine his/her ability to wear personal protective equipment, such as chemical resistant clothing and respirators. The medical examinations must be administered on a pre-employment and annual basis and as warranted by symptoms of exposure or specialized activities. These examinations shall be provided by employers without cost or loss of pay to the employee.

All site personnel involved with the Coker's Landfill Site Investigation activities may be required to have participated in a medical monitoring program meeting specifications of 29 CFR parts 1910.120 , due to the potential presence of compounds that may result in state or federally mandated site remediation. The examining physician is required to make a report to the employer of any medical condition which could place such employees at increased risk of wearing a respirator or other personal protection equipment. Each employer engaged in site work shall assume the responsibility of maintaining site personnel medical records as regulated by 29 CFR 1910.20 where applicable.

A medical program is required for all those employees who wear or may wear respiratory protection as regulated by 29 CFR 1910.134. This program must determine an individual's ability to wear respiratory protection while performing designated duties.

3.1 Personnel Training

Site personnel associated with those field activities in which the potential for exposure to hazardous substances exists may be required to participate in a health and safety training program

that complies with the U.S. Department of OSHA interim final regulation, 29 CFR 1910.120. This program must instruct employees on general health and safety principles and procedures, proper operation of monitoring instruments, and use of personal protective equipment.

In addition, site employees must undergo site-specific training prior to the start-up of any given project or task. As activities change at a particular site, related training must be provided as necessary. The site-specific training must address potential hazards and associated risks, site operating procedures and safe working practices, decontamination procedures, emergency response and site control methods to be employed. A Site-Specific Health and Safety Plan such as this must be developed and provided to all personnel involved in pertinent field activities.

Additional, specialized training must also be provided as dictated by the nature of site activities. Specialized training must be provided for activities such as confined space entry, excavations and handling of unidentified substances. Employees involved in these types of activities shall be given off-site instruction regarding the potential hazards involved with site activities and the appropriate health and safety procedures to be followed.

These training requirements may apply to the Coker's Landfill Site Investigation should any State or Federal agency mandate site remediation due to the potential compounds present. All site personnel involved in the Coker's Landfill field activities shall have received the required basic training discussed above where applicable. Exhibit 3-1 will be used to document site personnel as meeting the training requirements specified in 29 CFR 1910.120. The appropriate Health and Safety Plan shall be distributed to all site personnel and discussed prior to the start of field activities. Specialty training shall be provided as determined by task and responsibility. All training of personnel will be conducted under direct supervision of a trained Health and Safety officer.

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that complies with the U.S. Department of OSHA interim final regulation, 29 CFR 1910.120. This program must instruct employees on general health and safety principles and procedures, proper operation of monitoring instruments, and use of personal protective equipment.

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EXHIBIT 3-1

SUBCONTRACTOR OCCUPATIONAL SAFETY AND HEALTH CERTIFICATION

PROJECT: _____

CONTRACTOR: _____

1. Contractor certifies that the following personnel to be employed on the Coker's Landfill Site have met the following requirements of the OSHA Hazardous Waste Operations Standard (29 CFR 1910.120) and other applicable OSHA standards.

Contractor Personnel	Training	Respirator Certification	Medical Examination

2. Contractor certifies that it has received a copy of the Site Safety and Health Plan and will ensure that its employees are informed and will comply with its requirements.

3. Contractor further certifies that it has read and understands and will comply with all provisions of its contractual agreement with ERM, Inc., and/or Clean Sites, Inc.

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Signed _____ Date _____

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SECTION 4

SITE MONITORING AND PERSONAL PROTECTIVE EQUIPMENT

4.1 Site Monitoring

Field activities taking place within the Landfill area may create potentially hazardous conditions, such as the release of hazardous substances into the breathing space. These substances may be in the form of mists, vapors, dusts, or fumes that can enter the body through ingestion, inhalation, absorption and direct contact. Monitoring of these substances must be performed to ensure appropriate personal protective measures are employed during site activities.

Explosive environments may be encountered during the course of any field investigation or project. Based on available information, such conditions are not likely to be present during any phase of the Coker's Landfill Investigation. Monitoring for explosivity will be conducted periodically as a precautionary measure to ensure site personnel are not subjected to any adverse environmental conditions. Such monitoring will be conducted routinely whenever confined space conditions exist or as determined by information generated during the activities.

The following describes the monitoring parameters to be evaluated during the Coker's Landfill Site Investigation. Recommended instruments to be used are also provided in the discussion. All instruments to be used during site activities must meet the established requirements set forth by OSHA, MSHA, NIOSH and state agencies where applicable. Action levels based on monitoring results are discussed in the following section.

Organic Vapor Concentrations - will be monitored periodically in the breathing space with an organic vapor meter. Organic vapor concentrations may be used as action level criteria for upgrading or downgrading protective equipment and implementing additional precautions or procedures. A backup organic vapor meter should be present throughout site activities in the event of an instrument malfunction.

Explosivity - will be monitored periodically during site activity. Measurements obtained from this instrument will be used as action level criteria for institution of additional precautions, site evacuation and protective equipment selection. An instrument capable of indicating the percentage of the lower explosive limit for substances present at the site should be utilized. Again, a backup or secondary meter is recommended during site activities.

Toxic Gas - due to the characteristics of landfills in general, it is necessary to periodically monitor for toxic gas, particularly hydrogen sulfide, during applicable activities. The monitoring instrument should indicate the presence of hydrogen sulfide in parts per million and signal an alarm at concentrations of 5 ppm or greater.

Radioactivity - based on available information, it is not necessary to monitor for radioactivity during project activities.

All site monitoring will be conducted by or under the supervision of the Site Safety Officer. All readings obtained will be recorded in a dedicated site notebook by the Site Operations Manager and/or Consultant. The Site Safety Officer will maintain all monitoring instruments throughout the site investigation to ensure their reliability and proper operation.

4.2 Action Levels

The following action levels have been established for activity cessation, site evacuation, emergency response, and the upgrade or downgrade in the level of personal protective equipment. Level C personal protective equipment, as described in this Plan, has been established as a minimum requirement during initial activities that involve any type of surface disturbance or exposure to subsurface media, i.e., drilling, trenching, ground water sampling, etc. Level D personal protective equipment as described in this Plan will be permitted for all surficial sampling activities and other site operations that do not pose a potential threat of exposure to toxic or hazardous substances.

Organic Vapors

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Site personnel shall don self-contained breathing apparatus should organic vapor concentrations reach or exceed 5 ppm in the breathing space. A portable chromatograph may be used to characterize site compounds. The Site Operations Manager may downgrade the level of protection based upon verification of particular compounds present. The established action level is based on the permissible exposure limit of .1 ppm for acrolein and a protection factor of 50 for full-face respirators.

Explosivity

All site activity will cease wherever the lower explosive limit reaches or exceeds 20%. The site will then be evacuated of all personnel as quickly as possible. Fire officials will be informed of the situation so that effective measures can be taken to eliminate the risk of explosion. A lower explosive limit in the range of 10-20% will require the use of intrinsically safe instruments and equipment for all activity. Employees must use extreme caution under these conditions to avoid actions that may provide a source of ignition.

Toxic Gas

All site activity will cease where hydrogen sulfide concentrations reach or exceed 5 ppm. Site personnel will don self-contained breathing apparatus in order to continue activities where H_2S levels persist at or above 5 ppm.

4.3 Personal Protective Equipment

Personal protective equipment requirements must be established for the Coker's Landfill Site Investigation based on the assessment of potential hazards identified in preceding reports and site characterization (engineering controls shall also be implemented whenever possible to enhance worker protection throughout the investigation). All applicable state and federal regulations will be adhered to during the site operations regarding worker safety, engineering controls, and work practices.

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Level C protection as described in this Plan will be required, at a minimum, for those activities that involve surface and subsurface soil (strata disturbance such as well installation, pit excavation, and all subsurface media sampling activities such as split-spoon sampling, borings and ground water sampling). Some activities may require Level B protection as indicated by monitoring results and physical evaluation. The Site Safety Officer will determine whether or not a level of protection can be upgraded or downgraded. Changes in level of protection will be recorded in the dedicated site logbook along with an explanation as to why changes were made. Level D protection may be used for those activities that do not pose a potential threat of exposure to toxic or hazardous substances. Typical Level D activities may include surface water sampling and sediment sampling, as well as initial site surveys and audits. Level C protective equipment should be readily available at all times.

Level B Protection

a. Pressure demand cascade air system or other suitable self-contained, pressure demand breathing apparatus.

b. Chemical-resistant clothing such as Poly-coated Tyveks® or Saranex®. Suits will be one piece with booties and elastic wrist bands.

c. Outer nitrile and inner latex surgical gloves (both chemical resistant).

d. Leather boots with rubber overboots.

e. Chemical-resistant tape over protective clothing as necessary.

f. Options as required:

1. Coveralls
2. Disposable outer boots
3. Face shield
4. Escape mask as appropriate
5. Hard hat
6. Ear protection

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Level C Protection

a. Full-face air purifying respirator equipped with appropriate organic vapor canisters or cartridges must be worn (all personnel requiring respiratory protection are fit tested with the respirator to be used in the field). Dust pre-filters will be available and utilized as warranted by site conditions.

b. Chemical-resistant clothing such as Poly-coated Tyveks® or Saranex®. Suits will be one piece with booties and elastic wrist bands.

c. Outer nitrile gloves and inner latex surgical gloves.

d. Leather boots with rubber overboots.

e. Options as required:

1. Coveralls
2. Disposable outer boots
3. Escape mask
4. Hard hat
5. Face shield
6. Ear protection
7. Safety glasses
8. Chemical-resistant tape

Level D Protection

a. Coveralls or long sleeve shirts and long pants.

b. Outer nitrile gloves at a minimum. Inner latex surgical gloves are recommended where pratical.

c. Leather boots with rubber overboots.

d. Options as required

1. Disposable outer boots
2. Hard hat
3. Safety glasses
4. Ear protection

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SECTION 5

DECONTAMINATION

5.0 General

Personnel involved with the Coker's Landfill Site activities may be exposed to compounds in a number of ways, despite the most stringent protective procedures. Site personnel may come in contact with vapors, gases, mists, or particulates in the air, or may come in contact with site media while performing site duties. Use of monitoring instruments and site equipment can also result in exposure to hazardous substances.

In general, decontamination involves scrubbing with an Alconox/water solution followed by clean water rinses. All disposable items shall be disposed of in a dry container. Certain parts of contaminated respirators, such as harness assemblies and leather or cloth components, are difficult to decontaminate. If grossly contaminated, they may have to be discarded. Rubber components can be soaked in soap and water and scrubbed with a brush. In addition to being decontaminated, all respirators, non-disposable protective clothing, and other personal articles must be sanitized before they can be used again if they become soiled from exhalation, body oils, and perspiration. The manufacturer's instructions should be followed in sanitizing the respirator masks. The Site Safety Officer will be responsible for the proper maintenance, decontamination, and sanitizing of all respirator equipment.

The decontamination zone layout and procedures should match the prescribed levels of personal protection. A detailed discussion for the establishment of the decontamination zone and the procedures required for the various levels of personnel protection follows:

Exclusion Zone (EZ). The site of activity, it is considered to be potentially contaminated. Appropriate personal protective equipment must be worn while in this zone. This zone is normally separated from the contaminant reduction zone by a 'hotline' or barrier to prevent personnel from entering the exclusion zone boundary without protective equipment. The exclusion zone will extend to an area that

exhibits background levels of monitoring parameters. At a minimum, this zone will radiate to a distance of 20 feet from the point of operations.

Contaminant Reduction Zone (CRZ). It is within this zone that the decontamination process is undertaken. Personnel and their equipment must be adequately decontaminated before leaving this zone for the support zone.

Support Zone (SZ). The support zone is considered to be uncontaminated; as such, protective clothing and equipment are not required but should be available for use in emergencies. All equipment and materials are stored and maintained within this zone. Protective clothing is put on in the support zone before entering the contaminant reduction zone.

The nature of the Landfill Site Investigation is such that the establishment of a decontamination line may not be practical for all site employees. The following procedures have been established to provide site personnel with minimum guidelines for proper decontamination. These minimum procedures must be followed by personnel leaving the point of operations designated as the exclusion zone. The decontamination process shall take place at a reasonable distance away from any area of potential contamination.

5.2 Minimum Decontamination Procedure

Personnel leaving the point of operations should wash outer gloves and boots whenever possible. At a minimum, the outer boots shall be removed first and stored in an appropriate area or properly disposed of. Outer boots must be properly washed where gross contamination is evident. Personnel shall then remove and dispose of the Tyvek coveralls. Personnel should remove the Tyvek coveralls so that inner clothing does not come in contact with any contaminated surfaces. After Tyvek removal, personnel shall remove and discard outer nitrile gloves. Personnel shall then remove the respirator, where applicable. Respirators shall be disinfected between use with towelettes or other sanitizing methods. A wash station, at a minimum, will be present so that site personnel can thoroughly wash hands and face after leaving the point of operations. A portable shower unit may be necessary depending on prevalent site conditions or particular activities.

Portable wash stations shall be utilized for easy and efficient access. The wash station shall consist of a potable water supply, hand soap and clean towels. Portable sprayer units filled with Alconox solution and potable water should also be available to wash and rinse off grossly contaminated boots, gloves and equipment. The Site Safety Officer will monitor decontamination procedures to ensure their effectiveness. Modifications of the decontamination procedure may be necessary as determined by the Site Safety Officer's observations.

5.3 Standard Decontamination Procedure

The following decontamination procedures should be implemented during the Coker's Landfill Site Investigation whenever possible throughout site operations.

Level B - Personal Protection Decontamination Procedure

Step 1 -- Segregated Equipment Drop

Deposit equipment (tools, sampling devices, notes, monitoring instruments, radios, etc.) used on the site onto plastic drop cloths.

Step 2 -- Boot Covers and Glove Wash

Outer boot covers and outer gloves should be scrubbed with a decontamination solution of detergent and water.

Step 3 -- Rinse Off Boot Covers and Gloves

Decontamination solution should be rinsed off boot covers and gloves using generous amounts of water. Repeat as many times as necessary.

Step 4 -- Tape Removal

Remove tape from around boots and gloves and place into container with plastic liner.

Step 5 -- Boot Cover Removal

Remove disposable boot covers and place into container with plastic liner.

Step 6 -- Outer Glove Removal

Remove outer gloves and deposit in container with plastic liner.

Step 7 -- Suit/Safety Boot Wash

Completely wash splash suit, SCBA, gloves, and safety boots. Care should be exercised that no water is allowed into the SCBA regulator. It is suggested that the SCBA regulator be wrapped in plastic.

Step 8 -- Suit/Safety Boot Rinse

Thoroughly rinse off all decontamination solution from protective clothing.

Step 9 -- Tank Changes

This is the last step in the decontamination procedure for those workers wishing to change air tanks and return to the exclusion zone. The worker's air tank is exchanged, new outer glove and boot covers are donned, and joints taped.

Step 10 -- Removal of Safety Boots

Remove safety boots and deposit in container with a plastic liner.

Step 11 -- SCBA Backpack Removal

Without removing face piece, the SCBA backpack should be removed and placed on a table. The face piece should then be disconnected from the remaining SCBA unit and then proceed to the next station.

Step 12 -- Splash Suit Removal

With care, remove splash suit. The exterior of the splash suit should not come in contact with any inner layers of clothing.

Step 13 -- Inner Glove Wash

The inner gloves should be washed with a mild decontamination solution (detergent/water).

Step 14 -- Inner Glove Rinse

Generously rinse inner gloves with water.

Step 15 -- Face Piece Removal

Without touching face with gloves, remove face piece. Face piece should be deposited into a container which has a plastic liner.

Step 16 -- Inner Glove Removal

Remove inner glove and deposit in container with plastic liner.

Step 17 -- Field Wash

Wash hands and face thoroughly. If highly toxic, skin corrosive, or skin-absorbent materials are known or suspected to be present, a shower should be taken.

Level C and Level D Personal Protection Decontamination Procedure

This decontamination procedure for Level C and Level D personal protection will employ applicable steps detailed in the Level B decontamination process.

5.3 Sampling Equipment and Sample Container Decontamination

All non-disposable sampling equipment will be decontaminated with an Alconox/water solution followed by a clean water rinse. As an added precaution against cross-contamination, all non-disposable sampling equipment will be rinsed with distilled water. All disposable sampling equipment will be properly disposed of in dry containers.

Before leaving the site, all sample containers will be thoroughly decontaminated using an Alconox/water solution followed by a clean water rinse. The decontamination procedure should include a complete scrubbing of the container's surface to remove possible contamination. Care must be exercised to prevent damage to sample container identification labels.

SECTION 6

SITE CONTROL AND COMMUNICATIONS

6.0 Site Access

Access to the Coker's Landfill Site activities will be limited to authorized personnel. Such personnel include ERM employees, designated equipment operators, and designated Clean Sites Inc., representatives. However, access into the established exclusion zone will be limited to those personnel wearing appropriate personal protective equipment. The exclusion zone will be cordoned off with flagging tape or other suitable indicators designating the exclusion zone boundary. The zone will also be monitored by the Site Safety Officer to ensure personnel do not enter without proper personal protection.

Sign-in procedures may be implemented to ensure that authorized personnel only will participate in the investigatory activities. The Site Operations Manager will coordinate this effort and maintain the generated documentation accordingly.

6.1 Site Control

The Coker's Landfill is not entirely secured by fencing or other suitable site control means; and the site is not routinely patrolled by police or any independent security department. Thus, certain procedures must be followed to ensure suitable site control and limitation of access so that those persons who may be unaware of site conditions are not exposed to inherent hazards.

All excavations left open and unattended by site personnel will be appropriately barricaded and visibly posted with "No Trespassing" or other appropriate signs. Well caps will be secured by suitable locking devices to prevent unauthorized access. All heavy machinery and equipment shall be locked or chained each evening upon completion of daily activities. Lastly, all potentially contaminated media, such as purged ground water, cuttings, and soils, will be covered with plastic prior to leaving the site each day.

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SECTION 7

EMERGENCY RESPONSE

7.0 Emergency Response

In the event of an emergency, site personnel shall signal distress with three blasts from an appropriate horn (car horn, air horn, etc.). All appropriate authorities will then be immediately notified of the nature and extent of the emergency. Medical personnel will be informed of site hazards and activities prior to project initiation so that emergency situations can be handled most efficiently. Table 7-1 provides a list of important telephone numbers for use in necessary situations.

7.1 Responsibilities

The Site Safety Officer will be responsible for responding to all emergencies. The Site Safety Officer will:

1. Notify appropriate individuals, authorities and/or health care facilities of the activities and hazards of the investigation. Table 7-1 will be posted within the field office or any other visible location.

2. Ensure that the following safety equipment is available at the site: eyewash station, first aid supplies, and fire extinguishers.

3. Have working knowledge of all safety equipment available at the site.

4. Ensure that a map which details the most direct route to the nearest hospital shall be prominently posted with the emergency telephone numbers.

7.2 Accidents and Injuries

In the event of a safety or health emergency at the site, appropriate emergency measures must immediately be taken to assist those who have been injured or exposed and to protect

others from hazards. The Site Safety Officer will be immediately notified and will respond according to the seriousness of the injury. Personnel trained in First-Aid should be present during site activities to provide appropriate treatment of injuries or illnesses incurred during operations.

7.3 Site Communications

Two-way radios will be used throughout the Coker's Landfill Site activities to facilitate field communications. Hand signals will be utilized where radios are impractical or unsafe. If possible, mobile phones will be present during site activities for emergency response and office communications. Public telephones will be located prior to the start-up of activities as back up to the mobile phones or as the primary off-site communication network.

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TABLE 7-1

TELEPHONE NUMBER LIST

Affiliation (Name)	Telephone Number
ERM, Inc., Designated Representative and ERM Project Manager (Alan Funk)	(215) 692-8606 Business (215) 873-7272 Home
ERM, Inc., Site Manager (Frank Smith)	(215) 692-8606 Business (215) 296-2529 Home
CSI Designated Representative and CSI Project Manager (Richard Sobel)	(703) 683-8522 Business
Site Safety Officer (Frank Smith)	(215) 692-8606 Business (215) 296-2529 Home
ERM, Inc., Health and Safety Coordinator (Robert Deist)	(215) 692-8606 Business (215) 363-1395 Home

Emergency

Police (Delaware State Police Troop 3)	(302) 697-2104
Fire (Cheswold Fire Dept.)	911
Ambulance	911
Hospital (Kent General Hospital - Dover) Address: 640 S. State Street Dover, Delaware 19901	(302) 734-4701

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SECTION 8

SPECIAL PRECAUTIONS AND PROCEDURES

8.0 Potential Risks

The Coker's Landfill Investigtion poses potential exposure risks to both chemical and physical hazards. The chemical risks have been explained in detail in the previous sections. The potential for chemical exposure to hazardous substances is significantly reduced through the use of personal protective clothing, engineering controls and implementation of safe work practices.

Other potential hazards that are associated with the site activities include injury from heavy equipment, heat stress, and confined space conditions. Precautionary measures have been established to reduce these risks to a minimum during site activities.

8.1 Confined Space Conditions/Pit Excavations

The activities associated with the Landfill Investigation may create conditions that are considered confined or semi-confined work areas, such as pit excavations. Humidity, wind speed, wind direction, and other atmospheric conditions may affect the ventilation of excavated trenches or pits. Reduced ventilation can result in a build up of toxic or flammable vapors, or enable oxygen rich or deficient conditions to exist within the breathing space.

Confined or semi-confined space entry requires, at a minimum, continuous monitoring for organic vapors, toxic gas, atmospheric oxygen, and explosive conditions. Monitoring results will indicate whether the area can be entered safely, and if so, will determine the level of personal protection necessary for confined space activities. Five minute escape masks at a minimum must be readily available to all employees entering the confined or semi-confined space. Other precautions include the use of lifeline and life harness as determined by site conditions and activities.

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All excavation areas that must be entered for any reason shall be properly sloped or shored to ensure pit or trench stability.

8.2 Heat Stress

The timing of this project is such that heat stress may pose a threat to the safety of site personnel. Work/Rest regimens will be employed as necessary so that personnel do not suffer adverse effects from heat stress. Special clothing and an appropriate diet and fluid intake will be recommended to all site personnel to further reduce heat stress hazards.

8.3 Typical Hazards Associated with Site Activities

Inherent hazards exist due to the nature of most site investigations. The key hazards and associated precautions and procedures are provided below.

8.3.1 Heavy Machinery/Equipment

All site employees must remain aware of those site activities that involve the use of heavy equipment and machinery. Respiratory protection and protective eyewear may be worn frequently during site activities. This protective equipment significantly reduces peripheral vision of the wearer. Therefore, it is essential that all employees at the site exercise extreme caution during operation of equipment and machinery to avoid physically injury to themselves or others.

8.3.2 Construction Materials and Site Refuse

All construction materials and site refuse should be contained in appropriate areas or facilities. Site personnel should make certain that nails, lumber, cement etc. are not scattered throughout the area of activity and that all trash and scrap materials are immediately and properly disposed of.

8.3.3 Traffic

Areas of operations may be located along active thoroughfares. Traffic cones and "Men Working" signs must be appropriately located along streets to divert motorists safely around the site activities. Fluorescent traffic vests must be worn by site personnel at all times as an added precaution.

8.4 Additional Safety Practices

The following are important safety precautions which will be enforced during this investigation:

1. Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases that probability of hand-to-mouth transfer and ingestion of material is prohibited in any area designated as contaminated.

2. Hands and face must be thoroughly washed upon leaving the work area and before eating, drinking, or any other activity.

3. Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as possible after the protective garment is removed.

4. No excessive facial hair which interferes with the effectiveness of a respirator will be permitted on personnel required to wear respiratory protection equipment. The respirator must seal against the face so that the wearer receives air only through the air purifying cartridges attached to the respirator. Fit testing shall be performed prior to respirator use to ensure a proper seal is obtained by the wearer.

5. Contact with potentially contaminated surfaces should be avoided whenever possible. One should not walk through puddles, mud, or other discolored surfaces; kneel on ground; lean, sit or place equipment on drums, containers, vehicles, or the ground.

6. Medicine and alcohol can potentiate the effect from exposure to certain compounds. Prescribed drugs and alcoholic beverages should not be consumed by personnel involved in the project.

7. Personnel and equipment in the work areas should be minimized, consistent with effective site operations.

8. Work areas for various operational activities should be established.

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9. Procedures for leaving the work area must be planned and implemented prior to going to the site. Work areas and decontamination procedures must be established on the basis of prevailing site conditions.

10. Respirators will be issued for the exclusive use of one worker and will be cleaned and disinfected after each use.

11. Safety gloves and boots shall be taped to the disposable, chemical-protective suits as necessary.

12. All unsafe equipment left unattended will be identified by a "DANGER, DO NOT OPERATE" tag.

13. Noise mufflers or ear plugs may be required for all site personnel working around heavy equipment. This requirement will be at the discretion of the Site Safety Officer. Disposable, form-fitting plugs are preferred.

14. Cartridges for air-purifying respirators in use will be changed daily at a minimum.

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needs that could be implemented to achieve compliance will be described.

12.A.3 Provide an outline of the operation, maintenance, and monitoring requirements of the remedy.

12.A.4 Identify and review potential off-site facilities to ensure compliance with RCRA and other applicable EPA environmental program requirements, both current and proposed. Potential disposal facilities will be evaluated to determine whether off-site management of site chemical constituents could result in a potential for a future release from the disposal facilities.

12.A.5 Identify temporary storage requirements and off-site disposal needs and provide transportation plans.

12.A.6 Describe whether the alternative results in permanent treatment or destruction of the chemical constituents and, if not, the potential for future release to the environment.

12.A.7 Outline safety requirements for remedial implementation (including both on-s.te and off-site health and safety considerations).

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12.A.8 Describe how the alternative could be segmented into phases to allow implementation in differing areas.

12.A.9 Describe special engineering requirements of the remedy or site preparation considerations.

12.B Environmental Analysis

An environmental assessment for each alternative evaluated in Task 12 will be performed. The environmental assessment will focus on the site problems addressed by each alternative. The environmental assessment for each alternative will include, at a minimum, an evaluation of beneficial effects of the response, adverse effects of the response, and an analysis of measures to mitigate adverse effects. The No Action alternative will be fully evaluated to describe the current site situation and anticipated environmental conditions if no action is taken. The No Action alternative will serve as the baseline for the analysis.

12.C Public Health Analysis

Each alternative will be assessed in terms of the extent to which it mitigates long-term exposure and protects public health both during and after completion of the remedial action. The assessment will describe the levels and characterizations of chemical constituents on site, potential exposure routes, and potentially affected populations. The effect of "no action" will

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be described in terms of short-term effects, long-term exposure to any residual contamination, and resulting public health impacts. Each remedial alternative will be evaluated to determine the level of exposure and the reduction over time. The relative reduction in public health impacts for each alternative will be compared to the No Action level. For management of migration measures, the relative reduction in impact will be determined by comparing residual levels of each alternative with existing criteria, standards, or guidelines acceptable to EPA. For source control measures, or when criteria, standards, or guidelines are not available, the comparison will be based on the relative effectiveness of technologies. The No Action alternative will serve as the baseline for the analysis.

12.D Institutional Analysis

Each alternative will be evaluated based on relevant institutional needs. Specifically, regulatory requirements, permits, community relations, and participating agency coordination will be assessed.

12.E Cost Analysis

The cost of feasible remedial action alternatives (and for each phase or segment of the alternative) will be evaluated. The cost will be presented as a present worth cost and will include the total cost of implementing the alternative and the annual operating and maintenance costs. Both monetary costs and associated non-monetary costs will be included. A distribution of cost over time will be provided.

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12.F Evaluation of Cost-Effective Alternative

Alternatives will be compared using technical, environmental, and economic criteria. At a minimum, the following areas will be used to compare alternatives.

12.F.1 Present Worth of Total Costs

The net present value of capital and operating and maintenance costs will be presented.

12.F.2 Health Information

For the No Action alternative or management of migration measures, a quantitative risk assessment, including an estimated range of maximum individual risks, will be provided. Where quantification is not possible, a qualitative analysis will be provided. For source control measures, a quantitative risk assessment is not required.

12.F.3 Environmental Effects

The most important effects or impacts will be summarized. Reference will be made to supplemental information arrayed in a separate table, if necessary.

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12.F.4 Technical Aspects of the Remedial Alternatives

The technical aspects of each remedial alternative relative to the others will be clearly delineated. Such information will be based on the professional opinion of ERM regarding the site and the technologies comprising the remedial alternative.

12.F.5. Information on the Extent to Which Remedial Alternatives Meet the Technical Requirements and Environmental Standard of Applicable Environmental Regulations

This information will be arrayed so that differences in how remedial alternatives satisfy such standards are readily apparent. The general types of standards that may be applicable at the site include RCRA design and operating standards and drinking water standards and criteria.

12.F.6 Information on Community Effects

Information will be provided to address the extent to which implementation of a remedial alternative disrupts the community, i.e., traffic, temporary health risks, and relocation.

12.F.7 Other Factors

This category of information will include such items as institutional factors that may inhibit implementing a remedial alternative and any other site-specific factors as identified in

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the course of the detailed analysis that may influence which alternative is eventually selected.

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TASK 13

PRELIMINARY FINAL REPORT

A preliminary final report or draft report on the Feasibility Study will be prepared and will present the results of Tasks 8 through 12. Copies of the preliminary Final Report will be submitted for review and comment to Clean Sites, Inc. (CSI), EPA, and the State.

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TASK 14

FINAL REPORT

The Final Report will be prepared for submission to Clean Sites, Inc. (CSI), EPA, and the State. The report will include the results of Tasks 1 through 5 and through 13 and any supplemental information or revisions generated as discussed in Task 6 and 14. This report will include a responsiveness summary on public comments received.

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Date of QAPP Revision (No.)
11 May 1987 (0)
16 September 1987 (1)

QUALITY ASSURANCE PROJECT PLAN (QAPP) FOR THE REMEDIAL INVESTIGATION AT THE COKER'S LANDFILLS NO. 1 AND NO. 2
Cheswold, Delaware

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File No. 484-02

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QAPP RECIPIENTS

1. Alan C. Funk - ERM, Inc.
2. Rock J. Vitale - ERM, Inc.
3. David R. Blye - ERM, Inc.
4. Nick J. DeSalvo - ERM, Inc.
5. Dana R. Pizarro - ERM, Inc.
6. Richard Sobel - Clean Sites, Inc.
7. Robert Meierer - Compuchem Laboratories, Inc.

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SECTION 1

INTRODUCTION

1.1 Background

The Coker's No. 1 and No. 2 landfills near Cheswold, Delaware, were used for the disposal of latex rubber sludges from 1962 to 1976 and from 1976 to 1980, respectively. NUS Corporation was contracted by EPA to perform a site inspection and sampling of both landfills. Based on the findings of those studies, EPA is requiring an RI/FS study of the two sites.

The PRPs have retained Clean Sites, Inc., (CSI) to provide overall management of the RI/FS. ERM has been selected as the environmental consulting firm to perform the RI/FS.

Refer to Section 1 of the Work Plan for a detailed discussion of all pertinent background information and the investigation objectives.

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SECTION 2

PROJECT ORGANIZATION AND RESPONSIBILITY

While all personnel involved in an investigation and in the generation of data are implicitly a part of the overall project and quality assurance program, certain individuals have specifically delegated responsibilities. Within ERM these are the Project Manager, the Quality Assurance Manager, the RI Task Manager, the FS Task Manager, the Quality Assurance Officer, the Field Operations Manager/Project Geologist, and the Project Technicians. CompuChem Laboratories, Inc., Research Triangle Park, North Carolina, will provide all analytical services for these investigations. Specific laboratory personnel with quality assurance/quality control responsibilities include the Laboratory Quality Assurance Officer and Laboratory Sample Custodian. Figure 2-1 presents a project organization flow chart.

2.1 Project Manager

Mr. Alan C. Funk is Project Manager for the Coker's Landfills RI. The Project Manager maintains routine contact with the investigation's progress, regularly reviews the project schedule, and reviews all major work elements prior to submittal. The Project Manager oversees all scheduling and budgeting, and serves as the prime contact with local, state, and federal agencies.

2.2 Quality Assurance Manager

ERM's Mr. Rock J. Vitale serves as Quality Assurance Manager on all projects requiring the collection of data, and as such is not directly involved in the routine performance of technical aspects of the investigations.

It is the Quality Assurance Manager's responsibility to review project plans and revisions to the plans to assure proper quality assurance is maintained. Frequent and regular meetings will take place between the Quality Assurance Manager and the Quality

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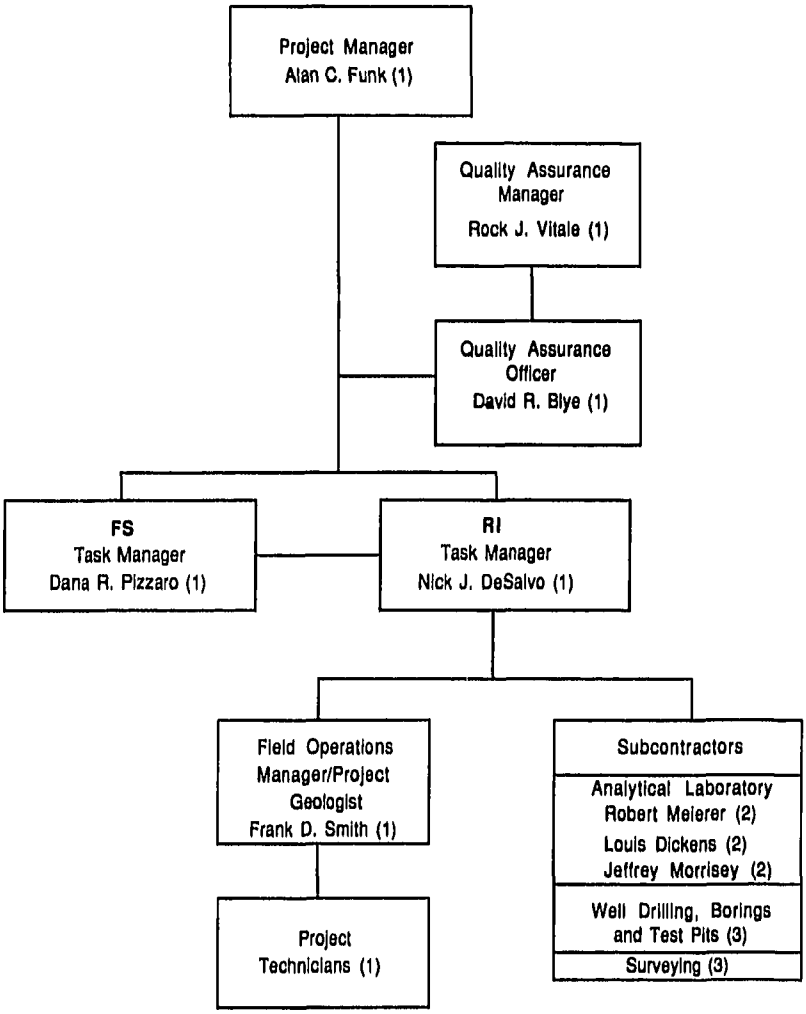
Figure 2-1
Project Organization Chart



(1) Environmental Resources Management, Inc.
999 West Chester Pike
West Chester, PA 19382
(215) 696-9110

(2) CompuChem Laboratories, Inc.
3308 Chapel Hill/Nelson Highway
Research Triangle Park, NC 27709
(919) 549-8263

(3) To Be Determined

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Assurance Officer to review all quality assurance activities. The Quality Assurance Manager is also responsible for all data processing activities, data processing quality control, and data quality review.

2.3 RI Task Manager

Mr. Nick J. DeSalvo will serve as RI Task Manager for this investigation, with the responsibilities of implementing the Work Plan and overseeing the day-to-day activities of all work to be conducted including that of subcontractor personnel.

2.4 FS Task Manager

Mr. Dana R. Pizarro will serve as the FS Task manager with the responsibility of preparing the FS Work Plan, budgeting and scheduling the FS in conjunction with the Project Manager, and implementing the FS Work Plan. Further clarification on the FS Task Manager's responsibilities and other FS personnel for Coker's Landfills will be included in the FS Work Plan.

2.5 Quality Assurance Officer

Mr. David R. Blye will serve as the Project Quality Assurance Officer. The Quality Assurance Officer has primary responsibility for overall project quality assurance. The Quality Assurance Officer's responsibilities include the development, evaluation, and documentation of the Quality Assurance Project Plan and procedures appropriate to the investigation. The Quality Assurance Officer is additionally responsible for field and laboratory audits, field quality assurance, and all other non-analytical data quality review. It is a major responsibility of the Quality Assurance Officer to insure that all personnel have a good understanding of the project quality assurance plan, an understanding of their respective roles relative to one another, and an appreciation of the importance of the roles to the overall success of the program.

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2.6 Field Operations Manager/Project Geologist

It is ERM's policy that a Field Operations Manager/Project Geologist be assigned to large-scale projects where the Task Manager cannot be present for all on-site activities. Mr. Frank

D. Smith will serve as the Field Operations Manager/Project Geologist for the Coker's Landfill No. 1 and No. 2. The Field Operations Manager/Project Geologist reports directly to the RI Task Manager and is immediately responsible for the day-to-day activities of all ERM field personnel. In this capacity, the Field Operations Manager/Project Geologist is responsible for all day-to-day quality assurance project activities and reports directly to the RI Task Manager concerning the maintenance of the Quality Assurance Project Plan. Further responsibilities include the verification for accuracy of field notebooks, driller's logs, chain-of-custody records, sample labels, and all other field-related documentation.

2.7 Project Technicians

Ground water, soil, and air sampling tasks required by this investigation will be conducted by experienced environmental technicians. Their responsibilities will include the documentation of the proper sample collection protocols, sample collection and field measurements, equipment decontamination, and chain-of-custody documentation.

2.8 CompuChem Laboratories Quality Assurance Officer

The volume of analytical work for a project of this size necessitates the subcontract analytical laboratory specify a Quality Assurance Officer whose duties are specific to the project. Mr. Robert Meierer will serve as CompuChem Laboratories' Quality Assurance Officer with the responsibility for maintenance of all laboratory quality assurance activities in association with the project.

2.9 Laboratory Sample Custodian

Mr. Louis Dickens and Mr. Jeffrey Morrisey will serve as project Laboratory Sample Custodians for CompuChem Laboratories. The Sample Custodian's responsibilities include insuring proper sample entry and sample handling procedures by laboratory personnel.

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SECTION 3

QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, REPRESENTATIVENESS, COMPARABILITY, AND COMPLETENESS

3.1 Overall Project Objectives

Data Quality Objectives (DQO) are quantitative and qualitative statements specifying the quality of the environmental data required to support the decision making process. The Project Manager in conjunction with the Quality Assurance group are responsible for defining the DQO. The intended use of data, analytical measurements and the availability of resources are an integral part in development of the DQO. DQO define the total uncertainty in the data that is acceptable for each specific activity during the investigation. This uncertainty includes both sampling error and analytical instrument error. Ideally, the prospect of zero uncertainty is the intent; however, the variables associated with the process (field and laboratory) inheritly contribute to the uncertainty of the data. It is the overall objective to keep the total uncertainty within an acceptable risk that will not hinder the intended use of the data. In order to achieve this objective, specific data quality requirements such as detection limits, criteria for accuracy and precisions, sample representativeness, data compatibility and data completeness will be specified. The overall objectives and requirements will be established such that there is a high degree of confidence for the intended use of the data. The data collected during the course of the investigation will be used to answer the following questions:

1. Are contaminants present or absent? (qualitatively)

2. If contaminants are present, what are the types or classes are present?

3. What quantities (concentrations) of contaminants are present (quantitative)?

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4. What are the pathways for contaminant release?

5. What are the boundaries of contaminant sources and pathways?

6. What are the environmental/public health factors?

7. What are the source pathway contaminant characteristics with respect to migration?

The sample media that will be collected to answer these questions will be ground water, surface water, seeps/leachates, soils and sediments. The specific analytical parameters for the samples collected during the investigation are specified in Task 2 of the Work Plan.

As stated earlier, the criteria that will be used to specify data quality requirements and to evaluate the analytical system performance are precision, accuracy, representativeness, completeness and comparability (PARCC). Table 3-1 presents definitions for these criteria.

3.2 Field Investigation Quality Objectives

The objectives with respect to the field investigation are to maximize the confidence in the data in terms of PARCC.

In terms of precision and accuracy, Section 9 presents the frequency with which field duplicates and field blanks will be collected such that a specific degree of precision and accuracy can be calculated. The data quality objective for field duplicates is to achieve precision equal to or greater than laboratory duplicate precision requirements under the CLP program.

Acceptable sample precision can be attained by careful sample homogenizing when appropriate. Precision will be calculated as relative percent difference (RPD) if there are only two (2) analytical points and relative standard deviation (RSD) if there are more than two (2) analytical points. The submission of field blanks will provide a check with respect to accuracy. Although accuracy is best assessed by evaluating the results of blanks,

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TABLE 3-1

DEFINITIONS OF DATA QUALITY INDICATORS

- Precision - a measure of the reproducibility of measurements under a given set of conditions.

- Accuracy - a measure of the bias that exists in a measurement system.

- Representativeness - the degree to which sample data accurately and precisely represent selected characteristics.

- Completeness - a measure of the amount of the valid data obtained from the measurement system compared to the amount that was expected under "normal" conditions.

- Comparability - express the confidence with which one data set can be compared with another.

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blanks do not monitor analyte losses. The submission of blanks will, however, monitor errors associated with the sampling process, field contamination, preservation, handling, and matrix. The data quality objective for field blanks is to meet or exceed those criteria established in the EPA's CLP IFB (organic and inorganic). In the event that the blanks are contaminated and/or poor accuracy (matrix and surrogate spikes) and precision (field duplicates and matrix spike duplicates) are obtained the associated data will be qualified as described in Section 12.3. Through the submission of field QC samples the distinction can be made between laboratory problems, sampling technique, and sample matrix variability.

Precision and accuracy for the field pH and conductivity are dependent on the type and condition of the instrument used and the care used in the standardization and operation. The precision and accuracy objectives for the instrumentation used are as follows:

- pH precision will be ±0.3 pH standard units and an accuracy of ±0.3 pH standard units.

- Conductivity precision will be ±3 umhos/cm on the 500 umhos/cm range, +25 umhos/cm on the 5,000 umhos/cm range, and ±250 umhos/cm on the 50,000 umhos/cm range. Accuracy for the conductivity measurements are a function of the conductivity reading for the probe and instrument combined and is given in Figure 2, page A2-7 of Attachment 3 of this QAPP.

To assure samples representativeness all sample collection will be performed in strict accordance the U.S. EPA-recommended procedures for the collection, and preservation, and holding times specified in EPA 600/4-79-020 (Methods for Chemical Analysis of Water and Wastes) and the Federal Register, 26 October 1984.

The data quality objective for the completeness of data with respect to the sampling (field investigation) is 100%. Although this goal appears rather ambitious, it can be attained. Through the phased sampling approach the critical data points will be identified. Every effort will be made to obtain valid data for all sampling points particularly those classified as critical points. In this regard the critical point samples which are identified will necessarily be selected as subsequent QC samples

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(duplicate and matrix spikes) at the frequency specified in Section 9.

In order to establish a degree of comparability such that observations and conclusions can be directly compared with all historical data, ERM will use standardized methods of field analysis, sample collection, holding times and preservation. In addition, field conditions will be considered as well as sampling in order to attain a high degree of data comparability.

3.3 Laboratory Quality Objectives

The laboratory will demonstrate analytical precision and accuracy, by the analysis of laboratory duplicates, field duplicates and matrix spike duplicates. Precision will also be demonstrated (as well as instrument stability) by comparison of response factors for calibration standards. Laboratory accuracy will be demonstrated by the addition of surrogate and matrix spikes compounds. Accuracy will be presented as percent recovery. Precision will be presented as RPD, RSD, or PD whichever is applicable to these type of QC samples. Laboratory blanks will also demonstrate accuracy with respect to the analyses. The frequency of laboratories duplicates, matrix spikes and laboratory blanks are specified in Section 9. As considerable reference is made to Attachment 1 in the remainder of this QAPP, it is suggested it be reviewed at this time. CompuChem Laboratories, Inc., data quality objectives are detailed in Attachment 1 to this QAPP.

The analysis laboratory will be expected to process (purge, extract or digest) an aliquot of sample such that the analytical results will provide a high degree of representation with respect to the sampling point. In addition the analysis laboratory will be expected to document all analytical problems encountered during the course of the investigation. This will enable ERM to achieve a 100% completeness goal through a phased sampling approach. Further the laboratory will be required to provide all data packages in full CLP deliverables (most recent) as to assure that analytical methods, parameters, and reporting units are compatable with other existing data.

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3.4 Criteria Objectives

The quantitative objectives (criteria) that ERM will require for both field and laboratory accuracy and precision are summarized in Table 3-2.

The laboratory will be expected (as an ideal objective) to report the method detection limits (MDL) for all samples in the appropriate statistical reporting units for all analyses as stated in the most current IFB used by the analysis laboratory. However, it should be noted that actual detection limits are sample specific and depend on variables such as dilution factors, sample matrices and the specific analyte. The handling of data reported at or near the MDL will be done cautiously since the stated data quality objectives for accuracy and precision may not "translate" well in some situations.

3.5 Data Management Objectives

It is a data management objective that all aspects of the investigation from sample design, collection, shipment analysis use/decisions, etc. be performed in conjunction with rigorous QA/QC documentation. The specific details of this documentation can be found throughout this document and the associated work plan.

It is expected that by the design of separate data quality requirements for field sampling and laboratory analysis, clear distinctions can be made such that any problems found in the system can be isolated with respect to the cause. Conversely, the data quality requirements are also designed to provide an indication of the variability inherit to the overall system.

Through the use of a phased approach of sampling, analysis, data assessment (data review), data qualification, and feedback the overall data management objective is to provide a complete data base with a high degree of confidence that will thoroughly characterize the environmental media collectively called Cokers No. 1 and Cokers No. 2.

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TABLE 3-2

CRITERIA OBJECTIVES

Precision Objectives	Aqueous	Solid/Other
Aqueous duplicate/Replicates (Blind or labeled)		
VOA	within 20% RPD	within 30% RPD
BNA	within 25% RPD	within 40% RPD
Pest/PCB	within 25% RPD	within 40% RPD
Inorganics	within 20% RPD	within 40% RPD
Laboratory Duplicates (Unspiked)		
VOA	within 20% RPD	within 30% RPD
BNA	within 25% RPD	within 40% RPD
Pesticide/PCB	within 25% RPD	within 40% RPD
Inorganics	within 20% RPD	within 40% RPD
Laboratory Duplicate (MSD)		
VOA	As specified in current IFB	
BNA	As specified in current IFB	
Pesticide/PCB	As specified in current IFB	
Accuracy Ojectives		
Field or trip blanks		
VOA	Less than the detection Limit	
BNA	Less than the detection Limit	
Pesticide/PCB	Less than the detection Limit	
Inorganics	Less than the detection Limit	
Laboratory Blanks		
VOA	As specified in current IFB	
BNA	As specified in current IFB	
Pesticide/PCB	As specified in current IFB	
Inorganics	As specified in current SOW	
Matrix spikes/surrogate spikes (All fractions)	As specified in current IFB/SOW	
Post - digestion spikes Inorganics	As specified in current SOW.	

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SECTION 4

SAMPLING PROCEDURES

The generalized sampling procedures used by ERM are presented as Attachment 2, "Standard Operating Procedures for the collection of Environmental Samples". These procedures have been standardized to allow applicability to a wide type of environmental investigations. Procedures associated with the soil gas survey, geophysical characterization, waste characterization, soil sampling, surface water/sediment sampling, and ground water sampling at Coker's Landfill No. 1 and No. 2 will be conducted according to Attachment 2, with site-specific procedures noted as below.

The numbers of samples, locations, and justifications for each sample media to be collected are presented in Task 2 of the Work Plan. Please refer to the Work Plan for this information.

4.1 Soil Gas Survey Procedures

The Work Plan identifies the use of two soil gas surveys to provide preliminary information and potentially delineate volatile organic contamination at the Coker's Landfill No. 1 and No. 2. One-inch borings to an approximate depth of 3 feet will be drilled using a gas powered stainless steel auger. A soil gas probe designed as depicted in Figure 4-1 will then be inserted into the boring and the annulus at the surface sealed. The fit between the probe and the boring is sufficiently tight to ensure that soil gas vapors enter only through the drilled holes and bottom of the soil gas probe. The measurement probe of a Foxboro Century 128 Flame Ionization Detector (FID) Organic Vapor Analyzer (OVA) is then connected to the tygon tubing of the soil gas probe. The pump of the OVA is used to draw gas vapors from the soil and the maximum reading recorded for each boring.

Prior to taking a measurement, background VOCs will be measured at the vicinity of the survey location and recorded. In addition

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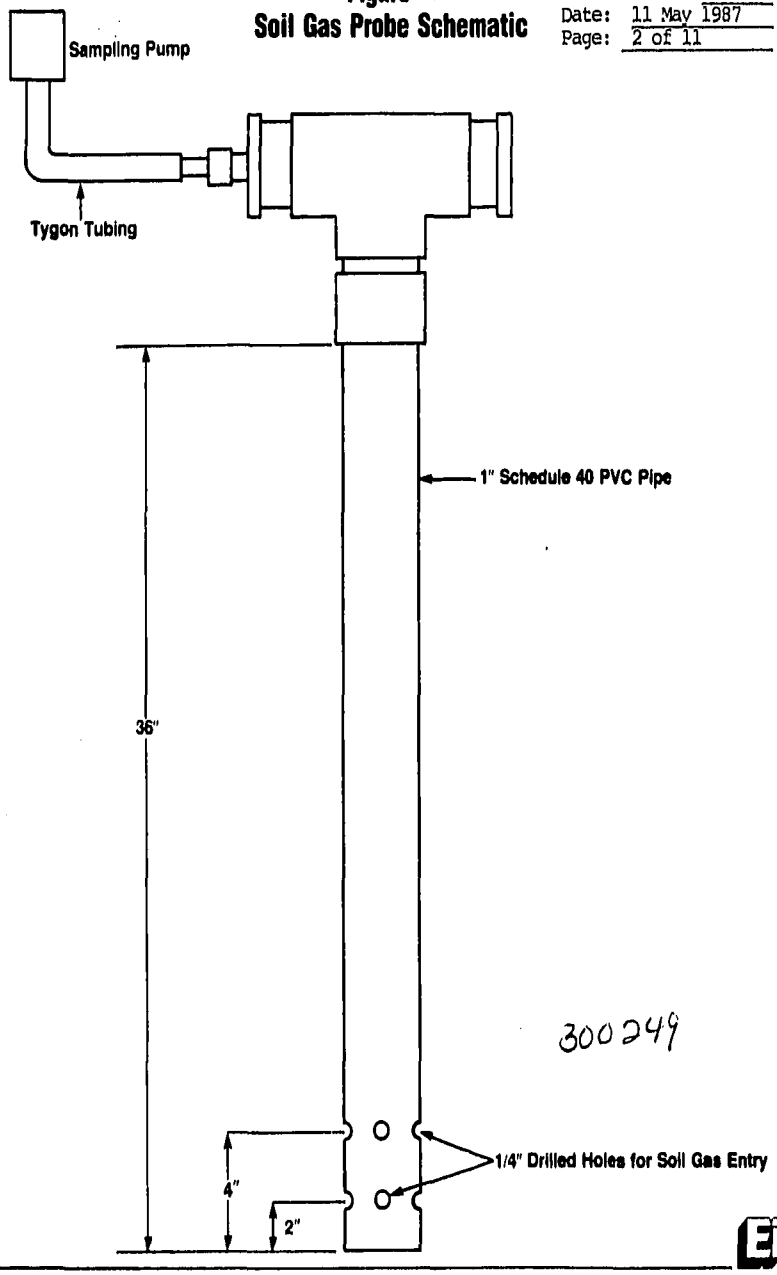
Figure 4-1
Soil Gas Probe Schematic



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to the maximum reading being measured, the stabilized VOC reading will be recorded. Elevated readings above background will be measured a second time to determine the presence or absence of methane contribution to the reading. A second boring will be drilled adjacent to the boring with the elevated reading, and a Photovac Tip II Photoionization Detector (PID) OVA will be used to obtain a measurement. The difference between the FID and PID measurements is attributable to methane.

4.2 Geophysical Characterization Procedures

Electromagnetic conductivity (EM) surveying will be used to locate and define contaminant plumes and other areas of high electrical conductivity as possible sources of contamination. The electromagnetic technique maps the earth's conductivity by measuring its response to an induced magnetic field. Since the conductivity of the earth is primarily a function of the conductivity of its pore water, which in turn is controlled mainly by the concentrations of dissolved salts, EM offers a rapid, low cost means of mapping contaminant plumes without direct ground contact.

The Geonics EM-34/3 will be utilized for conductivity measurements. By varying the intercoil spacings and the dipole orientation of the instrument, various sampling depths can be achieved. This instrument is calibrated by Geonics, Ltd., at their plant in Ontario, Canada, before shipping. ERM will perform a field calibration check daily to ensure that the equipment is functioning properly.

Survey lines will be located with a Brunton compass and measuring tape. All survey stations will be marked in the field for future reference. Following the completion of the survey, apparent conductivity contour maps will be plotted and interpreted by an ERM geophysicist. Contour maps will be generated at various apparent depths that are chosen in the field. Additionally, the contoured data and interpretations will be constructed for several lines where conductivity soundings at multiple depths are taken.

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4.3 Waste Characterization Sampling Procedures

4.3.1 Test Pit Sampling

A minimum of two test pits at each of the Coker's Landfills will be used to obtain waste characterization samples. At Coker's Landfill No. 1, the test pits will be dug through the waste to the bottom to obtain a profile of the material present. Each Coker's Landfill No. 1 waste sample will be composited from surface waste material, waste material from the center, and from the bottom waste material. Equal volumes of each layer will be homogenized on an enamel pan with a stainless steel trowel prior to placing the appropriate volume in the sample container. The sample collected for volatile organic analysis will be collected as a grab sample from the center depth to avoid VOC loss during the homogenization process.

The test pits at Coker's Landfill No. 2 are to be shallow in nature to avoid disturbing the liner of the waste cells. At these test pits, a grab sample from the upper waste will be collected and immediately placed into the appropriate sample containers.

Sample acquisition of the waste material will be dependent on the conditions encountered during digging the test pit. If safety conditions allow close proximity to the test pit, and depths are not too great, a stainless steel bucket auger will be used to obtain waste from the desired depth/location. If the above is not allowed, the waste will be sampled from material brought up by the bucket of the backhoe from the required depth.

4.3.2 Leachate Sample Collection

Leachate from the Coker's Landfill No. 1 will be allowed to pool into the bottom of the test pit. A polyethylene dipper sample with a six (6) foot extension will be used to collect a grab sample for transfer to the appropriate sample containers.

Leachate for Coker's Landfill No. 2 will be sampled from the existing leachate collection system. Depending on the accessibility, amount, and depth of leachate to sample, either a polyethylene grab sampler, a stainless steel bailer, or a small peristaltic pump will be used to obtain sufficient sample volume. If these devices prove unsuccessful, a special sampler may be fashioned to obtain the necessary sample. As leachate compound

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and constituent concentrations are expected to be elevated, dedicated equipment constructed of as inert material as possible to perform the task will be used.

4.4 Subsurface Soil Sampling

The Work Plan addresses collection of soil samples from test borings and well borings.

4.4.1 Split Spoon Soil Sampling

Split spoon soil samples will be collected as per ASTM D-1586. Each split spoon samples will be divided into two aliquots. One aliquot will be placed (using a stainless steel spatula) in laboratory supplied glass bottles with a Teflon®-lined enclosure and handled as described in Section 4.7.3 of this QAPP. Sufficient soil from the second aliquot will be placed to fill one eighth of a wide mouth liter container for headspace measurement. Immediately after the soil is placed into the container, the mouth of the jar will be lined with aluminum foil and the enclosure securely replaced.

Prior to taking a headspace VOC measurement, the measurement vessel containing the sample will be placed on a perforated pan above a boiling water bath for a duration of ten minutes. On each minute mark, the sample will be agitated (shaken) for ten seconds to aid in the disaggregation of the soil. At the completion of the ten minutes, the container will be removed and the maximum headspace reading recorded using a Foxboro, Century OVA 128. A three-eighths (3/8) inch hole drilled through the center of the plastic cap will allow the puncture of the aluminum seal with the probe of the OVA to measure total VOC content. The headspace measurements and physical observation will be used to select samples for laboratory analysis from each boring.

4.5 Surface Water and Sediment Sampling

4.5.1 Surface Water Sampling

Surface water sampling will proceed from the farthest downstream location and proceed to upstream locations to minimize potential cross-contamination from suspended material in the stream from sampling activities. Dependent upon depth and stream velocity, samples will be either collected directly into the appropriate sample containers at a point upstream of the samplers position or

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through the use of a long-handled polyethylene grab sampler from the bank of the stream.

Stream velocity and flow characteristics will be noted at each sampling location. Stream velocity will be measured using a Mead Pigmy HP-302 open channel velocity meter. Flow will be determined based on the calculated cross-section area at the stream sampling station.

4.5.2 Sediment Sampling

At each surface water sampling location a sediment sample will also be collected. If present, a composite of the equal volumes of fine sediments (surface) from two points in the vicinity of the surface water location will be homogenized on an enamel pan with a stainless steel spatula and an appropriately sized volume transferred to the sample containers. The sample for volatile organic analysis will be collected as a grab sample from one of the above locations.

Sediments will be collected with a stainless steel trowel and dewatered as much as possible prior to placement into the sample containers.

4.5.3 Seep/Leachate Sampling

The leachate to be sampled emanating from the wall of Coker's Landfill No. 1 will be collected by first digging a small catchment pool. The pool will be allowed to fill and run until clear of suspended turbidity. A glass beaker (organics) and polyethylene beaker (inorganics) will then be used to transfer leachate to the appropriate containers.

If leachate of sufficient quantity is not available for sampling, soil will be collected at the location where the leachate emanates from the landfill wall. A stainless steel hand trowel will be used to transfer the upper two (2) inches of soil into the sample containers.

4.6 Ground Water Sampling Procedures

In addition to the information presented in Section 3.1 of Attachment 2, site-specific protocols for Coker's Landfill No. 1 and No. 2 are presented in this section.

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4.6.1 Preparation for Sampling

Preparation for sampling includes the acquisition of all necessary monitoring equipment and site-specific information to perform the required monitoring. A location map for the proposed newly installed monitoring wells at Coker's Landfill No. 1 and No. 2 will be developed before entering the field. Prior to initiating any sampling activities, a complete round of depth to water levels will be measured to the nearest one hundredth of a foot.

Monitoring wells are to be evacuated and sampled proceeding from the suspected least to most contaminated well to minimize potential cross-contamination. The sampling order of the wells from least to most contaminated will be based on ground water flow directions, well location with respect to the suspected source areas, historical data, and field OVA readings on soil samples and of the well head during drilling. Total well depths necessary to calculate the required purge volumes will be tabulated in Table 4-1 after the completion of the installations.

4.6.2 Well Evacuation

Monitoring wells will be evacuated of three volumes of water standing in the well casing or until the well goes dry prior to sample acquisition. The volume of water to be purged for each well will be calculated as described in Section 3.1.1.2 of Attachment 2.

A site dedicated, stainless steel body, ISCO Model 2600 bladder pump with polyethylene tubing will be used to evacuate all the existing two-inch monitoring wells at Coker's Landfill No. 2 identified to be sampled in the Work Plan. Pump placement depth will be dependent on well yields. Bladder pump flow rates are typically low ($\leq$ 1.5 gpm), necessitating placement of the pump intake at the top of the water column in high yielding wells. Low well yields require pump placement to be at the bottom of the well. Proper pump placement will insure complete and proper evacuation. Upon completion of the reuired purge volume, the pumping system will be removed from the well. Wells that are inaccessible with the pump system will be hand bailed using a stainless steel bailer.

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TABLE 4-1

WELL DEPTH FOR
COKER'S LANDFILL No.1 AND No.2

Well No.	Total Depth (feet)

* Wells are 2" diameter.
** Wells are 4" diameter.

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ERM's newly installed large diameter wells (4") will be purged using a site dedicated stainless steel Grundfos® submersible pump fitted with stainless steel discharge tubing. A check valve placed immediately above the pump prevents purge water in the tubing from re-entering the well when the pump is turned off. Pump placement depth is again dependent on well yields (see above paragraph). An Up-2-Dazy® pump puller is used to install and retrieve the pump in the well.

4.6.3 Sample Acquisition

Sample acquisition will be as described in Section 3.1.1.3 of Attachment 2. Dedicated one and one-quarter (1-1/4) inch, bottom-loading stainless steel bailers will be used to collect grab, ground water samples for transfer into the proper sample containers. Monofilament polypropylene, or Teflon-coated single strand stainless steel wire, will be used to raise and lower the bailer. If well yields are low at the site, the samples will be collected as the well recovers and provides a sufficient volume for sample collection.

4.7 Decontamination and Post-Sampling Procedures

4.7.1 Drilling Equipment Decontamination

Drilling equipment will be decontaminated prior to initial use, between boring locations, and at the completion of drilling activities. Items necessary to decontaminate include:

- back of drilling rig
- auger flights
- down-hole equipment
- well casing and screen

A manual scrubbing to remove foreign material followed by a thorough steam cleaning will be used for decontamination of the above items. Drilling equipment, well screen, and well casing will be stored in a contaminant free location above ground on wooden supports after decontamination, and covered with plastic until use.

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4.7.2 Sampling Equipment Decontamination

All non-disposable equipment (bailers, split spoon samplers, hand trowels, etc.) will be decontaminated according to the procedures in Section 4.1 of Attachment 2. Each dedicated bailer will be individually wrapped in plastic trash bags and sealed following decontamination, and stored on-site at a contaminant free location or at ERM's warehouse for future use. The ISCO bladder pump will be decontaminated with clean tap water and distilled water as described on page 4-2, Section 4.1 of Attachment 2.

The submersible pump system will be decontaminated between wells by flushing with approximately 50 gallons of clean tap water. The outside of the pump and discharge tubing will be thoroughly rinsed with distilled water using a hand-held pressure sprayer.

The backhoe bucket will be cleaned by thoroughly steam cleaning between test pit locations. If the bucket is used for sample retreival, it will be steam cleaned prior to withdrawing the material to be sampled.

4.7.3 Sample Preparation and Preservation

Ground water samples collected for metals analysis will be field filtered through a 0.45 um pore size filter prior to preservation to allow determination of dissolved metals. The filtering system used will be as described in Section 4.2 of the SOP.

Immediately after collection, samples will be transferred to properly labeled (see Section 5 of this QAPP) sample containers with all necessary preservatives added. Sample containers are supplied by I-Chem of Hayward, CA and will be Type II grade (to meet EPA requirements) and preservatives are Ultrex grade quality. Table 4-2 lists the proper container material, volume requirement, and preservation needed for the Coker's Landfill No. 1 and No. 2 analyses. Samples requiring refrigeration for preservation will be immediately transferred to coolers packed with ice or ice packs. Proper chain-of-custody documentation will be maintained as discussed in Section 5 of this QAPP.

Field measurements for pH, specific conductance, and temperature will be obtained on ground water samples immediately following sample collection. A grab sample collected in a beaker will be used to obtain measurements. Surface water samples will be measured in situ. A one to four (1:4) sediment to distilled water slurry will be used to measure sediment pH in a Whirlipak® bag.

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TABLE 4-2

SAMPLE CONTAINERS AND PRESERVATION REQUIREMENTS
FOR ANALYSES IN CONJUNCTION WITH
COKER'S LANDFILL NO. 1 AND NO. 2 RI

Analysis	Sample Container	Preservation
WATER:		
TCL Volatiles	2-40 ml vials with Teflon™ screw cap septa	Cool to 4°C
Acrolein & Acrylonitrile	2-40 ml vials with Teflon™ screw cap septa	Cool to 4°C
TCL Semivolatiles	2 amber glass liters	Cool to 4°C
TCL Pesticides/PCBs	1 amber glass liter	Cool to 4°C
Task I & II Metals	1 plastic liter	Field filter (ground water only) with 0.45 filter followed by HNO_3 to pH $\leq$ 2
Cyanide (Task III)	1 glass liter	NaOH to pH $\geq$ 12
SOIL/SOLID SAMPLES:		
TCL Volatiles	1 glass 4 oz. wide-mouth with Teflon™ lined cap	Cool to 4°C
All Additional Analyses	1 glass 32 oz. wide-mouth with Teflon™ lined cap	Cool to 4°C

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SECTION 5

SAMPLE CUSTODY

The primary objective of sample custody procedures is to create an accurate written record which can be used to trace the possession and handling of all samples from the moment of their collection, through analysis, until their final disposition. Sample custody for samples collected during this investigation will be maintained by the Field Operations Manager (FOM) or the field personnel collecting the samples. The FOM or field personnel are responsible for documenting each sample transfer and maintaining custody of all samples until they are shipped to the laboratory. The preparation of sampling equipment will be documented as described in Section 11.2 of this QAPP.

All necessary sample bottles will be shipped to ERM by CompuChem Laboratories and received by the FOM or field personnel. All necessary chemical preservatives will be added to the bottle by ERM immediately upon bottle receipt. Sample bottles needed for a specific sampling task will then be relinquished by the FOM to the sampling team after the FOM has verified the integrity of the bottles and assured that the proper bottles have been assigned to the task to be conducted.

A self-adhesive sample label (Figure 5-1) will be affixed to each container before sample collection to minimize label loss during handling of the container. At a minimum, the sample label will contain:

- Client - Job Name (Coker's Landfill No.1 or No.2)
- ERM Traffic Report Number
- Sample identification - place of sampling
- Date and time collected
- Sampler's initials
- Testing required
- Preservatives added

Immediately after sample collection, each sample bottle will be sealed in an individual plastic bag. Samples will then be placed immediately into an insulated cooler for shipment to the laboratory. ERM field Chain-of-Custody records (Figure 5-2) and an ERM Traffic Report (Figure 5-3), completed at the time of sample collection will accompany the samples inside the cooler for shipment to the laboratory. The samples will be properly relinquished on the field Chain-of-Custody record by the sampling

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FIGURE 5-1

COMPUCHEM LABORATORIES
SAMPLE CONTAINER LABEL

COMPUCHEM LABORATORIES

CompuChem Laboratories
P.O. Box 12652
Chapel Hill/Nelson Highway
Research Triangle Park, NC 27709

RETURN POSTAGE GUARANTEED

COMPUCHEM LABORATORIES
CUSTODY SEAL
Signature
Date

COMPUCHEM LABORATORIES
CUSTODY SEAL
Signature
Date

COMPUCHEM LABORATORIES
CUSTODY SEAL
Signature
Date

S-ID#: _____ SAMPLING DATE: _____
ANALYZE FOR/CODE: _____

S-ID#: _____ SAMPLING DATE: _____
ANALYZE FOR/CODE: _____

S-ID#: _____ SAMPLING DATE: _____
ANALYZE FOR/CODE: _____

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ANALYZE FOR/CODE: _____

S-ID#: _____ SAMPLING DATE: _____
ANALYZE FOR/CODE: _____

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FIGURE 5-2
ERM CHAIN OF CUSTODY RECORD

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Sample Chain of Custody

Code: | Project Name:

Sampler:

ERM Traffic Report	Date	Time	COMP	GRAB	Station Location	Number of Containers							Remarks

Sample Relinquished by:	Sample Received by:	Date	Time	Reason for Transfer

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FIGURE 5-3

ERM TRAFFIC REPORT FORM

The ERM Group

Traffic Report

1 Project W.O. #	2 Sample Concentration	№ 1003
Project Name/Location	☐ Low Concentration	
	☐ Medium Concentration	3 Ship to:
	5 Sample Matrix	
4 Sampling Personnel Contact	☐ Liquid	
Sampler / Project Manager	☐ Solid	
Phone #	☐ Other _____	Attn:

6 Shipping Information	7 Specify Number of Containers, Approximate Volume and the Type of Analyses Requested		
(Name of Carrier)			
(Date Shipped)	ANALYSES/METHOD REQUESTED	# OF BOTTLES	TOTAL VOLUME
(Airbill Number)			
8 Sample Location			
Date:			
Time:			

9 Sample Description	10 Special Handling (e.g. Safety Procedures/Hazardous)
☐ Surface Water ☐ Soil	
☐ Ground Water ☐ Solid	
☐ Leachate Other _____	Additional comments:
☐ Sediment	

11 Condition of Samples Received (to be completed by Laboratory Log-in.)	
☐ Samples received intact	
☐ Samples at 4 degrees (C)	Log-in Person's Signature
☐ Samples not leaking	
☐ Container numbers match as specified in Item 7	
☐ Container tags match Chain of Custody	
☐ Cooler received with Custody Seals intact	

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Copies: White - Sampler, Yellow - Lab, Pink - Client, Gold - File

team. These record forms will be sealed in a ziplock plastic bag to protect them against moisture. Each cooler will contain sufficient ice and/or ice packs to insure that proper temperature is maintained, and will be packed in a manner to prevent damage to sample containers. The FOM will then initial and custody seal (Figure 5-4) each sample cooler. All coolers will be shipped by an overnight courier according to current US DOT regulations. Prior to releasing the coolers, the FOM will require the courier to sign an ERM Cooler Transfer Acknowledgment (Figure 5-5). Upon receiving the samples, the laboratory Sample Custodian will inspect the condition of the samples, compare the information on the sample labels against the field Chain-of-Custody record and Traffic Reports, assign a Compuchem Laboratory control number, and log the control number into the computer sample inventory system. A detailed description of this log-in procedure is given in Attachment 1, Section 5.0.

The preparation of all sample bottles (cleaning technique, preservative added, etc.) will be documented. When samples requiring preservation by either acid or base are received at the laboratory, the pH will be measured and documented. The Laboratory Sample Custodian will then store the sample in a secure sample storage cooler maintained at 4°C and maintain custody until assigned to an analyst for analysis.

The Laboratory Sample Custodian will note any damaged sample containers or discrepancies between the sample label and information on the field Chain-of-Custody record when logging the sample and will note any discrepancies in Section 11 of the ERM Traffic Report. This information will also be communicated to the FOM or field personnel so proper action can be taken. The Chain-of-Custody form will be signed by both the relinquishing and receiving parties each time the sample changes hands, and the reason for transfer indicated.

An internal Chain-of-Custody form will be used by Compuchem Laboratories to document sample possession from laboratory Sample Custodian to Analysts and final disposition (Attachment 1, Section 5.0). All Chain-of-Custody information will be supplied with the data packages for inclusion in the document control file.

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FIGURE 5-4

ERM CUSTODY SEAL

The ERM Group	OFFICIAL CUSTODY SEAL	Name _____ Date _____

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ERM COOLER TRANSFER ACKNOWLEDGEMENT

DATE / TIME	CLIENT / PROJECT / CLIENT NUMBER	NUMBER OF COOLERS	ERM RELEASE (SIGNATURE)	RECEIVED BY (SIGNATURE)	DATE / TIME

FIGURE 5-5
ERM COOLER TRANSFER ACKNOWLEDGEMENT

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SECTION 6

CALIBRATION PROCEDURES AND FREQUENCY

6.1 Laboratory Calibration

Laboratory calibration and frequency for the required methods specified for this study are presented in Attachment 1, Section 6.0.

6.2 Field Calibration

In addition to the laboratory analyses conducted during the course of this investigation, field measurements of pH, specific conductance, and temperature will be taken for all surface and ground water samples. An OVA meter will be used to measure total volatile organics in air or soil headspace. All calibrations will be recorded in the field notebook of the individual responsible for the calibration.

The frequency of field calibration procedures will, at a minimum, include the following:

- The pH and specific conductance meters will be calibrated a minimum of once daily and documented in the calibrator's field book. Calibration will be checked as necessary to insure proper measurements are taken.

- pH meters will be calibrated using specific techniques according to the manufacturer's instructions given in Attachment 3 and two standard certified buffer solutions (either 4, 7, or 10) obtained from chemical supply houses. The pH values of these buffers will be compensated for temperature according to the values supplied on the manufacturer's bottle label. The temperature (measured as below) at which the sample pH was measured will then be used to compensate for temperature on the meter.

- Temperature measurements will be performed using field thermometers (Thomas Science No. 9329A10).

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- Specific conductance meters will be calibrated using a 1413.0 umho (KCl) solution prepared by ERM according to Standard Methods for the Analysis of Water and Wastewater, 16th Edition, 1985, Method 205, 3b, page 79. The conductivity probe cell constant will be calculated according to the formula:

$$K = \frac{1413.0 \frac{1}{(C)}}{1 + 0.02\ (T - 25°C)}$$

Where:

K = probe cell constant (unitless)
C = measured conductance value of standard
T = temperature (°C) of standard

Table 6-1 will be used to correct for the standard solutions' conductivity value if it is not at 25°C.

Using the cell constant calculated above and the following formula, field specific conductance measurements will be corrected to 25°C.

$$S = \frac{K \cdot C}{(1 + 0.02\ (T - 25))}$$

Where:

S = specific conductance at 25°C (umhos/cm)
K = calculated cell constant
C = field specific conductance (umhos/cm)
T = temperature (°C) of sample at which conductance was measured

- The Foxboro Century OVA 128 will be calibrated to a methane in air standard (87 ppm) daily to insure total volatile organic readings are accurate. The methane in air standard is manufactured by Liquid Carbonic and marked with its certified concentration. The standard

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is run directly into the intake of the pickup probe and the gain adjustment of the OVA 128 is then used to calibrate the reading to 87 ppm. Any OVA, total volatile organic readings will to reported as "X ppm as methane".

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TABLE 6-1

CONDUCTIVITY TEMPERATURE CORRECTIONS
FOR 1,413 UMHOS/CM CONDUCTIVITY STANDARD

Temperature, °C	umhos/cm
15	1,141.5
16	1,167.5
17	1,193.6
18	1,219.9
19	1,246.4
20	1,273.0
21	1,299.7
22	1,326.6
23	1,353.6
24	1,380.8
25	1,408.1
26	1,436.5
27	1,463.2
28	1,490.9
29	1,518.7
30	1,546.7

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SECTION 7

ANALYTICAL PROCEDURES

All analytical procedures to be used are officially approved EPA procedures. The appropriate references are given in Attachment 1, Section 7.0.

The analytical methods which are to be used for the analysis of the sample media collected at Cokers No. 1 and No. 2 will be in accordance with Contract Laboratory Program (CLP) IFB for Organics and the Statement of Work (SOW) for inorganics. The specific version will be the current awarded contract CompuChem Laboratories is operating under. These methods were chosen to provide comparability with other data typically collected for CERCLA investigations and to meet the project DQO. These methods are the most appropriate to achieve all DQO. As stated by the laboratory, these methods are applicable to aqueous, solids, seeps and leachate samples.

Two additional compounds which will be analyzed for in several aqueous samples are acrolein and acrylonitrile. The method of analysis is discussed below. A complete list of the organic and inorganic compounds/constituents and the applicable detection limits that will be required for all samples collected for the subject investigation is presented in Table 7-1. The detection limit for acrolein and acrylonitrile will be 100 ug/l respectively.*

The methods to be used for acrolein, acrylonitrile, pH, specific conductance and TOC by CompuChem Laboratories are presented on Table 7-2. The characterization of grain size will be performed by Metuchen Analytical, Metuchen, New Jersey. The method to be used for grain size characterization is also presented on Table 7-2.

Holding times that are required to be met are presented on Table 7-3.

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

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TABLE 7-1

COKER'S LANDFILLS ORGANIC COMPOUNDS AND INORGANIC CONSTITUENTS FOR ANALYSIS AND QUANTITATION LIMITS

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

Volatiles	CAS Number	Quantitation Limits** Water ug/L	Quantitation Limits** Low Soil/Sediment# ug/Kg
1. Chloromethane	74-87-3	10	10
2. Bromomethane	74-83-9	10	10
3. Vinyl Chloride	75-01-4	10	10
4. Chloroethane	75-00-3	10	10
5. Methylene Chloride	75-09-2	5	5
6. Acetone	67-64-1	10	10
7. Carbon Disulfide	75-15-0	5	5
8. 1,1-Dichloroethene	75-35-4	5	5
9. 1,1-Dichloroethane	75-35-3	5	5
10. 1,2-Dichloroethene (total)	540-59-0	5	5
11. Chloroform	67-66-3	5	5
12. 1,2-Dichloroethane	107-06-2	5	5
13. 2-Butanone	78-93-3	10	10
14. 1,1,1-Trichloroethane	71-55-6	5	5
15. Carbon Tetrachloride	56-23-5	5	5
16. Vinyl Acetate	108-05-4	10	10
17. Bromodichloromethane	75-27-4	5	5
18. 1,1,2,2-Tetrachloroethane	79-34-5	5	5
19. 1,2-Dichloropropane	78-87-5	5	5
20. cis-1,3-Dichloropropene	10061-01-5	5	5
21. Trichloroethene	79-01-6	5	5
22. Dibromochloromethane	124-48-1	5	5
23. 1,1,2-Trichloroethane	79-00-5	5	5
24. Benzene	71-43-2	5	5
25. trans-1,3-Dichloropropene	10061-02-6	5	5
26. Bromoform	75-25-2	5	5
27. 2-Hexanone	591-78-6	10	10
28. 4-Methyl-2-pentanone	108-10-1	10	10
29. Tetrachloroethene	127-18-4	5	5
30. Toluene	108-88-3	5	5

(continued)

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TABLE 7-1
(Continued)

Volatiles	CAS Number	Quantitation Limits** Water ug/L	Quantitation Limits** Low Soil/Sediment* ug/Kg
31. Chlorobenzene	108-90-7	5	5
32. Ethyl Benzene	100-41-4	5	5
33. Styrene	100-42-5	5	5
34. Xylenes (Total)	133-02-7	5	5

*Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Volatile TCL Compounds are 100 times the individual Low Soil/Sediment CRQL.

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

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

TABLE 7-1
(Continued)

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

Semivolatiles	CAS Number	Quantitation Limits** Water ug/L	Low Soil/Sediment[b] ug/Kg
35. Phenol	108-95-2	10	330
36. bis(2-Chloroethyl) ether	111-44-4	10	330
37. 2-Chlorophenol	95-57-8	10	330
38. 1,3-Dichlorobenzene	541-73-1	10	330
39. 1,4-Dichlorobenzene	106-46-7	10	330
40. Benzyl Alcohol	100-51-6	10	330
41. 1,2-Dichlorobenzene	95-50-1	10	330
42. 2-Methylphenol	95-48-7	10	330
43. bis(2-Chloroisopropyl) ether	39638-32-9	10	330
44. 4-Methylphenol	106-44-5	10	330
45. N-Nitroso-Dipropylamine	621-64-7	10	330
46. Hexachloroethane	67-72-1	10	330
47. Nitrobenzene	98-95-3	10	330
48. Isophorone	78-59-1	10	330
49. 2-Nitrophenol	88-75-5	10	330
50. 2,4-Dimethylphenol	105-67-9	10	330
51. Benzoic Acid	65-85-0	50	1600
52. bis(2-Chloroethoxy) methane	111-91-1	10	330
53 2,4-Dichlorophenol	120-83-2	10	330
54. 1,2,4-Trichlorobenzene	120-82-1	10	330
55. Naphthalene	91-20-3	10	330
56. 4-Chloroaniline	106-47-8	10	330
57. Hexachlorobutadiene	87-68-3	10	330
58. 4-Chloro-3-methylphenol (para-chloro-meta-cresol)	59-50-7	10	330
59. 2-Methylnaphthalene	91-57-6	10	330
60. Hexachlorocyclopentadiene	77-47-4	10	330
61. 2,4,6-Trichlorophenol	88-06-2	10	330
62. 2,4,5-Trichlorophenol	95-95-4	50	1600
63. 2-Chloronaphthalene	91-58-7	10	330
64. 2-Nitroaniline	88-74-4	50	1600

(continued)

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TABLE 7-1
(Continued)

Semivolatiles	CAS Number	Quantitation Limits** Water ug/L	Quantitation Limits** Low Soil/Sediment[b] ug/Kg
65. Dimethyl Phthalate	131-11-3	10	330
66. Acenaphthylene	208-96-8	10	330
67. 2,6-Dinitrotoluene	606-20-2	10	330
68. 3-Nitroaniline	99-09-2	50	1600
69. Acenaphthene	83-32-9	10	330
70. 2,4-Dinitrophenol	51-28-5	50	1600
71. 4-Nitrophenol	100-02-7	50	1600
72. Dibenzofuran	132-64-9	10	330
73. 2,4-Dinitrotoluene	121-14-2	10	330
74. Diethylphthalate	84-66-2	10	330
75. 4-Chlorophenyl Phenyl ether	7005-72-3	10	330
76. Fluorene	86-73-7	10	330
77. 4-Nitroaniline	100-01-6	50	1600
78. 4,6-Dinitro-2-methylphenol	534-52-1	50	1600
79. N-nitrosodiphenylamine	86-30-6	10	330
80. 4-Bromophenyl Phenyl ether	101-55-3	10	330
81. Hexachlorobenzene	118-74-1	10	330
82. Pentachlorophenol	87-86-5	50	1600
83. Phenanthrene	85-01-8	10	330
84. Anthracene	120-12-7	10	330
85. Di-n-butylphthalate	84-74-2	10	330
86. Fluoranthene	206-44-0	10	330
87. Pyrene	129-00-0	10	330
88. Butyl Benzyl Phthalate	85-68-7	10	330
89. 3,3'-Dichlorobenzidine	91-94-1	20	660
90. Benzo(a)anthracene	56-55-3	10	330
91. Chrysene	218-01-9	10	330
92. bis(2-ethylhexyl)phthalate	117-81-7	10	330
93. Di-n-octyl Phthalate	117-84-0	10	330
94. Benzo(b)fluoranthene	205-99-2	10	330

(continued)

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TABLE 7-1
(Continued)

Semivolatiles	CAS Number	Quantitation Limits** Water µg/L	Low Soil/Sediment[b] µg/Kg
95. Benzo(k)fluoranthene	207-08-9	10	330
96. Benzo(a)pyrene	50-32-8	10	330
97. Indeno(1,2,3-cd)pyrene	193-39-5	10	330
98. Dibenz(a,h)anthracene	53-70-3	10	330
99. Benzo(g,h,i)perylene	191-24-2	10	330

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

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

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

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

Pesticides/PCBs	CAS Number	Quantitation Limits** Water ug/L	Low Soil/Sediment[c] ug/Kg
100. alpha-BHC	319-84-6	0.05	8.0
101. beta-BHC	319-85-7	0.05	8.0
102. delta-BHC	319-86-8	0.05	8.0
103. gamma-BHC (Linda-	58-89-9	0.05	8.0
104. Heptachlor	76-44-8	0.05	8.0
105. Aldrin	309-00-2	0.05	8.0
106. Heptachlor Epoxide	1024-57-3	0.05	8.0
107. Endosulfan I	959-98-8	0.05	8.0
108. Dieldrin	60-57-1	0.10	16.0
109. 4,4'-DDE	72-55-9	0.10	16.0
110. Endrin	72-20-8	0.10	16.0
111. Endosulfan II	33213-65-9	0.10	16.0
112. 4,4'-DDD	72-54-8	0.10	16.0
113. Endosulfan Sulfate	1031-07-8	0.10	16.0
114. 4,4'-DDT	50-29-3	0.10	16.0
115. Endrin Ketone	53494-70-5	0.10	16.0
116. Methoxychlor	72-43-5	0.5	80.0
117. alpha-chlordane	5103-71-9	0.5	80.0
118. gamma-chlordane	5103-74-2	0.5	80.0
119. Toxaphene	8001-35-2	1.0	160.0
120. Aroclor-1016	12674-11-2	0.5	80.0
121. Aroclor-1221	11104-28-2	0.5	80.0
122. Aroclor-1232	11141-16-5	0.5	80.0
123. Aroclor-1242	53469-21-9	0.5	80.0
124. Aroclor-1248	12672-29-6	0.5	80.0
125. Aroclor-1254	11097-69-1	1.0	160.0
126. Aroclor-1260	11096-82-5	1.0	160.0

[c]Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Pesticide/PCB TCL compounds are 15 times the individual Low Soil/Sediment CRQL.

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

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

Table 1. Elements Determined by Inductively Coupled Plasma Emission or Atomic Absorption Spectroscopy

Element (Task I and II Metals)	Contract Required Detection Level[1,2] (ug/L)
Aluminum	200
Antimony	60
Arsenic	10
Barium	200
Beryllium	5
Cadmium	5
Calcium	5000
Chromium	10
Cobalt	50
Copper	25
Iron	100
Lead	5
Magnesium	5000
Manganese	15
Mercury	0.2
Nickel	40
Potassium	5000
Selenium	5
Silver	10
Sodium	5000
Thallium	10
Vanadium	50
Zinc	20

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Table 2. Cyanide Determination

Element (Task III Inorganics)	Contract Required Detection Level[1, 2] (ug/L)
Cyanide	10

1: Any analytical method specified in SOW Exhibit D may be utilized as long as the documented instrument or method detection limits meet the Contract Required Detection Level (CRDL) requirements. Higher detection levels may only be used in the following circumstance:

If the sample concentration exceeds two times the detection limit of the instrument or method in use, the value may be reported even though the instrument or method detection limit may not equal the contract required detection level. This is illustrated in the example below:

For lead:
Method in use = ICP
Instrument Detection Limit (IDL) = 40
Sample concentration = 85
Contract Required Detection Level (CRDL) = 5

The value of 85 may be reported even though instrument detection limit is greater than required detection level. The instrument or method detection limit must be documented as described in Exhibit E.

2: These CRDL are the instrument detection limits obtained in pure water that must be met using the procedure in Exhibit E. The detection limits for samples may be considerably higher depending on the sample matrix.

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TABLE 7-2

ANALYTICAL METHODOLOGY FOR ADDITIONAL PARAMETERS

Parameter	Soil/Seep Samples	Aqueous Samples
pH	SW-846 Method 9045	CAWW Method 150.1
Specific Conductance	SW-846 Method 9050	CAWW Method 120.1
TOC	SW-846 Method 9060	CAWW Method 415.1
Grain Size	ASTM Method E112-77	N/A
Acrolein and Acrylonitrile	N/A	SW-846 Method 8240

SW-846 - Test Methods for Evaluating Solid Waste, November 1986
3rd Edition

CAWW - Methods for Chemical Analysis of Water and Wastes, March 1983

ASTM - American Society of Testing Materials Methods of Analysis

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TABLE 7-3

RECOMMENDED HOLDING TIMES FOR ANALYSES
TO BE CONDUCTED ON SAMPLES FOR THE
COKER'S LANDFILLS RI

	Sample Analysis	Holding Time: Water[1]	Holding Time: Soil/Sediment
1.	Target Compound List Volatile Organics	7 days	10 days
2.	Acrolein and Acrylonitrile	3 days	NA
3.	Target Compound List Semivolatile Organics	7 days until extraction 40 days after extraction	7 days until extraction 40 days after extraction
4.	Target Compound List Pesticides/PCBs	7 days until extraction 40 days after extraction	7 days until extraction 40 days after extraction
5.	Task I & II Metals	6 months (28 days for Hg)	6 months (28 days for Hg)
6.	Cyanide (Task III)	14 days	14 days
7.	TOC	28 days	28 days
8.	Field pH and conductivity	Measured immediately after sample collection	NA

[1] Unless otherwise specified, Federal Register, Friday, October 26, 1984.

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SECTION 8

DATA REPORTING, VALIDATION, AND REDUCTION

Data validation practices will be followed to insure that raw data are not altered and that an audit trail is developed for those data which require reduction. All the field data, such as those generated during field measurements, observations and field instrument calibrations, will be entered directly into a bound field notebook. Each project team member will be responsible for proofing all data transfers made, and ERM's Quality Assurance Officer will proof at least ten percent of all data transfers.

CompuChem group leaders will check and validate all data generated by their group as specified in Attachment 1, Section 8.0.

Upon receipt of the sample data packages, the laboratory data will again be quantitatively and qualitatively validated by ERM's Quality Assurance Manager. Data validation is discussed in detail in Section 12.

It is anticipated that ERM's data reduction for this investigation will be minimal and will consist primarily of tabulating analytical results from CompuChem's Form I (Analytical Reports) onto summary tables through the use of computerized spreadsheet software. All reduced data will be assigned document control identification numbers and placed in the central file maintained by the Project Manager.

All analytical data obtained during the course of the investigation for ground waters, surface waters, seeps and leachates will be reported as ug/l. Laboratory data for soil analyses will be reported as ug/kg (organics) and mg/kg (inorganics) on a dry weight basis. Data packages associated with the analyses of samples collected during the RI will be prepared utilizing full CLP deliverables. The required deliverables are stated in Section B of the IFB and SOW currently in use by CompuChem.

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ERM will require a rigorous data control program that will insure that all documents for the investigations are accounted for when they are completed. Accountable documents include items such as log books, field data records, correspondence, chain-of-custody records, analytical reports, data packages, photographs, computer disks, and reports. The Project Manager is responsible for maintaining a central file in which all accountable documents will be inventoried.

To maintain control in the transfer of data, all copies of raw data from the field notebooks, and the data as received from the laboratory, will be entered into a data file and assigned an appropriate document control identification number. The data file will serve as the ultimate archive for all information and data generated during this investigation.

The documentation of sample collection will include the use of bound field log books in which all information on sample collection will be entered in indelible ink. Appropriate information will be entered to reconstruct the sampling event, including: site name (top of each page), sample identification, brief description of sample, date and time of collection, sampling methodology, field measurements and observations, and sampler's initials (bottom of each page, and dated). An example of a field log is presented in Figure 8-1. ERM's Sampling Notebook SOP is photocopied and attached to the front cover of all field books issued. This insures all required information is recorded. A copy of the SOP is presented as Figure 8-2.

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FIGURE 8-1

Typical Logbook Entries

Acme Waste Company

Joe Smith-EPA Region V	(315) 672-3396
Marin Astare-PADER	(717) 629-3396
Peter Shoperton -Site Owner	(215) 276-9377
Paul Detchic-Project Manager	(215) 687-9560
Joe Perryton-Geologist	(215) 687-9560
Pauline Jenlan-Sampler	(215) 687-9560

Checked out traffic reports 1600-1609 with 3 chain of custody 8/25/87 _ bottles delivered by lab courier 8/22/87. JP took bottle custody. Arrived on site 8/27/87 @ 11:00. Cool (57F), Sunny, Entire site on a slight slope to the north. Met Joe Smith, Marin Astare & Peter Shoperton for site recon.
<u>OVA Backround Levels</u> 0ppm. Stable

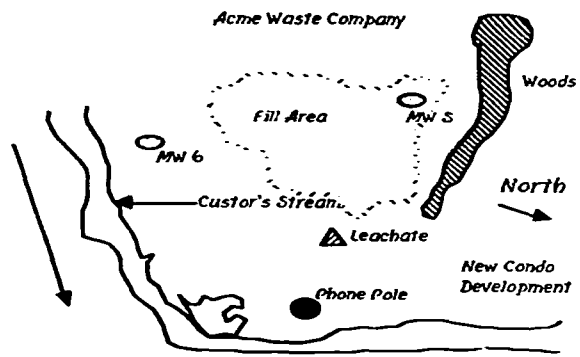
-OVA calibrated 8/25/87 see log entry page 2

12:10 Pauline sampling leachate TR 1601 photo 3, sample smells like sulfur and is rainbow in color with an oily sheen. Leachate was observed 3 feet west of the phone on site.

12:50 Joe P. samples a seep at the base of Custor's Stream TR 1602 seep is bright red and has the viscosity similar to motor oil, Photo 4.

- ·ge 3

Paul Detchic



13:00 Paul is Purging Monitoring well #5 while Joe is preparing to collect a grab sample.
14:00 Joe is bailing the well #5 and @ 14:13 is filtering for metals (dissolved).
Sample acidified w/HNO_3 pH<2 after filteration was complete TR 1603 Photo 5

15:30 Sampling from well #5 completed in triplicate so an MS and MSD can be submitted for well #5. (1604-MS, 1605-MSD)

16:50 Team left site.

Paul Detchic

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FIGURE 8-2

SAMPLING LOGBOOKS

One or more bound books will be maintained for each site; the book(s) will remain with the site file, which will be kept by the Field Services Coordinator. Copies should be made for the person who made the entries and the PM if requested.

All entries in the Logbook must be made in ink.

First Page should contain:

- Site name and number
- Date and time started
- Personnel on site

Next page(s) DTW for all wells if required by the sampling plan. S/N of the DTW meter.

Each new day should contain:

- Date and time started
- Weather
- Personnel on site - including any non-ERM personnel
- Sampling information (see next page)

* Note when a mistake is made in the Log, put a single line through it in ink and initial and date.

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SAMPLE INFORMATION

- Sample # (Traffic Report)
- Date and Time Sample collected
- Source of Sample (well, stream, domestic well, field etc.)
- Purged Well - type of equipment, purge volume, rate of purge, and decon procedures
- Location of Sample - document with a site sketch and/or written description, where sample was taken so that it could be found again.
- How was sample taken? (bailer, trowel, SS spoon, thief, etc.)
- Analysis and QAQC required (601, 602, Metals, Tier I, Tier II, etc.)
- Chemical Preservation used (HNO_3, H_2SO_4, NaOH, etc.)
- Field Data (pH, DO, spec. and temp., etc.)
- Field Observations - significant observation should be documented.
    - Sample condition (color, odor, turbidity, oil, sheen)
    - Site condition (stressed vegetation, exposure of buried wastes, erosion problems, etc.)
- How sample was shipped, date, time and where to, and if legal seals were attached to transport container(s).
- Comments - Any observation or event that occurred that would be relevant to the site; exps. weather changes or effect it had on sampling, conversations with the client, public official or private citizen; instrument calibration, equipment problems, etc.

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SECTION 9

INTERNAL QUALITY CONTROL CHECKS

9.1 Laboratory Internal Quality Control Checks

CompuChem's Internal Quality Control Checks are presented in Attachment 1, Section 9.0. These will be a continuation of ERM's Field Internal Quality Control Checks presented below.

9.2 Field Internal Quality Control Checks

Field Internal Quality Control Checks will be utilized during this investigation through the use of the following:

- Field (Travel) Blanks - These blanks consist of ultrapure, deionized water contained in each sample container with any preservatives required for that analysis. These blanks will be submitted under false identification or "blind". ERM produces ultrapure deionized water by use of a Hydrospherics Deionized Water System. These blanks will accompany the samplers during the sampling process and will serve as QC check on container cleanliness, external contamination, and the analytical method. Travel (field) blanks will be submitted once per day per analytical fraction for ground water, surface water, leachates, and seeps samples. A travel blank will be submitted daily for soil/solid samples which will be analyzed for organics only. These blanks are comprised of sodium sulfate (Na_2SO_4) and pretested clean sand.

- Field Duplicate Samples - Duplicate samples will be collected to allow determination of analytical precision. One "blind" duplicate sample will be collected and submitted for analysis for each sample matrix. These samples will be collected from critical sampling locations. Critical sampling locations are those which will be used to directly achieve DQO.

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- Matrix Spike/Matrix Duplicate Samples - Matrix Spike (MS) and Matrix Spike Duplicate (MSD) samples will be submitted as further QC checks. One MS and MSD in every twenty (20) ground water, surface water, leachate and seep samples will be collected, and one in every twenty (20) soil or sediment samples will be collected and submitted for analysis. These will allow accuracy to be determined by the recovery rates of compounds (the matrix spike and/or surrogate spike compounds defined in the analytical methods). The purpose of these laboratory spikes is to monitor any possible matrix effects specific to samples collected from the subject site. The addition of known concentrations of compounds/constituents into the sample also monitors extraction/digestion efficiency.

  The analysis of MS and MSD samples checks precision by comparison of the respective spiked recoveries. In addition, any non-spiked analytes present in the sample, MS and MSD can be assessed for precision in essentially triplicate analysis.

Duplicate/replicate and matrix spike sample aliquots will be acquired for ground, surface waters, and leachate/seeps by collecting sequential grab samples after collecting of the initial sample aliquot. Therefore, the specific sample location which will be used for matrix spikes and duplicates/replicates will be chosen by the Quality Assurance Officer to represent a critical location. Soil duplicate and matrix spike samples will be collected by splitting the sample between the sample container, duplicate container, and matrix spike container. Homogenizing is discouraged prior to splitting to avoid the loss of volatile organic compounds. If insufficient soil sample is present at a particular location to collect the three sample volumes, a single sample bottle will be split at the laboratory for MS and MSD analysis.

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SECTION 10

PERFORMANCE AND SYSTEM AUDITS

10.1 On-Site Audit

An on-site system audit will be performed monthly during major field activities to review all field-related quality assurance activities. The system audit will be conducted by ERM's Quality Assurance Officer. Figure 10-1 presents ERM's Quality Assurance Audit forms. Deficiencies found during the audits will be brought to the attention of the responsible individuals and corrective action as per Section 13 of this QAPP will be initiated. Copies of the audits will be distributed to all project personnel.

Specific elements of the on-site audit include the verification of:

- Completeness and accuracy of sample Chain-of-Custody forms, including documentation of times, dates, transaction descriptions, and signatures.

- Completeness and accuracy of sample identification labels, including notation of time, date, location, type of sample, person collecting sample, preservation method used, and type of testing required.

- Completeness and accuracy of field notebooks, including documentation of times, dates, drillers' names, sampling method used, sampling locations, number of samples taken, name of person collecting samples, types of samples, results of field measurements, soil logs, and any problems encountered during sampling.

- Adherence to health and safety guidelines outlined in the Site Health and Safety Plan including wearing of proper protective clothing.

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The ERM Group

- Adherence to decontamination procedures outlined in Section 4 of this QAPP, including proper decontamination of pumps and pump tubing, bailers, and sampling equipment.

- Adherence to sample collection, preparation, preservation, and storage procedures.

10.2 Laboratory Audit

10.2.1 Internal Laboratory Audits

CompuChem performs regular systems and performance audits, and these are described in Attachment 1, Section 10. ERM's Quality Assurance Officer will also conduct a system audit of the laboratory once during the project to insure that proper quality assurance measures are being incorporated into the sample handling and analysis. Table 10-1 lists the checklist that will be used for the system audit. Deficiencies found during the audits will be brought to the attention of the responsible individuals and corrective action as per Section 13 of this QAPP will be initiated. Copies of the audit will be distributed to the Project Manager and ERM's Quality Assurance group.

10.2.2 ERM's Performance Audit of CompuChem

As CompuChem Laboratories participate in EPA's Contract Laboratory Program (CLP), a performance audit sample will not be submitted for analysis. The most recent CLP Performance Evaluation samples analyzed during the investigation will be requested and reviewed to evaluate laboratory accuracy.

Results of both the field and laboratory audit will be submitted to ERM's Project Manager for review and incorporation into the status reports prepared by ERM for Clean Sites, Inc.

If the results of the audit necessitate further action, the Project Manager will be notified of such and will be appraised of any action taken.

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TABLE 10-1

ERM'S SYSTEM AUDIT CHECKLIST FOR COMPUCHEM

I. Chain-of-Custody

- Log-In Procedures Evaluated
- Sample Custodian is Assigned and Oversees Sample Transfers
- Sample Routing and Pickup is Documented and Accounted For
- Separate Area for Sample Storage and Maintained in Locked Storage

II. Sample Preparation

- Correct Sample Preparation Procedures are Followed
- Areas Designated for Sample Preparation (Organic and Inorganic)
- Holding Times Maintained

III. QA/QC Procedures

- Procedures are Being Followed According to Methods Specified
- Data Validation and Reduction Processes Reviewed by Group Leaders
- Proper Documentation of QA Procedures
- Internal QC Maintained
- Data Transfers and Reporting Checked by Group Leaders
- Awareness of Personnel of QA Requirements

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The ERM Group

TABLE 10-1
(Continued)

IV. Equipment Maintenance

- Maintenance Logs are Up-to-Date
- Instrumentation is in Repair
- Reasonable Spare Parts are on Hand

V. Miscellaneous

- Overall Housekeeping in Order
- Certifications Up-to-Date

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FIGURE 10-1

ERM QUALITY ASSURANCE AUDIT

PROJECT _____ W.O.# _____

DATE _____ AUDIT CONDUCTED FROM ___ HR. TO __ HR.

AUDITOR(S): _____

_____

ON-SITE PERSONNEL: _____

_____

Audit Conducted on the Following:

_____ Soil Sampling
_____ Surface Water/Sediment
_____ Ground Water
_____ Decontamination
_____ Health & Safety

Sample Collection:

Do sampling locations agree with those specified in the Work Plan? _____

Is the location of the sampling location documented sufficiently to allow it to be found/sampled again in the future? _____

Are sampling times, ERM Traffic Report Numbers and sample description noted? _____

Is sampling proceeding from the suspected least contaminated area to the most contaminated area? _____

Have sample bottles been labeled properly? _____

Have proper containers and preservatives been used? _____

Are samples being refrigerated/iced immediately after collection? _____

Does a travel blank exist for each matrix present? _____

Does the potential for sample cross-contamination exist based on procedures observed? _____

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ERM Group

FIGURE 10-1
(Continued)

Soil Sampling (Check if not applicable _____):
Type: _____ Hand _____ Auger or Rig

Are samples being collected at proper depths? _____

Are samples being screened with an OVA (if specified in Work Plan and applicable)? _____

Is a description of soils/materials being logged? _____

(Have soils been homogenized where applicable (specified by the Sampling Plan)? _____

Surface Water/Sediment Sampling (Check if not applicable _____):

Have stream flow and velocity parameters been noted? _____
Estimated _____ or Measured _____

Has sampling proceeded from downstream to upstream locations? _____

Has the sampler acquired the water sample upstream of his position to minimize suspended sediment from entering the sample? _____

Have sediments been characterized as to type and size distribution? _____

Has the proper sediment fraction (fine, depth) been sampled for the analyses of interest? _____

Are the selected locations effectively monitoring effects of the potential source? _____

Ground Water Sampling (Check if not applicable _____):

Have the well specifications been noted properly (i.e., Total Depth, Casing diameter, Depth-to-water, etc.)? _____

Has the purge volume been calculated properly? _____

What evacuation method has been used?
_____ Bailer _____ Submersible _____ Bladder Pump
_____ Other (_____)

If metals are being analyzed, have the samples been field filtered? _____

Are field pH, conductivity, and temperature being measured? _____ Is there documentation of calibrating the instruments? _____

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The ERM Group

FIGURE 10-1
(Continued)

Is bailer line and bailer dedicated to each well and line disposed of after use? _____
Bailer type _____ Line type _____

Have appropriate measures been taken to dispose of contaminated purge water? _____

For Domestic Wells - Has as much information on the well and distribution system been obtained, i.e., depth, casing type, diameter, treatment present, etc.? _____

Has the sample been collected prior to treatment and as close to the well head as possible? _____

Has the domestic well been purged sufficiently to reach temperature stabilization? _____

Decontamination:

Has sampling equipment been decontaminated properly for the given analytes? _____

Have the proper decontamination solutions been used? _____

For large equipment (backhoes, drill rigs), has decontamination taken place in an appropriate area? _____

Has decontaminated water/solution been collected for proper disposal? _____ Where disposed? _____

Safety:

Is the proper level of protective clothing being worn for the tasks? _____ Level A __ B __ C __ D __

Is the site Health and Safety Plan present with proper emergency contacts included? _____

Is monitoring equipment present? _____ OVA _____
H_2, O_2 meter _____ Explosimeter _____ Other _____

Is the vehicle equipped with a First Aid Kit? _____

Is contaminated protective clothing being disposed of properly? _____

Are personnel aware of the contaminants present at the site? _____

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General:

Are employees conducting the investigation in a professional manner? _____

Are the objectives of the sampling activities understood by the field personnel? _____

Is weather conditions effecting sample quality or representativeness? _____

Audit Summary and Comments:

_____

Signed by: _____ Print: _____

_____ _____

_____ _____

Date: _____

DB/gl

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SECTION 11

PREVENTIVE MAINTENANCE

11.1 Laboratory Maintenance

A typical standard operating procedure for maintenance, including specific routine and preventive procedures, and maintenance logs for the gas chromatograph/mass spectrometer is given in Attachment 1, Section 11.0.

11.2 Field Maintenance

ERM's field equipment is maintained through the use of a tracking system incorporating the tagging of each equipment item. This tag identifies its most recent maintenance, battery charge, and condition. When damaged or equipment in need of repair is returned to the equipment warehouse, it is appropriately flagged for the required maintenance to be performed. This process assures only operable and maintained equipment enters the field. Routine daily maintenance procedures conducted in the field will include:

- Removal of surface dirt and debris from exposed surfaces of the sampling equipment and measurement systems.
- Cleansing of filters in the organic vapor analyzer.
- Storage of equipment away from the elements.
- Daily inspections of sampling equipment and measurement systems for possible problems (e.g., cracked or clogged lines or tubing or weak batteries).
- Check instrument calibrations as described in Section 6.2 of this QAAP.

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- Charging any battery packs for equipment when not in use.

Spare and replacement parts stored in the field to minimize downtime include:

- Appropriately sized batteries
- Locks
- Extra sample containers and preservatives
- Bailer line
- Additional bailers
- OVA igniters and filters
- OVA H_2 gas, battery charger, and support equipment
- Spare filters for filtration apparatus.
- Extra pH probes, conductivity probes, samples coolers, packing material, and sample location stakes.
- Additional supply of health and safety equipment i.e., respirator cartridges, boots, gloves, tyvek ect.
- Additional equipment as necessary for the field tasks.

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SECTION 12

SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

12.1 Overall Project Assessment

Overall data quality will be assessed by a thorough understanding of the data quality objectives which are stated during the design phase of the investigation. By maintaining thorough documentation of all decisions made during each phase of sampling, performing field and laboratory audits, thoroughly reviewing (validating) the analytical data as it is generated by the laboratory, and providing appropriate feedback as problems arise in the field or at the laboratory, ERM will closely monitor data accuracy, precision and completeness.

12.2 Field Quality Assessment

To assure that all field data are collected accurately and correctly, specific written instructions will be issued to all personnel involved in field data acquisition by the Project Manager. The quality assurance officer will perform field audit(s) during the investigation to document that the appropriate procedures are being followed with respect to sample (and blank) collection. These audits will include a thorough review of the field books used by the Project personnel to insure that all tasks were performed as specified in the instructions. The field audits will necessarily enable the data quality to be assessed with regard to the field operations.

The evaluation (data review) of field blanks, and other field QC samples will provide definitive indications of the data quality. If a problem that can be isolated arises, corrective actions can be instituted for future field efforts.

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12.3 Laboratory Data Quality Assessment

Specific measures that will be taken by CompuChem to assess data quality are presented in Attachment 1, Section VIII.

12.4 ERM's Laboratory Data Assessment

12.4.1 ERM Data Validation

All analytical data generated during the investigation will undergo a rigorous ERM data review. This review will be performed in accordance with the "Functional Guidelines for the Evaluation of Organic (and Inorganic) Analysis".

A preliminary review will be performed to verify all necessary paperwork (chain-of-custodies, traffic reports, analytical reports, laboratory personnel signatures) and deliverables (as stated in the current IFB (organics) and SOW (inorganics) are present.

A detailed quality assurance review will be performed by the ERM Quality Assurance Manager (or a staff reviewer) to verify the qualitative and quantitative reliability of the data as it is presented. This review will include a detailed review and interpretation of all data generated by CompuChem. The primary tools which will be used by experienced data review chemists will be guidance documents, established (contractual) criteria, and professional judgement. Table 12-4 presents the items examined during the quality assurance review.

Based upon the review of the analytical data, an organic and inorganic quality assurance report will be prepared which will state in a technical yet "user friendly" fashion the qualitative and quantitative reliability of the analytical data. The report will consist of a general introduction section, followed by qualifying statements that should be taken into consideration for the analytical results to best be utilized. Based upon the quality assurance review, qualifier codes will be placed next to specific sample results on the sample data table. These qualifier codes will serve as an indication of the qualitative and quantitative reliability.

300299

TABLE 12-4

ITEMS REVIEWED DURING THE ERM DATA VALIDATION

Areas Examined	Applicability (organic, inorganic, both)
ERM and Laboratory Chain of Custodies (Traffic Reports, Field Notes, Etc)	Both
Laboratory Narrative and QC Summaries	
Holding Times	Both
Extraction/Digestion Logs	Both
Blanks - field and laboratory (accuracy)	Both
Instrument Tune	Organic
Standards	Both
Linearity	Both
Sensitivity/Stability	Both
Selectivity/Specificity	Both
EPA Criteria (SPCC & LCS)	Both
Variability of Technique (internal standards)	Organic
Analyte Breakdown	Organic
Analytical Sequence	Organic
ICP Interference	Inorganic
Control Standards	Inorganic
Samples	
Detection Limits	Both
Instrument Printouts	Both
ICP data	Inorganic
AA data	Inorganic
GC data	Organic
GC/MS data	Organic
Autoanalyzer data	Inorganic
Qualitative Identification	Both
Mass spectra	
Pesticide/PCB results	
Tentatively identified compounds	

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TABLE 12-4
(Continued)

Quantitative Reliability	Both
Calculations/Equations	Both
Matrix spikes (accuracy)	Both
Bias	
Matrix spike duplicates	Organic
Bias	
Accuracy & Precision	
Surrogate Spikes	Organic
Bias	
Duplicates (field and laboratory)	Both
Precision	
Representativeness	
Post-Digestion Spikes	Inorganic
Matrix Effects	

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During the course of the data review, an organic and inorganic support documentation package is prepared which will provide the backup information that will accompany all qualifying statements presented in the quality assurance review.

Once the review has been completed, the Quality Assurance Manager will then submit these data to the Project Manager. These approved data tables and quality assurance reviews will be signed and dated by the Quality Assurance Manager.

12.5 Data Management Quality Assessment

As the analytical data generated from the subject investigation are validated, qualified and submitted to the Project Manager, the quality of the data will be assessed from an overall management perspective be direct comparison of analytical results obtained from previous samplings. Information that can be obtained includes comparison of results obtained from samples taken within the same general vicinity, and the identification of missing data points. By examination of the data at the "back-end" of the process, the data quality can be assessed with respect to representativeness, precision, compatibility and completeness.

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SECTION 13

CORRECTIVE ACTION

13.1 CompuChem's Corrective Action

Correction actions for CompuChem are presented in Attachment I, Section 13. CompuChem will provide documentation as to what, if any, corrective actions were initiated concerning this study and report them to ERM's Quality Assurance Manager.

13.2 ERM's Corrective Action

Field quality assurance activities will be reported topically to ERM's Project Manager. Problems encountered during the study affecting quality assurance will be reported on a Corrective Action Form as presented in Figure 13-1. The Project Manager will be responsible for initiating the corrective actions and for insuring that the actions are taken in a timely manner, and that the desired results are produced. The Project Manager will report to the Quality Assurance Manager and Quantity Assurance Officer on all necessary corrective actions taken, the outcome of these actions, and their affect on data produced. All corrective action taken will be reported to Clean Sites, Inc.

300303

FIGURE 13-1
ERM'S CORRECTIVE ACTION FORM

Corrective Action Form

Date: _____

Job Name: _____

Initiator's Name and Title: _____

Problem Description: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Reported To: _____

- -

Corrective Action: _____

_____

_____

_____

_____

_____

_____

_____

Reviewed and Implemented By: _____

cc: Project Manager - _____
QA Manager - _____
QA Officer - _____

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SECTION 14

QUALITY ASSURANCE REPORTS TO MANAGEMENT

Every sixty (60) days after project initiation the Project Manager, in conjunction with the Quality Assurance Manager and Officer, will submit in the RI progress report, summaries of all applicable quality assurance activities. These summaries shall contain at least the following types of information:

- The status and coverage of various laboratory and field quality assurance project activities.
- Data quality assurance reviews including assessment of: accuracy, precision, completeness, representativeness, and comparability.
- Significant quality assurance problems discovered, corrective actions taken, progress and improvements, plans, and recommendations for further implementation or updating of the investigative QAPP.
- Any significant field observations noted in the field notebook during the sampling procedure.
- A summarization of the results of performance and system audits.

These quality assurance reports to management will be submitted to the following persons:

Addressee:

EPA Project Officer - Michael Bass
State Project Officer - Augustus M. Mergenthaler
Clean Sites, Inc. Project Manager - Richard Sobel

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ATTACHMENT 1

COMPUCHEM'S LABORATORY QUALITY ASSURANCE PLAN
FOR THE COKER'S NO. 1 AND NO. 2
LANDFILL SITE

300807

The ERM Group

Quality Assurance Project Plan

Prepared for:

ERM, Inc.
999 West Chester Pike
West Chester, PA 19382

Prepared by:

CompuChem® Laboratories, Inc.
Post Office Box 12652
3308 Chapel Hill/Nelson Highway
Research Triangle Park, North Carolina 27709

This document conforms to "Guidelines and Specifications for Preparing Quality Assurance Project Plans" as published by the EPA's Quality Assurance Management Staff, Office of Monitoring Systems and Quality Assurance, Office of Research and Development.

Director of Quality Assurance: Robert E. Mieres

Issued To: _____

Date: _____

Copy Number: _____

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		Revision	Date
1.0	Project Description	0	May 11, 1987
2.0	Project Organization and Responsibilities	0	May 1, 1987
3.0	QA Objectives for Measurement Data, in terms of precision, accuracy, completeness, comparability, and representiveness	0	May 1, 1987
4.0	Sampling Procedures	0	May 1, 1987
5.0	Sample Custody	0	May 1, 1987
6.0	Calibration Procedures and References	0	May 1, 1987
7.0	Analytical Procedures	1	May 1, 1987
8.0	Data Analysis, Validation, and Reporting	0	May 1, 1987
9.0	Internal QC Checks	0	May 1, 1987
10.0	Performance and Systems Audits	0	May 1, 1987
11.0	Preventive Maintenance Procedures & Schedules	0	May 1, 1987
12.0	Specific Procedures to be used to routinely assess data precision, completeness, accuracy, comparability, and representativeness of specific measurement parameters involved	0	May 1, 1987
13.0	Corrective Action	0	May 1, 1987
14.0	QA Reports to Management	0	May 1, 1987

300309

PROJECT DESCRIPTION

Environmental Resources Management, Inc. of West Chester, Pa. has requested that CompuChem Laboratories, Inc. provide analytical support for their RI/FS at COKERS LANDFILL, NO.'S 1 & 2. An as yet undefined number of samples will be submitted for analysis for organic and inorganic hazardous substance lists of compounds using USEPA Contract Laboratory Protocols. The work is anticipated to begin in late June 1987 with shipment of final results four weeks from the date of receipt for each group of samples received.

In preparation for this task ERM, Inc. has requested the submission of this Quality Assurance Project Plan which will address the QA/QC policies and procedures which will be employed by CompuChem Laboratories, Inc. in conducting the analyses requested for the duration of the project.

CompuChem Laboratories, Inc. will employ the protocols described in the most recent USEPA CLP Statement of Work in effect at the time of the project for which the USEPA has released bid lots.

300310

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

CompuChem® is dedicated to providing the highest quality data available. In addition to a Quality Assurance Director, who is responsible for the overall quality assurance program at CompuChem®, the QA Department consists of Quality Assurance Specialists and support staff. The QA program meets or exceeds EPA recommended guidelines, with quality control samples accounting for at least 20% of the total number of samples analyzed. The Computerized Laboratory Management System (CLMS) automatically schedules the introduction of QC samples (spikes and duplicates), and internal performance statistics are determined quarterly on each test parameter, using the total sample data base. These data can be used to update control limits, or in the case of programs with defined control limits, the data serves to demonstrate overall lab performance.

Data are reviewed at three levels, including a final review by the senior technical staff, and a percentage data audit by the QA Department.

The lab must demonstrate that the analytical procedures and techniques are in control. This is established by the use of specified laboratory proficiency or method validation studies. Once the studies are complete and the data have been assessed, normal QC activities are performed. These activities include duplicates, matrix spikes, blank spikes and the use of surrogates for all organic analyses, which evaluates total system control on a per sample basis.

2.1 QUALITY ASSURANCE POLICY STATEMENT

Statement of Authority and Responsibility

The Management of CompuChem® Laboratories is fully and firmly committed to the quality assurance program described in this Plan. Each director, manager, and supervisor as well as their staff members, as assigned in accordance with this Plan, are obligated to comply with its stated requirements, responsibilities, and objectives.

The QA program will be maintained and expanded or modified as necessary, to ensure all reportable data are of uncompromising quality.

The Director of Quality Assurance is responsible for the contents of the Plan and is committed to assuring that the stated requirements are met. The Director of Quality Assurance has the additional responsibility and authority to terminate nonconforming work.

Robert Meierer
Director of Quality Assurance

300312

2.2 QUALITY ASSURANCE MANAGEMENT

Introduction

The Computerized Laboratory Management System (CLMS) Chart shown on the next page illustrates the interaction of quality control functions with all laboratory units. As shown, the Quality Assurance Department's staff monitors and reviews all laboratory units and operates independently of production areas.

300323

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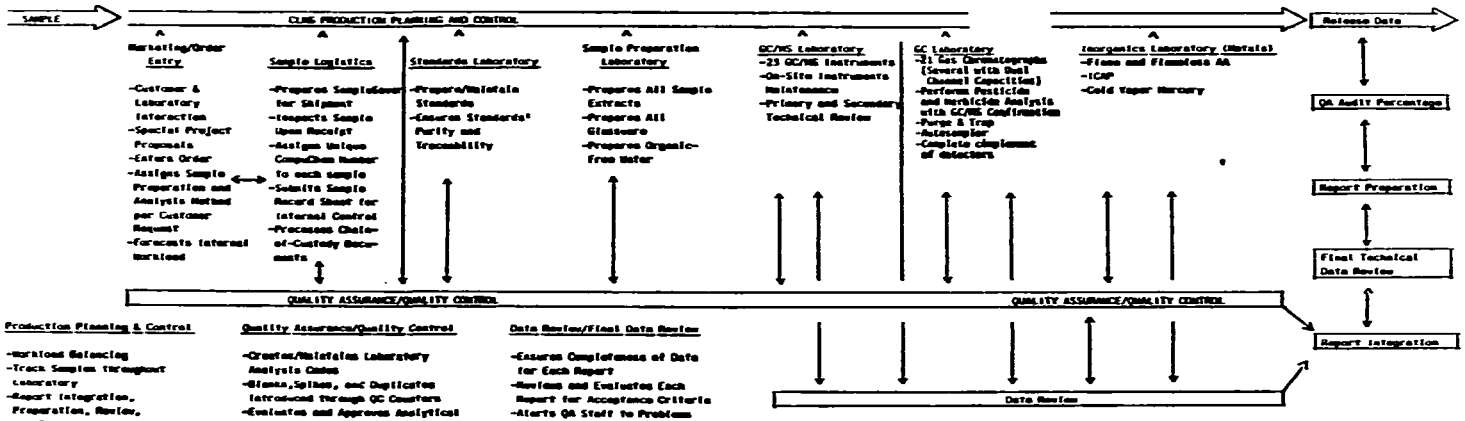
Computerized Laboratory Management System (CLMS)

A System for Enhanced Quality Control and Sample Tracking in Volume Oriented Organic and Inorganic Analyses

(ENVIRONMENTAL)



2.3 Assignment of Responsibilities

The Quality Assurance Department operates independently of all data generating areas. The QA Director reports directly to the President.

Roles and Responsibilities:

The main objectives of the laboratories' QA program are to assure that our laboratories generate high quality results, identify and implement policies to improve quality, and maintain the necessary records that document laboratory performance. The success or failure of the program depends on the people carrying out the various steps of the program.

A Listing of QA personnel responsibilities and authorities follows.

Responsibility and Authority of the QA Director:

To be certain that the laboratories achieve QA objectives, the Director of Quality Assurance monitors and directs the QA programs goals, in strict adherence to the procedures and requirements stated in this Plan.

The QA Director is independent of and separate from all personnel directly involved in the direction and operation of the technical program.

Additionally, the QA Director's duties include:

Monitoring the QA program as documented in the QA Plan and ensuring that the program is carried out.

Developing and implementing new QA programs, including statistical procedures and techniques.

Conducting regular audits and inspections, reporting the results to management, and when needed, ensuring that corrective action is taken.

Maintaining current copies of all measurement procedures routinely used in the laboratories, including subcontract laboratories.

Informing management of the status of the QA program.

Seeking out and evaluating new ideas and current developments in the field of QA and recommending means for their application wherever advisable.

In conjunction with his interactions with the Marketing Department, the QA Director advises Marketing on appropriate QC procedures concerning sample analyses.

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The QA Director implements or modifies analysis codes and procedures as needed.

The QA Director has the final authority to stop or change any incorrect or improper sampling or analytical procedure to assure data/product quality.

Responsibilities and Authorities of the QA Staff:

Spot-checking work in progress for quality and completeness.

Providing deviation reports to laboratory managers and the QA Director on out-of-control analyses and providing recommendations for corrective action.

Overseeing corrective action as required.

Assuming the responsibilities of QA Director, if necessary.

Ensuring that the laboratories meet all requirements as documented in this plan, as well as their specific SOP manuals.

Ensuring generation, analysis, and documentation of QC Data.

Establishing the control limits using QC data from routine analyses.

Providing information and documentation for audits or inspections.

Functioning as a liaison between the QA Director and personnel within the laboratories.

Communicating to the QA Director any quality problem or potential quality problem within the laboratories.

Writing QA notices for inclusion in data packages.

Conducting unannounced audits.

Reviewing and approving Performance Evaluation sample data before release to the client.

Coordinating projects with other QA staff.

Introducing internal "blind" check-samples into the system and reporting their performance to management, including blind performance checks of subcontractors.

Ensuring that all standards are approved and traceable to standards provided by the National Bureau of Standards (NBS) or EPA.

Responsibilities of Laboratory Personnel and Management:

Preventative maintenance, including routine and scheduled.

Compliance with methods as written.

Ensuring that the instruments meet calibration and tuning requirements.

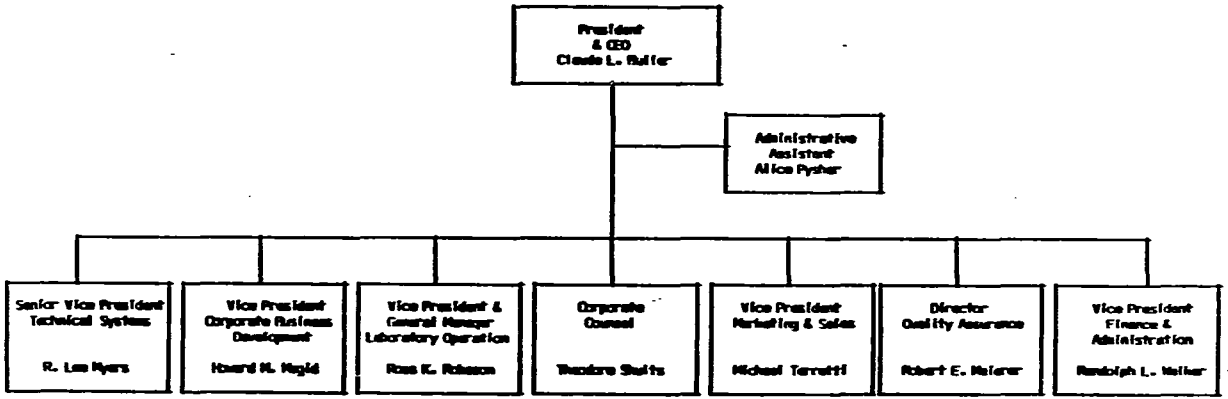
Ensuring that instrument and calibration logs are maintained.

Responding to corrective action requirements.

Performance of action steps based on QC acceptance critera.

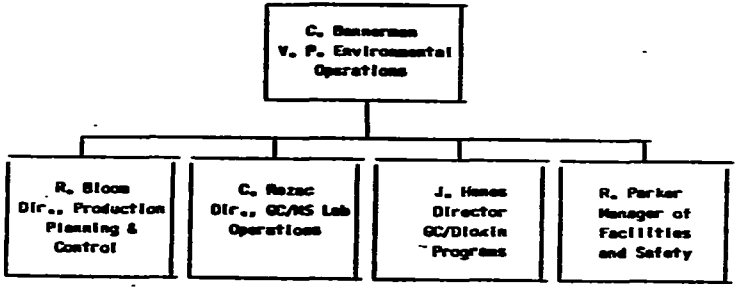
300318

CompuChem Laboratories, Inc.
President's Office
July, 1985



300319

CompuChem Laboratories
Environmental Laboratory
Organizational Chart, Fall 1985



3.0 QA OBJECTIVES FOR MEASUREMENT OF DATA IN TERMS OF PRECISION, ACCURACY, COMPLETENESS, COMPARABILITY, AND REPRESENTATIVENESS

Introduction

Precision: The Laboratory objective for precision is to equal or exceed the precision demonstrated for the applied analytical methods on similar samples. Relative Percent Difference (RPD) criteria, published by the EPA as part of the EPA's Invitation for Bid (IFB) Contract Laboratory Program (CLP) for organic and inorganic analyses and those determined from laboratory performance data, are used to evaluate precision between matrix spike duplicates.

Accuracy: The Laboratory objective for accuracy is to equal or exceed the accuracy demonstrated for the applied analytical methods on similar samples. Percent Recovery Criteria, published by the EPA as part of the EPA's-IFB-CLP for organic and inorganic analyses, those published in the Federal Register (October 26, 1984), and those determined from laboratory performance data, are used to evaluate accuracy in matrix spike and blank spike Quality Control samples. Control limits to assess data by matrix and methodology are presented in Section 7.

Representativeness: The representativeness of the data from the sampling sites depends on the sampling procedures. The representativeness of the analytical data is a function of the procedures used in processing the samples. The objective for representativeness is to provide data of the same high quality as other analyses of similar samples using the same methods during the same time period within the laboratory. Representativeness can be determined for this objective by a comparison of the quality control data for these samples against other data for similar samples analyzed at the same time.

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Comparability: The results of analyses can be compared with other analyses by other laboratories because the objectives of the laboratory for comparability are: to demonstrate traceability of standards to NBS or EPA sources; to use standard methodology; to report results from similar matrices in consistent units; to apply appropriate levels of quality control within the context of the Laboratory Quality Assurance Program; and to participate in interlaboratory studies to document laboratory performance. By using traceable standards and standard methods, the analytical results can be compared to other laboratories operating similarly. The QA Program documents internal performance, and the interlaboratory studies document performance compared to other laboratories. Quarterly laboratory proficiency studies are instituted as a means of monitoring intralaboratory performance.

Completeness: CompuChem's objective for completeness is to be able to provide analyses for 100% of samples received intact and for which back-up sample is available should initial analysis not meet acceptance criteria.
When requested, the completeness of an analysis can be documented by including in the report sufficient information to allow the data user to assess the quality of the results. The information delivered may include such items as: chromatograms, spectra, QC data, and summaries of results. Additional information, such as the Laboratory worksheets, notes, etc. are stored with the sample results in the Laboratory. The raw data (prior to data reduction) are archived indefinitely on magnetic tape. All analytical information, per sample, is retained by the laboratory whether or not the client requests results substantiation.

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4.0 SAMPLING PROCEDURES

Not applicable. Though CompuChem® supplies instructions on the correct methods of sample collection, CompuChem's clients are responsible for sample collection.

5.0 CHAIN-OF-CUSTODY

Introduction

The basic components for maintaining sample chain-of-custody are to ensure that the samples and aliquots/extracts are at all times either in the possession of the appropriate laboratory staff member or maintained in a secure area, and that adequate documentation accompanies the samples throughout the laboratory.

CompuChem® accomplishes these objectives through an elaborate document control system. This system includes procedures for documentation of the receipt of the sample into the laboratory using chain-of-custody records. These documents give information about the individuals taking the samples, the collection time, date, location and the type of analysis required. Though CompuChem® supplies instructions on the correct methods of sample collection, CompuChem's clients are responsible for sample collection. When the samples are received in the laboratory, these documents are signed by the receiving staff. The integrity of the samples within the laboratory are assured by the security of the facility itself. The building security is controlled by an electronic card entry system. The exterior doors and the doors of various controlled access areas within the building are equipped with card readers. Each member of the staff has an access card that is coded only for those areas where their job function requires access. For example, only those members of the staff who have responsibility for standard preparation are allowed access to that area. The system also maintains a record of the movements of the staff throughout the building. The original sample containers are kept in a locked refrigerator (or

in secure storage if refrigeration is not required) either during analysis or pending analysis. When the analysis is complete the final extracts for the extractable portions of the sample are kept in a locked freezer. These storage locations are the responsibility of the Sample Custodian.

A complete description of CompuChem's sample tracking procedures follows. Chain-of-custody procedures are fully documented in the laboratory's Standard Operating Procedures Manual.

Sample Receiving and Handling:

Depending on the client's requirements, chain-of-custody can be initiated by CompuChem® when the shipping containers (SampleSavers) are sent to the field or by the client at the time of sampling. Custody tape is provided to ensure the integrity of the SampleSaver® and its contents. The chain-of-custody form (see Example 1) accompanying the incoming samples is evaluated and reviewed by the Sample Receiving Supervisor to ensure that document control information is accurate and complete. If samples are not in good condition (i.e. broken or leaking bottles) or chain-of-custody information is incorrect or inadequate, the client is contacted immediately. The condition of the sample including integrity of seals is also noted on receiving documents.

If chain-of-custody is intact, as-received samples are logged into the Computerized Laboratory Management System (CLMS) and scheduled for preparation/analysis according to the client's analytical requirements. At this point the client's sample identifier is assigned a unique CompuChem® identification number.

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Labels are automatically generated by the computerized system, and securely affixed to the sample container. The sample is now ready to be transferred to the raw sample storage refrigerator. A copy of the chain-of-custody and sample receiving documents are inserted into a file folder, labeled with the sample's CompuChem® number, and transferred to the Production Planning and Control data files. The original chain-of-custody is mailed to the client with a letter acknowledging receipt of the samples.

Raw Sample Storage:

The Sample Custodian is responsible for organizing and maintaining the security of the raw sample storage refrigerator. Routine access to this locked refrigerator is restricted to the Sample Custodian. Sample containers are removed by the Custodian only when accompanied by the appropriate chain-of-custody tracking forms.

Transfers for Sample Preparation:

The Sample Request Form (see Example 2) is used by the individual laboratory stations to request release of raw sample containers by the Sample Custodian. It documents transfer of sample containers from the storage refrigerator to the designated sample preparation laboratories.

Transfers of Prepared Samples to Storage:

Once the extract/aliquot is prepared from the raw sample, it is returned to the Sample Custodian for storage. The Extraction Worksheet (see Example 3A) or Sample Preparation Worksheet (see Example 3B), depending on the preparation

requirements, is used to document this transfer. Again, the prepared samples are stored in a locked, restricted-access refrigerator.

Transfers of Extracts to Instrument Laboratories:

Depending on the analytical requirements, the sample extract is released to the appropriate instrument lab. Chain-of-custody for this transfer is documented by any of several lab Worklists, divided according to fraction type (see Examples 4A, 4B, 4C, 4D and 4E). Pesticide and TCDD extracts, because they can be analyzed in large numbers via autosampler sequences, are sent directly from the Sample Preparation Laboratory to the GC Laboratory. Chain-of-custody for this transfer is accomplished with the use of the appropriate Extraction Worksheet (see Examples 5A and 5B).

Transfer of Extracts from Instrument Laboratories to Sample Storage:

After the laboratories have completed the sample's scheduled analysis, the extracts are returned to the sample storage area. The appropriate lab worksheets are signed by the Sample Custodian and the individual returning the sample. The sample is then stored in the appropriate storage refrigerator.

Commercial samples are stored for thirty days after reporting, and EPA samples are stored for 60 days after reporting on the analyses. Sample extracts are stored for 6 months. When these storage periods have expired, the samples and extracts are disposed of as hazardous wastes, in accordance with Federal and State regulations.

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Data Report Chain-of-Custody:

Computer-generated hardcopies from the instrument analysis contain the sample identification number on each page. As part of the data report, the GC or GC/MS Worksheets (see Examples 6A and 6B) are used to record information pertinent to the analysis of each extract (i.e. instrument, data of injection, analyst, etc.). Once the data report is assembled and evaluated by the laboratory's Data Review Staff, it is transferred to the Production Planning and Control data filefolder. Along with the original chain-of-custody and sample receiving information, the report is reviewed by a member of the Technical Review Staff. A key concern in this step of the review hierarchy is to ensure that the chain-of-custody is documented and unbroken.

Data Storage:

Copies of the data report and all associated chain-of-custody documents are archived in a locked, off-site storage facility for an indefinite period of time.

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COMPUCHEM LABORATORIES

CHAIN OF CUSTODY RECORD

PROJ. NO. | PROJECT NAME

SAMPLERS: (Signature)

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS							REMARKS

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

Distribution: Original Accompanies Shipment; Copy to Field Files

Example 1

300328

Example 2A

EXTRACTIONS AND VOLATILE SAMPLE REQUEST FORM

CHECK WHERE APPLICABLE:

Laboratory: _____

EPA _____ Water _____ Requested By: _____

Comm. _____ Soil _____ Date: _____

Samples for 1 2 3 shift
(circle one)

CompuChem #	Pulled ( )
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____
9. _____	_____
10. _____	_____
11. _____	_____
12. _____	_____
13. _____	_____
14. _____	_____
15. _____	_____
16. _____	_____
17. _____	_____
18. _____	_____

COMMENTS:

_____

_____

_____

_____

_____

_____

CompuChem #	Pulled ( )
19. _____	_____
20. _____	_____
21. _____	_____
22. _____	_____
23. _____	_____
24. _____	_____
25. _____	_____

Relinquished by: _____ Date: _____ Received by: _____ Date: _____

Relinquished by: _____ Date: _____ Received by: _____ Date: _____

Relinquished by: _____ Date: _____ Received by: _____ Date: _____

200429

Example 2B

INORGANICS SAMPLE REQUEST FORM

CHECK WHERE APPLICABLE:

Laboratory: _____

EPA _____ Water _____

Requested By: _____

Comm. _____ Soil _____

Date: _____

CompuChem #	Pulled ( )
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____
9. _____	_____
10. _____	_____
11. _____	_____
12. _____	_____
13. _____	_____
14. _____	_____
15. _____	_____
16. _____	_____
17. _____	_____
18. _____	_____

Samples for 1 2 3 shift
(circle one)

COMMENTS:

_____

_____

_____

_____

_____

_____

CompuChem #	Pulled ( )
19. _____	_____
20. _____	_____
21. _____	_____
22. _____	_____
23. _____	_____
24. _____	_____
25. _____	_____

Relinquished by: _____ Date: _____ Received by: _____ Date: _____

Relinquished by: _____ Date: _____ Received by: _____ Date: _____

Relinquished by: _____ Date: _____ Received by: _____ Date: ___

600330

Semi Volatiles/Mosaic

DATE ASSIGNED _____

ASSIGNED TO _____

PAGE _____ OF _____

SAMPLE NUMBER	PREP CODE	CASE #	EPA #	QC SAMPLE TYPE	QC SAMPLE ORIG NO	SAMPLE WEIGHT (g) VOLUME (ml)	FINAL EXTRACT VOL (MLS) SV SCREEN	SV / B/N	ACID	PEST	ADJUSTED PH B/N	A	DATE COMPT	COMMENTS

300332

		S-Vol	Acid	B/N	Pest	TCDD	Other
SURROGATE	NO						
	AMT.						
	LOT						
SPIKE	NO						
	AMT.						
	LOT						

MANUAL COUNTER _____

FINAL VOLUME VERIFIED _____

SUPERVISOR REVIEWED _____

EXTRACTS RECEIVED BY _____

№ 9927

Example 3B

VOLATILE PREP WORKSHEET

Assigned to: _____ Date: _____

Sample Number	Prep Code	Case No.	QC Sample		Sample Weight (g) Volume (ml)	Date Comp.	Screens				Comments
			Type	Original			LIQ	S	L	M	
			B								
			B								
			B								

Surrogate No. _____ Schedule Reference _____

Amount _____ Manual Operator _____

Lot _____

Relinquished by _____ Date _____ Received by _____ Date _____

Relinquished by _____ Date _____ Received by _____ Date _____

300332

Example 4A

SV

GC/MS WORKLIST
SAMPLE REQUEST FORM

CASE _____
DUE DATE _____

DELIVERABLES CODE/INSTRUMENT CODE _____

CompuChem #	Sample Prep	Date Run	OWA#	Operator	Date Reviewed	Comments
1.						Blank # 1
2.						Blank # 2
3.						Sample Spike
4.						Sample Spike
5.						Original Used
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						
15.						
16.						
17.						
18.						
19.						
20.						

Relinquished by _____ Date _____ Received by _____ Date _____

Relinquished by _____ Date _____ Received by _____ Date _____

Relinquished by _____ Date _____ Received by _____ Date

300333

Example 4B

SV

GC/MS WORKLIST
SAMPLE REQUEST FORM

CASE _____
DUE DATE _____

DELIVERABLES CODE/INSTRUMENT CODE _____

CompuChem #	Sample Prep	Date Run	OWA#	Operator	Date Reviewed	Comments
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						
15.						
16.						
17.						
18.						
19.						
20.						

Relinquished by _____ Date _____ Received by _____ Date _____

Relinquished by _____ Date _____ Received by _____ Date _____

Relinquished by _____ Date _____ Received by _____ Date _____

300334

Example 4C

BN

GC/MS WORKLIST
SAMPLE REQUEST FORM

CASE _____
DUE DATE _____

DELIVERABLES CODE/INSTRUMENT CODE _____

CompuChem #	Sample Prep	Date Run	OWA#	Operator	Date Reviewed	Comments
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						
15.						
16.						
17.						
18.						
19.						
20.						

Relinquished by _____ Date _____ Received by _____ Date _____

Relinquished by _____ Date _____ Received by _____ Date _____

Relinquished by _____ Date _____ Received by _____ Date _____

300335

Example 4D

A

GC/MS WORKLIST
SAMPLE REQUEST FORM

CASE _____
DUE DATE _____

DELIVERABLES CODE/INSTRUMENT CODE _____

CompuChem #	Sample Prep	Date Run	OWA#	Operator	Date Reviewed	Comments
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						
15.						
16.						
17.						
18.						
19.						
20.						

Relinquished by _____ Date _____ Received by _____ Date _____

Relinquished by _____ Date _____ Received by _____ Date _____

Relinquished by _____ Date _____ Received by _____ Date _____

300336

Example 4E

VOA

GC/MS WORKLIST
SAMPLE REQUEST FORM

CASE _____
DUE DATE _____

DELIVERABLES CODE/INSTRUMENT CODE _____

CompuChem #	Sample Prep	Date Run	OWA#	Operator	Date Reviewed	Comments
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						
15.						
16.						
17.						
18.						
19.						
20.						

300337

ASS. ED TO _____

EXTRACTION WOR T
COMMERCIAL TC SOIL

-135

DATE STARTED/POSTED _____

QUEUE # 49

PAGE 1 OF 1

	SAMPLE NUMBER	QC TYPE	SAMPLE ORIG #	SAMPLE WEIGHT	DATE /INT.	DUAL COLUMN	CARBON COLUMN	FINAL VOLUME	COMP. DATE	COMMENTS
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21		BLANK								
22		BLANK								

	#	AMOUNT	LOT #
SURR	389	100 UL.	_____
SPIKE	EPA #1	100 UL.	_____

CHECKED AND VERIFIED _____(TCDD)

AUTO. COUNTER 205/_____

MANUAL COUNTER 204/_____

-135

Example 5A

300338

ASSIGNED TO _____

EXTRACTION WORKSHEET
COMMERCIAL PESTICIDE WATER
PCB's ONLY
-002

DATE ASSIGNED/POSTED _____

QUEUE # 64

	SAMPLE NUMBER	QC TYPE	SAMPLE ORIG #	SAMPLE VOLUME	OPTIONAL FLORISIL START VOL.	FINAL VOLUMES I	II	III	COMB INIT	TOTAL FINAL	COMP. DATE	COMMENTS
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
		BLANK										
		BLANK										

Example 5B

	#	AMOUNT	LOT #
SURROGATE	395	1 ML	_____
SPIKE	4551	1 ML	_____

CHECKED AND VERIFIED _____ (GC LAB)

AUTO. COUNTER 210/____

MANUAL COUNTER 211/____

-002 PCB ONLY

300336

Example 6A

COMMERCIAL
PESTICIDES
EXTRACTIONS GC
WORKSHEET

SDWA/RCRA

DATE DUE _____

COMPUCHEM # _____
SAMPLE PREP CODE 002
INSTRUMENT CODE 101
COMPOUND LIST 009
SURROGATE STANDARD 395

WATER _____

SIS _____
BLANK ASSOCIATED WITH CASE #'s _____ _____ _____ _____ _____

ASSOCIATED BLANK _____

EXTRACTION INFORMATION: CALC USED? YES [ ] NO [ ] COMMENTS:

WT OF SAMPLE _____g FINAL VOL OF EXTRACT _____mls

PORTION OF VOL IN PEST _____

ANALYSIS INFORMATION:

DATE	INSTRUMENT #	SEQUENCE	DILUTION FACTOR	REPORT
				[ ]
				[ ]
				[ ]
				[ ]

SEND TO QA [ ]
QA APPROVED [ ]
NEED GC/MS CONFIRMATION [ ]

_____ ANALYST _____ DATE

SURROGATE INFORMATION
DIBUTYL CHLORENDATE
(CONTROL LIMIT 48-136%)

AREA IN SAMPLE / AREA IN STD _____

AMOUNT ADDED: _____ / 100 ul X 100 X

EXTRACT VOL: _____ / 10mls mls/PORTION _____

EQUALS _____% RECOVERY

AUDITED BY _____ DATE _____

SAMPLE DISPOSITION

		CODE
[ ]	COMPLETE.....	
[ ]	REQUIRES RE-EXTRACTION.....	002
[ ]	REQUIRES FLORISIL.....	901

CONDITION CODE [ ]

QA NOTICE: QNA

[ ] 1G [ ] 2G [ ] 3G [ ] 4G

REV. 2/18/85

300340

Example 6B

LAB INSTRUCTIONS: **21 DAY TURN**

CASE#:5893-1 DUE DATE: 6/20/86

VOA-SCREEN
GC/MS WORKSHEET COMPUCHEM#: 87955

R1[ ] R2[ ] D1[ ] (:1)
R3[ ] R4[ ] D2[ ] (:1)

LOW LEVEL SOLID

SAMPLE PREP CODE--- -158
INSTRUMENT CODE------112
COMPOUND LIST--------000
SURROGATE STD--------381
INTERNAL STD---------000

SAMPLE ID: C#5893-JA107

Dry Weight Factor_____

GC/MS ANALYSIS
Amount Purged: [ ] 10mls/Xg soil or [ ]Dilution_____ul/10000ul/Xg soil
Internal Standard Volume Added_____ul
Surrogate Standard Volume Added_____ul
BFB Filename_____Disk( )
Blank Filename_____Disk ( )
Standard Filename_____Disk ( )
Sample Filename_____Disk ( )

ANALYST(S): Injection_____ Work-up_____

GC/MS REVIEW

CONDITION CODE _____

Entry Codes OK,EA,ES,SM,JS,SL,SH,JA,DA

Non-Entry Codes IM,IL,IH,SW,CT,CS,PC,NR
IF,LA,DI,CO,RN,DW,SI,SF
UP,BB,OT,VC,FO,NS

Disposition: [ ] Complete

Extraneous Peak Search Results:
# of Peaks Found:_____

[ ] Reprep neat required

[ ] Reprep using_____g

Quality Assurance Notice(s):
Notices Required_____

[ ] Dilute (:1)

COMMENTS:

GC/MS Review_____ Date___/___/___ Auditor_____Date___/___/___

REPORT INTEGRATION Total # of Injections:_____
Final Reportable Package(s):_____/_____

QA COMMENTS:

Initials_____ Date___/___/___

FINAL REVIEW: Initi 300341 ___/___/___

AC393 (11/85)

6.0 CALIBRATION PROCEDURES AND REFERENCES

Standards: Calibration standards are traceable to the National Bureau of Standards (NBS) or EPA whenever such standards are available. Commercial sources of standards and reagents are checked for purity, and approved, prior to their use in analysis.

All standards prepared for use throughout the laboratory are assigned a code number. The standard code number is entered in a bound standard notebook with all information regarding the preparation of that standard, i.e., date, technician, name of each compound and amount used, final volume, and solvent used. All standard containers are labelled with the standard's identification, lot number, code and date.

The instrument response obtained for each compound in a newly prepared standard is compared to the response obtained from the previous standard. The two standards must agree within 15% (for all but a few compounds recognized as being chromatographably atypical) or the new standard may not be used until the discrepancy has been resolved. The working lifetime of standard preparations are dependent upon the compound types comprising the standards. Shelf-life of standards is determined during storage stability studies carried out by the Standards Laboratory.

GC/MS: The Gas Chromatograph/Mass Spectrometer analysis is extremely important to the overall accuracy and precision of the CompuChem® service. To assure that the results from this phase are of the highest quality, a rigorous program of calibration and quality assurance has been established.

Instruments are calibrated before being put into service. Instruments must be recalibrated at regular intervals specified or approved by the accrediting body, and consistent with the manufacturer's recommendations. Instrument response is subjected to checks between the regular recalibrations. The nature and frequency of such checks are specified in the Instrument Procedures. The laboratory maintains adequate records of all calibrations, recalibrations and in-service checks of instruments. The schedule of checks depends on the experience of the laboratory's maintenance needs. All calibrations are traceable to primary standards of measurement. Where the concept of traceability of measurements to primary standards is not applicable, the laboratory provides satisfactory evidence of correlation or accuracy of test results.

Analysts, assistant managers, lab managers, and QA staff inspect all calibration data for completeness and validity. Forms are checked for arithmetic and procedural errors. Recurring errors, caused either by individual operators or by ambiguously worded instructions, are brought to the attention of the department senior laboratory staff or laboratory management for corrective action.

The mass spectrometer must first be calibrated according to the manufacturer's procedures using FC-43.

Once per shift the instrument is fine tuned using Decafluorotriphenylphosphine (DFTPP) or Bromofluorobenzene (BFB), depending on the use of the instrument. The mass spectrum from DFTPP obtained should meet the criteria described by the USEPA Caucus Organics Protocol of the Contract Laboratory

Program (CLP), or that specified in the Federal Register (October 20, 1984). For DFTPP, the key ion and ion abundance criteria are:

TABLE I

m/e	Ion Abundance Criteria
51	30-60% of mass 198
68	less than 2% of mass 69
70	less than 2% of mass 69
127	40-60% of mass 198
197	less than 1% of mass 168
198	base peak, 100% relative abundance
199	5-9% of mass 198
275	10-30% of mass 198
365	1% of mass 198
441	less than mass 443
442	greater than 40% of mass 198
443	17-23% of mass 442

300344

When volatile organics are analyzed, DFTPP cannot be used because of its low volatility. In these cases, Bromofluorobenzene (BFB) is used. The key ion abundance criteria are:

TABLE II

m/e	Ion Abundance Criteria
50	15-40% of the base peak
75	30-60% of the base peak
95	Base Peak, 100% relative abundance
96	5-9% of the base peak
173	Less than 1% of the base peak
174	Greater than 50% of the base peak
175	5-9% of mass 174
176	Greater than 50% of the base peak
177	5-9% of mass 176

Once the instrument has met key ion abundance criteria for the above mentioned compounds, it is calibrated. Calibration curves are generated as outlined in the Caucus Organics Protocol, (Rev. 1985), and in the Federal Register (October 26, 1984).

Calibration of the GC/MS System: After the master set of instrument calibration curves has been established, they are verified each shift by injecting at least one standard solution. If significant drift has occurred, a new calibration curve must be constructed. The drift is defined in either EPA's requirements as specified in the CLP or in the Federal Register (October 26, 1984).

Inorganics: Metals, except mercury, are analyzed using flame and furnace AAS and ICP spectroscopy. The analysis procedure involves two steps: digestion and subsequent instrumental analysis. The quality of these results is assured by several key procedures.

300345

For each batch of samples in the digestion process, a method blank is included. This blank is analyzed along with the samples to assure there were no contaminants introduced by the reagents or laboratory procedures.

Calibration of the AAS and ICP Systems

For inorganic analysis by AAS and ICP, initial calibration is performed using dilutions of stock metal solutions. For AAS calibration, a blank and at least three calibration standards are employed. For ICP analysis a mid-concentration level standard is analyzed. Prior to the ICP calibration and on a quarterly basis, a linear range verification check standard is analyzed for each element. The analytically determined concentration of the standard must be within 5% of the true value. This concentration, then, is the upper limit of the ICP linear range. Results cannot be reported beyond that upper concentration level unless they are a result of an appropriate dilution/reanlysis.

After the AAS and ICP systems have been calibrated for every analyte, the initial calibration is required to be verified for accuracy. This is accomlished by immediately analyzing on EPA Initial Calibration Verification Solution or any other independent standard at at concentration other than that used for calibration, but with the calibration range. An independent standard is one composed of the elements from a different source than those used in the initial calibration.

In order to assure calibration accuracy during the course of sample analyses another QC sample, a Continuing Calibration Verification Standard, is analyzed at a frequency of 10% or every 2 hours during the analysis run, for each

analyte. The analyte concentrations in Continuing Calibration Verfication Standard are near the mid-range level of the calibration curve. The Initial and Continuing Calibration Verfication Control Limits are:

INITIAL AND CONTINUING CALIBRATION VERIFICATION
CONTROL LIMITS FOR INORGANIC ANALYSES

Analytical Method	Inorganic Species	% of True Value (EPA Set)	
		Low Limit	High Limit
ICP Spectroscopy/ Flame Atomic Absorption Spectrometry	Metals	90	110
Furnace AA	Metals	90	110
	Tin	80	120
Cold Vapor AA	Mercury	80	120
Other	Cyanide	85	115

300347

7.0 ANALYTICAL PROCEDURES

Commercial Organic and EPA - CLP Contract Required Surrogate Spike Control Limits*

Volatile Surrogates	Solid	Liquid
D4-1,2-Dichloroethane	(70-121)	(76-114)
4-Bromofluorobenzene	(74-121)	(86-115)
D8-Toluene	(81-117)	(88-110)

Base/Neutral Surrogates	Solid	Liquid
D5-Nitrobenzene	(23-120)	(35-114)
D10-Pyrene	(17-125)**	(40-130)**
D14-Terphenyl	(18-137)	(33-141)
2-Fluorobiphenyl	(30-115)	(43-116)

Acid Surrogates	Solid	Liquid
2-Fluorophenol	(25-121)	(21-100)
2,4,6-Tribromophenol	(19-122)	(10-123)
D5-Phenol	(24-113)	(10-94)

Pesticide Surrogate	Solid	Liquid
Dibutylchlorendate (DBC)	(20-150)***	(24-154)***

Herbicide Surrogate	Solid	Liquid
2,4-DB	(16-124)	(28-104)

* as noted in IFB (WA-87J 001/2/3, 1-87) and subject to modification based on data supplied in the CLP
** laboratory optional surrogate only; no action limits at this time
*** advisory surrogate; minimum 10% recovery used as action limit

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EPA-CLP MATRIX SPIKE RECOVERY LIMITS*

Fraction	Matrix Spike Compound	Water*	Soil/Sediment*
VOA	1,1-Dichloroethene	61-145	59-172
VOA	Trichloroethene	71-120	62-137
VOA	Chlorobenzene	75-130	60-133
VOA	Toluene	76-125	59-139
VOA	Benzene	76-127	66-142
BN	1,2,4-Trichlorobenzene	39-98	38-107
BN	Acenaphthene	46-118	31-137
BN	2,4-Dinitrotoluene	24-96	28-89
BN	Di-n-Butyl phthalate	11-117	29-135
BN	Pyrene	26-127	35-142
BN	N-Nitroso-Di-n-Propylamine	41-116	41-126
BN	1,4-Dichlorobenzene	36-97	28-104
Acid	Pentachlorophenol	9-103	17-109
Acid	Phenol	12-89	26-90
Acid	2-Chlorophenol	27-123	25-102
Acid	4-Chloro-3-Methylphenol	23-97	26-103
Acid	4-Nitrophenol	10-80	11-114
Pest.	Lindane	56-123	46-127
Pest.	Heptachlor	40-131	35-130
Pest.	Aldrin	40-120	34-132
Pest.	Dieldrin	52-126	31-134
Pest.	Endrin	56-121	42-139
Pest.	4,4'-DDT	38-127	23-134

*These limits are for advisory purposes only (as noted in WA-87J 001/2/3, 1-87). They are not to be used to determine if a sample should be reanalyzed. When sufficient multi-lab data are available, action limits will be calculated. Presently, the laboratory has established an internal policy mandating that a majority of Percent Recovery measurements in each fraction fall within the above limits.

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WATER AND WASTEWATER QC ACCEPTANCE CRITERIA-METHOD 608

Federal Register, October 26, 1984

Parameter	Percent Recovery
Aldrin	42 - 122
alpha-BHC	37 - 134
beta-BHC	17 - 147
delta-BHC	19 - 140
gamma-BHC (Lindane)	32 - 127
Chlordane	45 - 119
4,4'-DDD	31 - 141
4,4'-DDE	30 - 145
4,4'-DDT	25 - 160
Dieldrin	36 - 146
Endosulfan I	45 - 153
Endosulfan II	D - 202
Endosulfan Sulfate	26 - 144
Endrin	30 - 147
Heptachlor	34 - 111
Heptachlor epoxide	37 - 142
Toxaphene	41 - 126
PCB-1016	50 - 114
PCB-1221	15 - 178
PCB-1232	10 - 215
PCB-1242	39 - 150
PCB-1248	38 - 158
PCB-1254	29 - 131
PCB-1260	8 - 127

WATER AND WASTEWATER QC ACCEPTANCE CRITERIA

HERBICIDES*

2,4-D	38 - 152
2,4,5-TP	35 - 142
2,4,5-T	38 - 141

*Advisory use only; minimum 10% recovery used for action limits.

300350

WATER AND WASTEWATER QC ACCEPTANCE CRITERIA-METHOD 624

Federal Register, October 26, 1984

Parameter	Percent Recovery
Benzene	37 - 151
Bromodichloromethane	35 - 155
Bromoform	45 - 169
Bromomethane	D - 242
Carbon Tetrachloride	70 - 140
Chlorobenzene	37 - 160
Chloroethane	14 - 230
2-Chlorethylvinyl ether	D - 305
Chloroform	51 - 138
Chloromethane	D - 273
Dibromochloromethane	53 - 149
1,1-Dichloroethane	59 - 155
1,2-Dichloroethane	49 - 155
1,1-Dichlorothene	D - 234
trans-1,2-Dichloroethene	54 - 156
1,2-Dichloropropane	D - 210
cis,1,3-Dichloropropene	D - 227
trans-1,3-Dichloropropene	17 - 183
Ethyl benzene	37 - 162
Methylene chloride	D - 221
1,1,2,2-Tetrachloroethane	46 - 157
Tetrachloroethene	64 - 148
Toluene	47 - 162
1,1,1-Trichloroethane	52 - 162
1,1,2-Trichloroethane	52 - 150
Trichloroethane	71 - 157
Vinyl chloride	D - 251
Acrolein	D - 150
Acrylonitrile	D - 150

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WATER AND WASTEWATER QC ACCEPTANCE CRITERIA-METHOD 625

Federal Register, October 26, 1984

Parameter	Percent Recovery
Acenaphthene	47 - 145
Acenaphthylene	33 - 145
Anthracene	27 - 133
Benzo(a)anthracene	33 - 143
Benzo(b)fluoranthene	24 - 159
Benzo(k)fluoranthene	11 - 162
Benzo(a)pyrene	17 - 163
Benzo(ghi)perylene	D - 219
Benzyl butyl phthalate	D - 152
Bis(2-Choroethyl)ether	12 - 158
Bis(2-chloroethoxy)methane	33 - 184
Bis(2-chloroisopropyl)ether	36 - 166
Bis(2-ethylhexyl)phthalate	8 - 158
4-Bromophenyl phenyl ether	53 - 127
2-Chloronaphthalene	60 - 118
4-Chlorophenyl phenyl ether	25 - 158
Chrysene	17 - 168
Dibenzo(a,h)anthracene	D - 227
Di-n-butyl phthalate	1 - 118
1,2-Dichlorobenzene	32 - 129
1,3-Dichlorobenzene	D - 172
1,4-Dichlorobenzene	20 - 124
3,3'-Dichlorobenzidine	D - 262
Diethyl phthalate	D - 114
Dimethyl phthalate	D - 112
2,4-Dinitrotoluene	39 - 139
2,6-Dinitrotoluene	50 - 158
Di-n-octylphthalate	4 - 146
Fluoranthene	26 - 137
Fluorene	59 - 121
Hexachlorobenzene	D - 152
Hexachlorobutadiene	24 - 116
Hexachloroethane	40 - 113
Indeno(1,2,3-cd)pyrene	D - 171
Isophorone	21 - 196
Naphthalene	21 - 133
Nitrobenzene	35 - 180
N-Nitrosodi-n-propylamine	D - 230
Phenanthrene	54 - 120
Pyrene	52 - 115

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1,2,4-Trichlorobenzene	44 - 142
4-Chloro-3-methylphenol	22 - 147
2-Chlorophenol	23 - 134
2,4-Dichlorophenol	39 - 135
2,4-Dimethylphenol	32 - 119
2,4-Dinitrophenol	D - 191
2-Methyl-4,6-dinitrophenol	D - 181
2-Nitrophenol	29 - 182
4-Nitrophenol	D - 132
Pentachlorophenol	14 - 176
Phenol	5 - 112
2,4,6-Trichlorophenol	37 - 144

SOLID QC ACCEPTANCE CRITERIA

Parameter	Concentration of Spike Added (ug)	Percent Recovery
1,1-Dichloroethane	0.20	59 - 172
Trichloroethene	0.20	62 - 137
Chlorobenzene	0.20	60 - 133
Toluene	0.20	59 - 139
Benzene	0.20	66 - 142
1,2,4-Trichlorobenzene	100	38 - 107
Acenaphthene	100	31 - 137
2,4-Dinitrotoluene	100	28 - 89
Di-n-Butyl phthalate	100	29 - 135
Pyrene	100	35 - 142
N-Nitroso-Di-n-Propylamine	100	41 - 126
1,4-Dichlorobenzene	100	28 - 104
Pentachlorophenol	100	17 - 109
Phenol	100	26 - 90
2-Chlorophenol	100	25 - 102
4-Chloro-3-Methylphenol	100	26 - 103
4-Nitrophenol	100	11 - 114
Lindane	0.20	46 - 127
Heptachlor	0.20	35 - 130
Aldrin	0.20	34 - 132
Dieldrin	0.50	31 - 134
Endrin	0.50	42 - 139
4,4'-DDT	0.50	23 - 134
2,4-D	40	56 - 160
2,4,5-TP	10	61 - 113
2,4,5-T	10	63 - 109

* Soil-modified methods 624, 625, 608, and 615, based on acceptance criteria noted in IFB-WA-87J 001/2/3, 1-87, except herbicide.

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INITIAL AND CONTINUING CALIBRATION VERIFICATION
CONTROL LIMITS FOR INORGANIC ANALYSES

Analytical Method	Inorganic Species	% of True Value (EPA Set)	
		Low Limit	High Limit
ICP Spectroscopy/ Flame Atomic Absorption Spectrometry	Metals	90	110
Furnace AA	Metals	90	110
	Tin	80	120
Cold Vapor AA	Mercury	80	120
Other	Cyanide	85	115

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8.0 DATA ANALYSIS, VALIDATION, AND REPORTING

8.1 Collection

Analytical data is generated from the GC/MS computer software, GC computer, ICP, Atomic Absorption Spectrophotometers, Technicon Autoanalyzer, and associated laboratory instrumentation. The outputs include identifications of compounds or elements, concentrations, retention times, and comparisons to standards. Outputs are in graphic form (chromatograms), bar graph (spectra) and printed tabular form. The outputs are in standard format specified for each analysis type and are monitored for consistency. If incomplete or incorrect output is received, corrective actions are taken according to procedures established for each type of analysis and consistent with the manufacturer's recommendations.

All outputs of each of the instruments are checked manually for each procedure (e.g., GC chromatographic peak area integration and calculations are checked manually for accuracy).

In the data review process (see Validation), the data produced are compared to information concerning the sample history, sample preparations, QC data, etc. to judge the validity of the results.

Auxilliary data produced for internal records and not typically reported to customers as part of the analytical data, include the following: laboratory worksheets, laboratory notebooks, sample

tracking system forms, instrument logs, standard records, maintenance records, calibration records, and associated quality control. These sources are available for inspection during audits to determine the validity of data and many are also deliverable, depending on the client's needs.

A complete record of each sample's history must be available for documenting its progress through the laboratory from sample receipt to reporting. Document control and chain-of-custody requirements specified in those SOPs describe this documentation.

Data validation includes the use of dated and signed entries by analysts and supervisors on worksheets used for all samples; the use of sample tracking and numbering systems to logically follow the progress of samples through the laboratory, and the use of quality control criteria to accept or reject specific data.

Steps and checks used to validate precision and accuracy on the measured parameters and to support the representativeness, comparability and completeness of the work include:

- Description of the calibration of methods and instruments;
- Description of routine instrument checks (noise levels, drift, linearity, etc);
- Documentation on traceability of instrument standards, samples and data;
- Description of applicable performance audits with appropriate audit materials;
- Description of the controls for interference contaminants in analytical methods (use of reference blanks and check standards for method accuracy and precision);

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- Description of levels of routine maintenance to ensure analytical reliability; and

- Documentation on sample preservation and transport.

8.2 Validation

The analyst and supervisor review data to ensure the laboratory provides the following where appropriate:

- Calculates the recoveries of surrogate spikes;
- Verifies that there are no contaminants in associated blanks;
- Compares samples and duplicates for precision in data results;
- Reviews surrogate and spike recovery data to make sure they are within quality acceptance limits;
- Verifies calibration performance for acceptability;
- Reviews and verifies instrument tuning; and
- Reviews internal standard areas of response for acceptability.

Upon meeting all technical criteria; the sample folder is then reviewed by the Final Technical Review Staff to:

- Ensure surrogate recovery section has been completed and acceptance limits are not exceeded;
- Ensure that all analyte compounds have been properly recorded;
- Assure accuracy of calculations on compound quantitites; and
- Ensure confirmation by GC/MS has been performed and spectra are present.

The reviewer examines the entire sample folder to ensure that all data transcriptions and documentation included meet customer requirements. The Senior Technical Staff perform a final technical review to verify that the completed package conforms with all Quality Control criteria.

Upon completion of review, the customer report folders are forwarded to the Deliverables Department for mailing.

8.3 Report Storage

At every stage of data processing at which a permanent collection of data is stored, procedures are established to ensure data integrity and security. Specific QA project plans indicate how specific types of data are stored with respect to media, conditions, location, retention time, and access. The following chart indicates general guidelines as documented in the SOP Manual:

Media	Conditions	Location	Retention Time	Access
Hardcopy	locked warehouse	off-site	indefinitely (Comm) 120 days (EPA)	Sample Custodian or other designated personnel
Electronic	locked warehouse (environment controlled)	off-site	indefinitely	Facilities Manager or other designated personnel

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8.4 Transcription

All data transcriptions for final reports to commercial clients are performed by Report Integration Data Clerks and are reviewed by proof readers before reporting. For EPA-CLP reports, data transcriptions made by Report Integration Data Clerks are reviewed by the Final Technical Review staff.

Data trasnscription requirements vary but are monitored by the Supervisor of Report Integration in accordance with the various customer requirements for accuracy and legibility.

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8.5 Data Reduction

Data reduction includes all processes that change either the values or number of data items. The original data set from which the new set is generated cannot be recovered from the new set.

Data reduction frequently includes computation of summary statistics.

Documentation of the calculation process is required. Frequently, a programmable calculator or computer will be used in this process. The documentation permits the reviewer to check the validity of the reduction process. All of the computer system-generated compound lists containing the reportable results include formulae used in the computation process.

It is CompuChem's policy to report results to two significant figures. However, a minimum of one extra significant figure is carried through the calculations until the mathematical manipulations are complete, at which time normal rounding off processes are applied.

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9.0 INTERNAL QC CHECKS

9.1 Methods For Attaining Quality Control Requirements

The analytical and quality control requirements for each sample are achieved by means of our Computerized Laboratory Management System (CLMS). The System Analysis Codes are associated with specific Sample Preparation and Instrument Procedures and are dependent on sample matrix, fraction type, QC requirements, and detection limit requirements.

The Analysis Codes have associated with them Quality Control samples to be tripped automatically by the CLMS upon sample receipt. The particular types and frequencies of QC samples processed with a production sample are outlined in the USEPA Caucus Organics and Inorganics Protocols for the Contract Laboratory Program (CLP) 1985. Additional requirements are presented in other analytical method references (Federal Register, October, '84; customer specific QC sample requirements; and Project specific QC sample requirements). Following this section are tables of control limits for inorganic and organic QC requirements. Surrogate standards are used with each sample processed for organic analyses.

Blind samples are routinely sent to the laboratory for analysis. These may take the form of replicates as well as using external quality control samples. The samples are obtained from outside sources and contain known concentrations of specific compounds or are produced in the Standards Laboratory.

Organic Analysis

Organics surrogate recoveries are used to determine whether the sample processing and analysis functions are in control. The pesticide surrogate, dibutylchlorendate, is presently used "for advisory purposes only" (although a minimum recovery of 10% is required); all other organic surrogates must be

within the specified control limits for the sample fraction. Matrix spike control limits for organics samples associated with the EPA-CLP are also "for advisory purposes." Samples processed following procedures designated in the October, '84 Federal Register must meet acceptance criteria specified therein. The CLP methodologies require the calculation and documentation of Relative Percent Differences (RPDs) between recoveries of the matrix spike and matrix spike duplicate, although acceptance criteria have not been formally established. CompuChem® has adopted internal accuracy and precision criteria to be used as decision guidelines where the contract provides "advisory" criteria.

More than one-half of the QC spiking compounds must be recovered within acceptance criteria for each organic fraction. Similarly, more than one-half of the precision criteria (RPD) must be met per analytical fraction. If the criteria are not met, the matrix spike and matrix spike duplicate tests have to be repeated. For Federal Register requirements, full sample matrix spikes are performed for organic analyses. A blank spike is also processsed with the sample spike. If all compounds in the sample spike are not recovered within acceptance criteria, the blank spike is analyzed. If neither QC sample meets criteria, the entire batch is reprocessed.

Inoganic Analysis

Aside from the QC samples identified earlier and for which control limit tables are presented following this section, two other QC measures, dealing with ICP analyses are employed.

At the beginning and end of each analysis shift, an ICP Interference Check Sample is analyzed. This analysis verifies interelement and background correc-

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tion factors since it assesses analytes of interest in the presence of high concentration levels of other elements. Control limits for this test are presented following this section.

Additionally, for each batch of samples processed, an ICP Serial Dilution Analysis is performed. If an analyte is present at a sufficiently high enough level (minimally a factor of 10 above the instrumental detection limit), an analysis of a 1:4 dilution should agree with 10% of the original determination. If not within that limit, a chemcial or physical interference effect is likely, and the associated data would be qualified.

Minimum criteria for the evaluation and frequency of method blanks are addressed in their applicable method references. The Quality Assurance Department routinely audits method blank data to ensure that criteria are being adhered to and that potential sources of contamination are identified before samples are affected. In addition, numerous Quality Control samples are introduced regularly into the system to monitor the cleanliness of the glassware preparation operation, volatile instrumentation, volatile sample bottle storage facility, inorganics sample bottle preparation, and sample storage refrigerator. The SOPs for these tests are outlined in the Quality Assurance SOPs in the Environmental SOP Manual. Criteria of acceptance are outlined in that document.

The management and staff of CompuChem® make every attempt to generate data of the highest quality possible and will continue to apply state-of-the-art analytical methodologies to ensure that our data continues to be of the best quality available anywhere.

CompuChem® makes every attempt to produce and deliver analytical data which has been demonstrated to meet contract-, method-, or client-required quality control acceptance criteria. Should anomalies occur in the processing and/or analysis of samples which affect that objective, Quality Assurance or Laboratory Notices are typically generated and delivered with the data results to serve as qualifiers.

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COMMERCIAL ORGANIC AND EPA - CLP CONTRACT REQUIRED SURROGATE SPIKE CONTROL LIMITS*

Volatile Surrogates	Solid	Liquid
D4-1,2-Dichloroethane	(70-121)	(76-114)
4-Bromofluorobenzene	(74-121)	(86-115)
D8-Toluene	(81-117)	(88-110)

Base/Neutral Surrogates	Solid	Liquid
D5-Nitrobenzene	(23-120)	(35-114)
D10-Pyrene	(17-125)**	(40-130)**
D14-Terphenyl	(18-137)	(33-141)
2-Fluorobiphenyl	(30-115)	(43-116)

Acid Surrogates	Solid	Liquid
2-Fluorophenol	(25-121)	(21-100)
2,4,6-Tribromophenol	(19-122)	(10-123)
D5-Phenol	(24-113)	(10-94)

Pesticide Surrogate	Solid	Liquid
Dibutylchlorendate (DBC)	(20-150)***	(24-154)***

Herbicide Surrogate	Solid	Liquid
2,4-DB	(16-124)	(28-104)

* as noted in IFB (WA-87J 001/2/3, 1-87) and subject to modification based on data supplied in the CLP
** laboratory optional surrogate only; no action limits at this time
*** advisory surrogate; minimum 10% recovery used as action limit

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EPA-CLP MATRIX SPIKE RECOVERY LIMITS*

Fraction	Matrix Spike Compound	Water*	Soil/Sediment*
VOA	1,1-Dichloroethene	61-145	59-172
VOA	Trichloroethene	71-120	62-137
VOA	Chlorobenzene	75-130	60-133
VOA	Toluene	76-125	59-139
VOA	Benzene	76-127	66-142
BN	1,2,4-Trichlorobenzene	39-98	38-107
BN	Acenaphthene	46-118	31-137
BN	2,4-Dinitrotoluene	24-96	28-89
BN	Di-n-Butyl phthalate	11-117	29-135
BN	Pyrene	26-127	35-142
BN	N-Nitroso-Di-n-Propylamine	41-116	41-126
BN	1,4-Dichlorobenzene	36-97	28-104
Acid	Pentachlorophenol	9-103	17-109
Acid	Phenol	12-89	26-90
Acid	2-Chlorophenol	27-123	25-102
Acid	4-Chloro-3-Methylphenol	23-97	26-103
Acid	4-Nitrophenol	10-80	11-114
Pest.	Lindane	56-123	46-127
Pest.	Heptachlor	40-131	35-130
Pest.	Aldrin	40-120	34-132
Pest.	Dieldrin	52-126	31-134
Pest.	Endrin	56-121	42-139
Pest.	4,4'-DDT	38-127	23-134

*These limits are for advisory purposes only (as noted in WA-87J 001/2/3, 1-87). They are not to be used to determine if a sample should be reanalyzed. When sufficient multi-lab data are available, action limits will be calculated. Presently, the laboratory has established an internal policy mandating that a majority of Percent Recovery measurements in each fraction fall within the above limits.

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WATER AND WASTEWATER QC ACCEPTANCE CRITERIA-METHOD 608

Federal Register, October 26, 1984

Parameter	Percent Recovery
Aldrin	42 - 122
alpha-BHC	37 - 134
beta-BHC	17 - 147
delta-BHC	19 - 140
gamma-BHC (Lindane)	32 - 127
Chlordane	45 - 119
4,4'-DDD	31 - 141
4,4'-DDE	30 - 145
4,4'-DDT	25 - 160
Dieldrin	36 - 146
Endosulfan I	45 - 153
Endosulfan II	D - 202
Endosulfan Sulfate	26 - 144
Endrin	30 - 147
Heptachlor	34 - 111
Heptachlor epoxide	37 - 142
Toxaphene	41 - 126
PCB-1016	50 - 114
PCB-1221	15 - 178
PCB-1232	10 - 215
PCB-1242	39 - 150
PCB-1248	38 - 158
PCB-1254	29 - 131
PCB-1260	8 - 127

WATER AND WASTEWATER QC ACCEPTANCE CRITERIA

HERBICIDES*

2,4-D	38 - 152
2,4,5-TP	35 - 142
2,4,5-T	38 - 141

*Advisory use only; minimum 10% recovery used for action limits.

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WATER AND WASTEWATER QC ACCEPTANCE CRITERIA-METHOD 624

Federal Register, October 26, 1984

Parameter	Percent Recovery
Benzene	37 - 151
Bromodichloromethane	35 - 155
Bromoform	45 - 169
Bromomethane	D - 242
Carbon Tetrachloride	70 - 140
Chlorobenzene	37 - 160
Chloroethane	14 - 230
2-Chlorethylvinyl ether	D - 305
Chloroform	51 - 138
Chloromethane	D - 273
Dibromochloromethane	53 - 149
1,1-Dichloroethane	59 - 155
1,2-Dichloroethane	49 - 155
1,1-Dichlorothene	D - 234
trans-1,2-Dichloroethene	54 - 156
1,2-Dichloropropane	D - 210
cis,1,3-Dichloropropene	D - 227
trans-1,3-Dichloropropene	17 - 183
Ethyl benzene	37 - 162
Methylene chloride	D - 221
1,1,2,2-Tetrachloroethane	46 - 157
Tetrachloroethene	64 - 148
Toluene	47 - 162
1,1,1-Trichloroethane	52 - 162
1,1,2-Trichloroethane	52 - 150
Trichloroethane	71 - 157
Vinyl chloride	D - 251
Acrolein	D - 150
Acrylonitrile	D - 150

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WATER AND WASTEWATER QC ACCEPTANCE CRITERIA-METHOD 625

Federal Register, October 26, 1984

Parameter	Percent Recovery
Acenaphthene	47 - 145
Acenaphthylene	33 - 145
Anthracene	27 - 133
Benzo(a)anthracene	33 - 143
Benzo(b)fluoranthene	24 - 159
Benzo(k)fluoranthene	11 - 162
Benzo(a)pyrene	17 - 163
Benzo(ghi)perylene	D - 219
Benzyl butyl phthalate	D - 152
Bis(2-Choroethyl)ether	12 - 158
Bis(2-chloroethoxy)methane	33 - 184
Bis(2-chloroisopropyl)ether	36 - 166
Bis(2-ethylhexyl)phthalate	8 - 158
4-Bromophenyl phenyl ether	53 - 127
2-Chloronaphthalene	60 - 118
4-Chlorophenyl phenyl ether	25 - 158
Chrysene	17 - 168
Dibenzo(a,h)anthracene	D - 227
Di-n-butyl phthalate	1 - 118
1,2-Dichlorobenzene	32 - 129
1,3-Dichlorobenzene	D - 172
1,4-Dichlorobenzene	20 - 124
3,3'-Dichlorobenzidine	D - 262
Diethyl phthalate	D - 114
Dimethyl phthalate	D - 112
2,4-Dinitrotoluene	39 - 139
2,6-Dinitrotoluene	50 - 158
Di-n-octylphthalate	4 - 146
Fluoranthene	26 - 137
Fluorene	59 - 121
Hexachlorobenzene	D - 152
Hexachlorobutadiene	24 - 116
Hexachloroethane	40 - 113
Indeno(1,2,3-cd)pyrene	D - 171
Isophorone	21 - 196
Naphthalene	21 - 133
Nitrobenzene	35 - 180
N-Nitrosodi-n-propylamine	D - 230
Phenanthrene	54 - 120
Pyrene	52 - 115

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1,2,4-Trichlorobenzene	44 - 142
4-Chloro-3-methylphenol	22 - 147
2-Chlorophenol	23 - 134
2,4-Dichlorophenol	39 - 135
2,4-Dimethylphenol	32 - 119
2,4-Dinitrophenol	D - 191
2-Methyl-4,6-dinitrophenol	D - 181
2-Nitrophenol	29 - 182
4-Nitrophenol	D - 132
Pentachlorophenol	14 - 176
Phenol	5 - 112
2,4,6-Trichlorophenol	37 - 144

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SOLID QC ACCEPTANCE CRITERIA

Parameter	Concentration of Spike Added (ug)	Percent Recovery
1,1-Dichloroethane	0.20	59 - 172
Trichloroethene	0.20	62 - 137
Chlorobenzene	0.20	60 - 133
Toluene	0.20	59 - 139
Benzene	0.20	66 - 142
1,2,4-Trichlorobenzene	100	38 - 107
Acenaphthene	100	31 - 137
2,4-Dinitrotoluene	100	28 - 89
Di-n-Butyl phthalate	100	29 - 135
Pyrene	100	35 - 142
N-Nitroso-Di-n-Propylamine	100	41 - 126
1,4-Dichlorobenzene	100	28 - 104
Pentachlorophenol	100	17 - 109
Phenol	100	26 - 90
2-Chlorophenol	100	25 - 102
4-Chloro-3-Methylphenol	100	26 - 103
4-Nitrophenol	100	11 - 114
Lindane	0.20	46 - 127
Heptachlor	0.20	35 - 130
Aldrin	0.20	34 - 132
Dieldrin	0.50	31 - 134
Endrin	0.50	42 - 139
4,4'-DDT	0.50	23 - 134
2,4-D	40	56 - 160
2,4,5-TP	10	61 - 113
2,4,5-T	10	63 - 109

* Soil-modified methods 624, 625, 608, and 615, based on acceptance criteria noted in IFB-WA-87J 001/2/3, 1-87, except herbicide.

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9.5 Additional Laboratory Polices to Achieve QA Objectives

Sample Preparation: The quality of work in the sample preparation area is crucial to the overall quality of the CompuChem® service. Before beginning the preparation of samples, a technician must demonstrate his or her proficiency with the procedure. This can be done by analyzing or preparing samples to produce results which can be compared and evaluated against established criteria. The management of the Sample Preparation Laboratory maintains records of such proficiency tests, and those qualified to perform certain procedures are specified in the Initial Documentation Forms of the area's SOP manual, which also become a part of the indivduals personnel file. Blind samples are submitted for continuing evaluations of the analyst's performance. The goals that can be measured are to produce or demonstrate acceptable recoveries of spiked compounds from samples, show no sample contamination during processing, provide proper documentation with an analysis, demonstrate precise and reproducible work, and show the exercise of correct technical judgement and abilities.

A minimum of 3 surrogate standards are added to each organic sample requiring GC/MS analysis for volatiles, acids, and base neutrals.
For pesticide and herbicide analysis, one surrogate is added for each. These surrogate standards are quantitatively analyzed in the GC/MS or GC phase. Historical records are maintained on the percent recovery of surrogate standards for each sample and each analyst. These data form the statistical basis upon which preparation technique is monitored. Surrogate recoveries must meet acceptance criteria before the analytical data will be released. In some instances,

the sample matrix may produce interferences which adversely affect recoveries. These interferences must be confirmed by a repreparation and reanalysis of the sample; affected data are qualified by a Quality Assurance Notice.

With each new lot of reagents, a reagent blank is prepared and analyzed to assure that reagents do not introduce contaminants or interferences. A method blank is prepared at a frequency of at least one for every twenty samples processed for each analysis requested. The purpose of the method blank is to ensure that contaminants are not introduced by the glassware, reagents, personnel, or sample preparation environment.

Additional Instrumental QC Requirement

On a quarterly basis, instrument detection limits are determined for each ICP and AAS system used for the analyses of metals. This is accomplished by multiplying by three (3), the average of the standard deviations obtained on three (3) nonconsecutive days from the analysis of a standard solution of each analyte in reagent water. The concentration of each analyte in the standard solution is at 3-5 times the instrument detection limit and seven (7) consecutive measurements, per day, per analyte are required.

On a quarterly basis, interelement and background correction factors are determined for ICP analysis using an Interference Check Sample. This measure determines the potential false analyte signals caused by the presence of high levels of certain common occuring elements found in environmental samples.

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9.6 Standard Operating Procedures

SOPs are developed and used to implement routine QC requirements for all monitoring programs, repetitive tests and measurements, and for inspection and maintenance of facilities, equipment, and services.

The Environmental Laboratories' procedures are documented by two separate SOP manuals; the Sample Preparation Procedures (SPPs) and Instrument Procedures (IPs) are contained in one volume. The non-analytical Standarding Operating Procedures (SOPs) are contained in a two volume set, the SOP Manual: Environmental.

The indices for both procedure manuals (SPPs/IPs and non-analytical SOPs) are included in Appendix C. These indices should provide a good understanding of how thorough the documentation of procedures is at CompuChem; the documentation of procedures is considered to be very important to the ensurance of data quality.

Standard Operating Procedures (SOPs) are distributed by area; each section of the Environmental Laboratories receives its own set of SOPs. Complete copies of the SOP Manual are maintained in the library and the Quality Assurance office.

The organization of the SOP Manual reflects the progress of a sample through the laboratories. For instance, a sample first arrives in the receiving area (SOPs included in Production Planning and Control); it is prepared as necessary for analysis (SOPs included in the Sample Preparation Laboratory); it is analyzed as necessary (included in separate sets of laboratory SOPs); the data is then prepared, reviewed, and reported, as indicated.

If a question arises concerning the procedure followed for an activity in one of these areas, the SOPs for that particular area are consulted to resolve the question. These SOPs are also a valuable source of material for training purposes.

Completing the Initial Documentation Form: Each set of SOPs is accompanied by an Initial Documentation Form. This form is located at the end of each separate set of SOPs and serves as the procedures' sign-off documentation, indicating that the procedures are consistent with current laboratory practices. After the specific laboratory manager has determined that the procedure/s is accurate, he/she signs the Initial Documentation Form for those procedures and returns a copy to Quality Assurance.

The Initial Documentation Form is also used to ensure that personnel understand the tasks and responsibilities of their positions. All personnel review the SOPs for their positions and, provided they understand what they are responsible for, sign a copy of the Initial Documentation Form. The appropriate manager documents this understanding, after confirming that the employee does understand, by co-signing the form. Copies of the completed form are forwarded to Quality Assurance and are filed in the employee's folder in the Human Resources Department.

Revising and Creating Standard Operating Procedures: Standard Operating Procedures are updated as laboratory procedures change, and it is often necessary to create new SOPs, as new procedures are developed to meet the information needs of CompuChem's clients. The current procedures for revising and creating SOPs (Quality Assurance SOPs 3.2 and 3.3) can be found in the back of each section of SOPs.

Quality Assurance supports all sections in the developing, writing, editing, revising, and maintaining of current, accurate operating procedures. All procedures remain the property of CompuChem® Laboratories. All procedures that go outside the laboratories are CONFIDENTIAL.

10.0 PERFORMANCE AND SYSTEM AUDITS

10.1 Introduction

The Quality Assurance Department is responsible for conducting periodic inspections (audits) of the quality systems, data generation, and support systems of the laboratory. The purpose of the internal audits is to assist management in identifying and correcting deficiencies and to reinforce acceptable practices. This ensures that services meet the requirements of the Laboratory QA Program as well as the client. Also, these inspections help to ensure that the policies of the laboratory for production of high quality data are being followed, including: laboratory standard operating procedures; instrument procedures; sample preparation procedures and data review policies. If discrepancies are found, corrective action is taken. Two types of audits are in place: systems and performance. Additionally, there are audits by Data Generators and for subcontracted services.

10.2 A Systems Audit

This audit is an inspection and review of an entire data-generation and support system. Quality-related activities are reviewed, assessed, and compared against the Quality Assurance Program requirements for compliance. The system audits include inspection and evaluation of personnel, facilities, procedures, and records. The system audits will generally follow performance audits, and may be instituted as part of corrective action monitoring programs. This is done at least once each quarter.

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10.3 Performance Audits

These audits are quantitative checks of quality-related activities and instrumentation to verify conformance with the requirements of the laboratory's QA program. They are conducted by the QA Director or the QA staff on a regular basis, using available QA reference materials and devices. For example, the QA Department frequently schedules blind test samples for analysis as part of the performance audit program.

10.4 Audits by the Data Generators

Corrective action is minimized through the development and implementation of routine internal system controls. Analysts are provided with specific criteria that must be met for each procedure, operation, or measurement system. The SOP Manual documents correct procedures and provides a standard of comparison to ensure that laboratory personnel know and follow correct procedures at all times. Each measurement procedure, system, and instrument has predetermined limits to indicate when corrective action is required before data become acceptable. Standard Operating Procedures are established to identify the corrective actions and approval of SOPs is established organizationally. Quality Assurance staff audit a percentage of the data to monitor the effectiveness of the system controls. In a monthly report to management, the QA staff note any corrective actions taken or necessary procedural changes.

10.5 Independent Audits

The QA Department conducts several activities to ensure that the quality systems and policies of the laboratory are being followed. These include performance audits, systems audits, and comparison studies. Outside checks, such as results of audits from independent agencies (EPA or other customers), are also used to monitor performance.

10.6 Subcontracted Services

These are controlled to comply with the requirements of the Quality Assurance Progam. The Marketing Department establishes, with input from the laboratory, when subcontract requirements are needed. The QA Department verifies that the subcontractor complies with the methods written in their referenced SOPs. This is accomplished by an on-site audit. Additionally, the subcontract laboratory is provided with blind QC samples as a part of their performance audit.

11.0 PREVENTIVE MAINTENANCE PROCEDURES AND SCHEDULES

Analytical instruments are maintained by experts employed by CompuChem® on a full-time basis. Preventive maintenance as well as major instrument repairs can be accomplished on-site. An extensive in-house stock of spare parts allows for rapid repair. CompuChem® maintains service agreements with instrument manufacturers to further assure the operational viability of all in-house equipment.

The operational condition of instruments is one of the keys to successful completion of analytical tasks. This requirement is further magnified by the necessity to complete large programmatic requirements in a limited period of time. CompuChem's commitment to instrument maintenance assures clients that equipment will be available to generate the required data.

All GC/MS instrument repair logs and instrument service records are maintained in individual instrument files in the electronic repair shop, which is physically adjacent to the GC/MS laboratory.

In discussing instrument maintenance services at CompuChem®, a distinction between GC/MS instruments and other hardware is required. In the case of the GC/MS instrumentation, CompuChem® staff have full maintenance and repair responsibility. These staff have been trained by the instrument manufacturer and are fully qualified to perform the required work. For other instruments, we have service contracts for periodic maintenance visits by the vendor, although maintenance personnel do assess whether repairs can be made in-house before outside vendors are called.

All services performed on the instruments are recorded and filed on an instrument specific basis to maintain an on-going historical record of the date

and time of work performed. Similar records are maintained for preventive maintenance activities. Example 1, beginning on the next page of this section, shows a typical maintenance record for the GC/MS instruments.

A procedure manual outlining the proper use of each piece of equipment is maintained. These manuals are located with the instrumentation and include instructions for use, calibration, and maintenance of the instrument.

EXAMPLE 1

COMPUCHEM GC/MS SERVICE REPORT

R- 1234 A

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INSTRUMENT NO 1 2 DATE 0 7 2 3 8 6 TIME 1 1 5 1 OPERATOR: Susan Bass

GC oven not heating

START DATE 0 7 2 3 8 6 END DATE 0 7 2 3 8 6 RESPONSE TIME 5 S/E Lee Gregory

START TIME 1 0 1 5 END TIME 1 0 5 7 TOTAL DOWNTIME 1 2 JOB COMPLETE? YES X NO

ASSEMBLY NO.	REV LEVEL	REPAIR CODE	FAILURE CODE	COMPONENT DESIGNATOR	PART NO.	DESCRIPTION	QTY	COST
7 0 1 7 8 9 1 4 3 2 0	0 A	0 4	0 6	F 4	3 4 0 4 A	Fuse	1	1 35

COMMENTS: Oven not heating, 24 volt relay not engaging found fuse F4 blown in power supply. Replaced fuse F4, checked +24 volts, checked operation of GC, gave back to operator L.G.

OPERATOR ACCEPTANCE: DATE 0 7 2 3 8 6 TIME 1 1 0 0 REV07298216

EXAMPLE 1 (CONTINUED)

INSTRUCTIONS

INSTRUMENT NO. - LIST AS 05 FOR OWA05, 12 for OWA12, ETC. THE 4021 GC/MS/DS IS INSTRUMENT 00. ALL STANDALONE DATA SYSTEMS ARE INSTRUMENT 99.

2. DATE & TIME - ENTER DATE AS MM/DD/YY; AUGUST 28, 1985 IS 08/28/85. ENTER TIME BY 24-HOUR CLOCK. 9:25AM IS 0925 AND 9:25PM IS 2125. THE TIME AND DATE SHOULD BE WHEN A PROBLEM IS DISCOVERED AND REPORTED VIA THIS FORM.

3. OPERATOR - WHO YOU ARE.

4. PROBLEM CODE & DESCRIPTION - USE THE 3 DIGIT PROBLEM CODE THAT MOST APPROPRIATELY DESCRIBES YOUR PROBLEM. PLEASE DETAIL THE PROBLEM AS FULLY AS YOU CAN.

5. USE BLACK INK ONLY & WRITE OR PRINT LEGIBLY.

PROBLEM CODES (CAUSE & EFFECT)	
P.M.	000
CANNOT MEET TUNE	001
IDOS ERRORS - LIST AND FULLY DESCRIBE WHAT THE DATA SYSTEM WAS DOING	002
POOR SENSITIVITY	003
DRIFTING RET. TIMES	004
NO SPECTRA OR NO MS RESPONSE	005
SOFTWARE ANOMALIES	006
GAS CHROM.	007
DISC DRIVE	008
PRINTER	009
PURGE & TRAP	010
VACUUM FAULT	011
AIR LEAKS	012
TERMINAL	013
DATA SYSTEM	014
CANNOT BOOT	015
UNKNOWN	016

REPAIR ACTION CODES	
PIRATE PARTS	100
ADJUSTMENT - ELEC	102
ADJUSTMENT - MECH.	104
REPLACED ASSY.	106
RETURNED TO VENDOR REPAIR	108
RETURNED TO VENDOR WARRANTY	110
REQUESTED IN-HOUSE VENDOR SERVICE	112
WAITING FOR PARTS (NOTE P.O. #)	114
CLEANED SEPARATOR	116
CLEANED MASS FILTER	118
CLEANED SOURCE	120
REPLACE PART	122
REPAIR IN-HOUSE	124
UNABLE TO REPRODUCE	126

FAILURE ANALYSIS CODES	
UNKNOWN	200
MISCELLANEOUS	202
OPERATOR ERROR	204
SOFTWARE	206
HEADCRASH	208
MECH. DEFECT	210
OUT OF ADJUSTMENT	29*
INTERMITTANT	29*
EXCESSIVE NOISE	29*
EXCESSIVE WEAR	212
SHORTED COMPONENT	214
OPEN COMPONENT	216
FAULTY CRIMP	218
POOR CONTACT	220
POOR SOLDER JOINT	222
DIRTY/DUSTY	224
LEAKING	226
REPLACE * WITH	
1 = ELECTRICAL	
2 = MECHANICAL	
3 = VACUUM	
4 = SOFTWARE	

REV0729821600

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PREVENTIVE MAINTENANCE - 3 MONTH INTERVAL

REPAIR - PREVENTIVE MAINTENANCE CHECKS AND SERVICES GUIDE*

ITEMS TO BE INSPECTED	PROBABLE SYMPTOM	SERVICE INTERVAL: daily	bi-monthly	3 months	6 months	yearly	as required	SERVICE INTERNAL	PROCEDURE
								NOTE: Applicable procedures are presented in the Finnigan Operator Manual(s), unless otherwise specified.	
Sigma 3 GC									
1. Line fuses for the GC	Inactive GC, blown fuse						X	replace fuse	
2. Injector for packed columns							X		
3. Splitless injection for capillary columns							X		
4. Injector septum in the GC	obstruction, leaks	X					X	clean, inspect or replace as required	
5. Carrier gas connections/couplings	leakage						X		
6. Carrier gas filter in the GC	replace when new gas cylinder is installed						X		
7. Filter, flow controller	dirty filter			X				replace filter	
8. Capillary column							X	clean inspect or replace as needed	
9. Packed column (glass type)	excessive usage, leaks at injection and interface port of the zone heating block						X		
10. Packed column (metal type)							X		
11. Detector port to GC/MS interface							X		
12. GC cool down fan		X		X				Inspect and/or replace	

*These maintenance procedures meet or exceed Finnigan's recommended preventive maintenance checks and services.

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REPAIR - PREVENTIVE MAINTENANCE CHECKS AND SERVICES GUIDE (Cont.)

ITEMS TO BE INSPECTED	PROBABLE SYMPTOM	SERVICE INTERVAL: daily	bi-monthly	3 months	6 months	yearly	as required	SERVICE INTERVAL	PROCEDURE
Mass Spectrometer									
1. Glass jet separator	obstruction or glass						X	clean or replace	
2. Glass jet separator ferrules	breakage						X	replace	
3. Mass analyzer head assembly (in the vacuum manifold)	gross leaks, presistent pressure due to degasing of trapped gases in the vacuum system						X	inspect	
*magnet well flange assy	leakage, faulty CAL gas						X	inspect	
*CAL gas valve assy	pressure (see Pirani						X	inspect	
*vent valve assy	gauge)						X	inspect	
*water flow sensor switch	faulty switch						X		
4. Quadrupole mass analyzer				X				inspect and/ or replace	
5. Electron multiplier							X		
6. Alcatel vacuum pumps (2)				X				purge weekly and replace oil	
7. Pfeiffer turbo pump	dirty oil								
8. Balzer turbo pump				X					Balzer Manual pg...23
9. Vacuum system filter/drier	excessive use, dirty filter						X	clean & inspect	
10. Ion Source				X				replace	
*ion source filament assy	lack of sensitivity,			X				clean, inspect	
*collector	faulty peak shape,	Service concurrently with every filament assembly replacement						or replace as required	
*lens	no autotune								
*aperture									
*ion volume									
GC/MS Interface Oven									
1. Capillary interface tubing	plugged						X	clean, inspect and/or replace	
2. Separator divert fitting				X			X		
3. Vacuum divert valve				X			X		
Power Module									
1. MS power supply				X			X	measure & verify PCB	
2. Turbo power supply				X			X		
Card Cage Module									
1. Air filter at bottom of cage	dirty filter, obstruction of air flow			X				clean and/or replace	
2. Fan	burned out fan			X			X		
3. Signal cable on Digital I/O PCB							X	inspect for secure fit	

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REPAIR - PREVENTIVE MAINTENANCE CHECKS AND SERVICES GUIDE (Cont.)

ITEMS TO BE INSPECTED	PROBABLE SYMPTOM	SERVICE INTERVAL: daily	bi-monthly	3 months	6 months	yearly	as required	SERVICE INTERVAL	PROCEDURE
Nova Computer									
1. Fan	faulty fan rotation							inspect and/or replace	
Perkin-Elmer Disk Drive				X					
1. Output signal									
2. Adjustable DC voltages (+5V, +13V, -13V)				X				check and verify	
3. Brushes				X					
4. Positioner carriage guide rails								clean and/or replace	
5. Spindle chuck and cone					X			clean and inspect	
6. Read-write heads					X			clean and inspect	P/ECEM Manual
Fixed disk				X				inspect and repair	P/ECEM Manual
7. Air filter				X					
*prefilter						X			P/ECEM Manual
*main filter				X				replace	
9. Blower ground brush				X				replace	
10. Spindle ground brush						X		replace	
11. Blower drive belt						X		replace	
								replace	P/ECEM Manual

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12.0 SPECIFIC PROCEDURES TO BE USED TO ROUTINELY ASSESS DATA PRECISION, COMPLETENESS, ACCURACY, COMPARABILITY, AND REPRESENTATIVENESS OF SPECIFIC MEASUREMENT PARAMETERS INVOLVED

12.1 Introduction

Precision: The Laboratory objective for precision is to equal or exceed the precision demonstrated for the applied analytical methods on similar samples. Relative Percent Difference (RPD) criteria, published by the EPA as part of the EPA's Invitation for Bid (IFB) Contract Laboratory Program (CLP) for organic and inorganic analyses and those determined from laboratory performance data, are used to evaluate precision between matrix spike duplicates.

Accuracy: The Laboratory objective for accuracy is to equal or exceed the accuracy demonstrated for the applied analytical methods on similar samples. Percent Recovery Criteria, published by the EPA as part of the EPA's-IFB-CLP for organic and inorganic analyses, those published in the Federal Register (October 26, 1984), and those determined from laboratory performance data, are used to evaluate accuracy in matrix spike and blank spike Quality Control samples. Control limits to assess data by matrix and methodology are presented in Section 7.

Representativeness: The representativeness of the data from the sampling sites depends on the sampling procedures. The representativeness of the analytical data is a function of the procedures used in processing the samples. The objective for representativeness is to provide data of the same high quality as other analyses of similar samples using the same methods during the same time period within the laboratory. Representativeness can be determined for this objective by a comparison of the quality control data for these samples against other data for similar samples analyzed at the same time.

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Comparability: The results of analyses can be compared with other analyses by other laboratories because the objectives of the laboratory for comparability are: to demonstrate traceability of standards to NBS or EPA sources; to use standard methodology; to report results from similar matrices in consistent units; to apply appropriate levels of quality control within the context of the Laboratory Quality Assurance Program; and to participate in interlaboratory studies to document laboratory performance. By using traceable standards and standard methods, the analytical results can be compared to other laboratories operating similarly. The QA Program documents internal performance, and the interlaboratory studies document performance compared to other laboratories. Quarterly laboratory proficiency studies are instituted as a means of monitoring intralaboratory performance.

Completeness: CompuChem's objective for completeness is to be able to provide analyses for 100% of samples received intact and for which back-up sample is available should initial analysis not meet acceptance criteria.
When requested, the completeness of an analysis can be documented by including in the report sufficient information to allow the data user to assess the quality of the results. The information delivered may include such items as: chromatograms, spectra, QC data, and summaries of results. Additional information, such as the Laboratory worksheets, notes, etc. are stored with the sample results in the Laboratory. The raw data (prior to data reduction) are archived indefinitely on magnetic tape. All analytical information, per sample, is retained by the laboratory whether or not the client requests results substantiation.

13.0 CORRECTIVE ACTION

The QA Department is responsible for conducting periodic audits (inspections) of the data generation, quality control and support systems of the laboratory. The purpose of these internal audits is to reinforce acceptable practices and assist management in identifying and correcting any deficiencies. The audits verify that appropriate policies are in place in order to meet internal and client objectives. If discrepancies are found as a result of the audits, Corrective action is taken. Depending on the type of discrepancy found, the corrective action will vary but in all cases, discrepancies and the recommended corrective action will be documented. Follow-up audits include an assessment to verify that a proper corrective action has been taken for the identified discrepancy.

14.0 QA REPORTS TO MANAGEMENT

The Quality Assurance Department communicates to other areas of the laboratories and to Management via several different kinds of reports. The Director of Quality Assurance and the QA staff distribute memos to appropriate laboratory management detailing the results of internal and external audits, blind QC samples, and data audit reviews. These reports indicate that corrective action is needed, or in many cases they are used to reaffirm that the laboratory areas are performing in a satisfactory manner.

Every month the QA Department releases a report summarizing its activities during the previous month. Typically, the information in this report includes the results of internal and external audits, condition code reports, the labs' performance on internal blind QC samples, the labs' performance on external performance evaluation (PE) samples, summaries of special studies conducted, and summaries of any other activities conducted by the QA Department. This monthly report is sent to upper-level management and laboratory managers.

APPENDIX C

Proposed Sampling Plan for Remedial Investigations
Phase II Studies at the
Coker's Sanitation Site
in Cheswold, Delaware

8 March 1989

Prepared for:

Clean Sites, Inc.
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Prepared by:

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File No.: 484.02

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Section 1

Introduction

Following review by EPA of Volumes I, II, and III of the Coker's Sanitation Site Draft Remedial Investigation Report and discussions with EPA and NOAA representatives, additional stream bioassay and water quality sampling will be conducted to resolve the Bioassay Report comments in a letter received on 6 December 1988 from the U.S. Environmental Protection Agency, Region III to Dr. Albert F. Vickers. The additional data resulting from the bioassay and the sampling will be used to further assess the effect or lack of effect of the site on Willis Branch and the surrounding environment. This document is intended to serve as an addendum to the approved Remedial Investigation/Feasibility Study (RI/FS) Work Plan and as such refers the reader back to the QAPP associated with the RI/FS Work Plan for specifics on sampling protocols. This Phase II RI work was provided for in the approved Work Plan.

Section 2

Background

Per the approved (RI/FS) Work Plan (ERM, 1987), a number of tasks were performed to assess the environmental impact of Coker's Landfills No. 1 and No. 2. These tasks included: surface water and stream sediment samples; wetland delineation/habitat assessment; macroinvertebrate survey; and a leachate bioassay study. The locations of the surface water and sediment samples and the macroinvertebrate stations are presented in Figure 3-9 and 3-11, respectively. Results from these sampling efforts are discussed below.

Surface Water and Sediment Sampling

With the exception of 3 ug/l of methylene chloride in sample SW-2, which was also found in blank samples, no volatile organic compounds were detected in any of the surface water samples. Additionally, no semi-volatile organic compounds, pesticides, PCBs, or TICs were detected in any of the surface water samples. Inorganic concentrations reported for the background sample locations, SW-6 and SW-8 (Figure 3-9), were higher than the concentrations reported in downstream sample locations. Analytical results of the total dissolved solids and sulfates indicate that the background samples contain concentrations that are higher than, or within 10 percent of

the remaining samples. Water hardness ranged from 16 to 70 ug/l, meaning the water is classified as "soft."

Between two and four volatile organic compounds were reported in all nine sediment samples. Of the four compounds, methylene chloride and acetone were the most prevalent, and were reported in all samples at concentrations similar to those detected in the blank samples. These concentrations are considered to be of questionable qualitative significance and are more likely representative of laboratory contamination than representative of site conditions. Similarly, a concentration of 24 ug/l of 2-butanone reported in sample SD-7 is of questionable qualitative significance. Chloroform was detected at a quantitatively estimated concentration of 2 ug/l in sample SD-4. Six semi-volatile organic compounds were reported as quantitative estimates and only detected in one sample, SD-7. Bis (2-ethylhexyl) phthalate was detected in samples SD-5, SD-6, and SD-7 at concentrations similar to those detected in the blank samples. All of these compounds are classified as polynuclear aromatics (PNAs) and are common low-level environmental contaminants associated with asphalt products and the combustion of fossil fuels.

Concentrations of quantitatively confirmed pesticides, ranging from 29 ug/l to 45 ug/l, were detected in samples SD-1, SD-4, and SD-7. These concentrations are characteristic of areas having some agricultural activity, such as the Coker's site.

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Background concentrations in sediment (i.e., SD-6 and SD-8) of aluminum, barium, calcium, chromium , cobalt, copper, lead, magnesium, manganese, and zinc were exceeded in the three most downstream locations, SD-1, SD-2, and SD-3. Background concentrations for arsenic were exceeded in all of the sampling stations. Concentrations of beryllium from locations SD-1, SD-2, SD-3, SD-4, and SD-7 exceeded background concentrations. Background concentrations for iron and vanadium were exceeded in sampling locations SD-1, SD-2, SD-3, and SD-7. The difference between the concentrations in the two background samples and those in the remaining samples does not appear to be significant in light of the difference between the concentrations in sediment sample SD-2 and its duplicate sample, SD-9. In some cases, the reported concentration in SD-2 is two to three times that of the concentration in SD-9. This variation is greater that the variation between the background samples and the remaining samples.

In summary, there were no elevated levels of TCL organic or inorganic constituents reported for the surface water or sediment samples.

Wetland Delineation/Habitat Assessment

The results of the qualitative habitat assessment indicate that the wetland areas and the landfills support a diverse flora and fauna community. No stressed vegetation was observed in any of the observed areas. There is no known occurrence of any rare, threatened or endangered species of birds, mammals, fish, reptiles, amphibians, or plants within

the study area according to the Delaware Department of Natural Resources and Environmental Control (DNREC). The adjacent wetlands provide excellent habitat for a wide variety of mammals and other wildlife.

Macroinvertebrate Survey

A total of 21 different species totaling 587 specimens was collected from the combined seven stations during the qualitative macroinvertebrate survey. Small clams of the family sphaeriidae, midge fly larva and small worms (5 to 25 mm in length) made up the bulk of the benthic organisms collected.

Stations 2, 3, 4, and 5 (Figure 3-11) adjacent to and downstream of Landfill No. 1 show Shannon-Weaver diversity indices ranging from 1.92 to 3.74, whereas the two background stations, 6 and 8, and station 7 show diversity values ranging from 1.05 to 1.49. The particle sizes of all sediment samples are predominantly medium to fine sand. The percentage of sample retained by the #200 sieve varies from 64.2 at station 2 to 97.2 at station 8. Stations 2 and 3 contain more silt than the other stations while stations 4 and 8 contain the least amount of silt.

Higher species diversities in the lower stations as compared to the background stations (6 and 8) are probably due to habitat differences such as stream width and depth, which was much greater in the lower stations, rather than surface water or sediment quality.

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Leachate Bioassay

A short-term chronic toxicity bioassay using *Ceriodaphnia dubia* was performed on a leachate sample collected from the north slope of Landfill No. 1 and on Willis Branch water collected from the background station upstream of the landfill. The results of the range-finding test indicate a 100 percent mortality from the leachate when *Ceriodaphnia* were exposed to 100 percent concentration and partial mortality from the 50 percent concentration.

Results of the 7-day chronic test on the leachate show the No Observed Effect Concentration (NOEC) and the Lowest Observed Effect Concentration (LOEC) at 25 and 50 percent, respectively. The Chronic Value of the leachate was 35 percent. However, because a large number of males were produced during the test, the NOEC, LOEC, and the Chronic Value are only estimations. The results of the leachate bioassay indicate that the leachate does exhibit acute and chronic toxicity.

Section 3

Description of Work

3.1 Stream Bioassay

As discussed during several phone conversations with Alyce Fritz of NOAA, an additional stream bioassay will be conducted on Willis Branch water to determine the effect or lack of effect from Coker's Landfill No. 1 leachate on the receiving stream and the surrounding environment.

Type of Tests

As requested by Ron Preston of EPA Region III, the following tests will be conducted according to EPA procedures outlined in Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, EPA, 1985:

- 7-day chronic static renewal, survival and growth test using 10, less than 24-hour old fathead minnow larvae per test chamber;

- 7-day chronic static renewal, survival and reproduction test using 20, less than 24-hour old *Ceriodaphnia dubia* neonates per test solution.

Acclimation

One to two weeks prior to the definitive test, a sample collected from the background station No. 6 will be used to acclimate individual reproducing *Ceriodaphnia* females, so that the third or fourth generation neonates can be used in the definitive test. During acclimation and the definitive test, the *Ceriodaphnia* will be fed a mixture of algae, *Selenastrum capricornutum* and *Ankistrodesmus falcatus*, to provide maximum reproduction.

Sample Collection

As discussed with Alyce Fritz of NOAA, three locations along Willis Branch will be tested. The background sample collected from station 6 will be used as the control sample. Samples collected from stations 3 and 5 will be used as the test solutions. Station 5 is located adjacent to Landfill No. 1 while Station 3 is located on Willis Branch immediately upstream of the confluence with the unnamed eastern tributary. Water from these stations will be tested at full strength, no dilutions will be required. Samples from all 3 locations will be collected on the first, third, and fifth day of the test and will be used daily for renewal of the test solutions. The holding time for stream samples before commencement of the test will not exceed 36 hours.

Along with the bioassay water samples, surface water samples will be collected from the 3 stations during each sampling event to be analyzed for TDS, TSS, hardness, alkalinity, total ammonia, and ammonia-nitrogen. Analytical methods,

containers, detection limits, and holding times which apply to analyses being conducted on the surface water samples collected during the Phase II sampling are presented in Tables 1 and 2.

Temperature, conductivity, pH, and dissolved oxygen will be field measured and all sample collection will follow protocols presented in Section 4 of the QAPP, dated 16 September 1987, and the Health and Safety Plan, dated 29 May 1987, associated with the approved RI/FS Work Plan.

Data Analysis

As discussed during a phone conversation with Bob Donaghy of EPA Region III, *Ceriodaphnia* test results from stations 3 and 5 will be compared to the background station 6 using a Students-T-Test while a Dunnetts Analysis will be used for the fathead minnow results. These statistical analyses will determine, at a 95% confidence level, if there is a significant difference between the impact zone and the background zone in mortality and growth for the fathead minnows or mortality and reproduction for the *Ceriodaphnia*.

Subcontractors

Aqua Survey, Inc., a New Jersey certified bioassay laboratory will be performing the stream bioassay while Lancaster Laboratories, Inc., of Lancaster, Pennsylvania, a CLP laboratory, will perform the analyses on the surface water samples.

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3.2 Possible Additional Work

If the results from Stations 3 and 5 do not show a significant difference in mortality, growth, or reproduction at 95% confidence level from the background station 6, then the data will indicate there is no impact from the leachate on the receiving stream and no additional studies are needed. However, if the results do show a statistically significant difference in mortality, growth, or reproduction at 95% confidence level, then a toxic reduction evaluation (TRE) may be needed to determine the fraction or fractions within the leachate which are responsible for the environmental stress. Results will be discussed with EPA and NOAA personnel. If the TRE is requested, then detailed procedures will be provided as another addendum to the work plan at that time.

3.3 Schedule

Upon EPA's review and approval of the Phase II Sampling Plan, the proposed schedule for Phase II work will commence. The proposed effort will take a total of 11 weeks from date of EPA approval. If the results of the sampling and bioassay work indicate that there are no unexceptable results, the Final RI Report will be submitted to EPA at the end of that period. Activities that will be performed during the 11 weeks include collection of acclimation water, collection of water samples for the bioassay and laboratory, conduct the two 7-day chronic bioassays, laboratory analysis on the water samples, review of the bioassay results, data validation on the water sample results, and incorporation of the results of the Phase II sampling into the final RI Report.

Should the bioassay results indicate unexceptable results, additional time may be required to complete TRE studies or similar Phase II investigations before the RI Report can be submitted in final form.

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TABLE 1

SAMPLE CONTAINERS AND PRESERVATION REQUIREMENTS FOR ANALYSES IN CONJUNCTION WITH THE PHASE II SAMPLING PLAN FOR THE COKER'S SANITATION SITE

Analysis	Sample Container	Preservation
WATER:		
TDS, TSS	1 Plastic liter	Cool to 4°C
Alkalinity	1-500ml Plastic	Cool to 4°C
Hardness	1-500ml Plastic	H_2SO_4 to pH<2 Cool to 4°C
Kjeldahl nitrogen, Ammonia nitrogen	1 Plastic liter	H_2SO_4 to pH<2 Cool to 4°C
BIOASSAY:		
Acclimation Sample	1-20 liter Polycarbonate carboy	Cool to 4°C
Definitive Test Samples	1-7.5 liter plastic	Cool to 4°C

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TABLE 2

ANALYTICAL METHODOLOGY REFERENCES AND HOLDING TIMES FOR ANALYSES IN CONJUNCTION WITH THE PHASE II SAMPLING PLAN FOR THE COKER'S SANITATION SITE

Parameters	Method Reference (1)	Holding time
TDS	Method 160.1	7 Days
Alkalinity	Method 310.1	14 Days
TSS	Method 160.2	7 Days
Hardness	Method 130.2	6 Months
Kjeldahl Ammonia	Method 351.3	28 Days
Ammonia Nitrogen	Method 350.2	28 Days
pH	Method 150.1	Immediately
Specific Conductance	Method 120.1	28 Days
Dissolved Oxygen	Method 360.1	Immediately
Temperature	Method 170.1	Immediately

(1) U.S. EPA. 1979. Methods for Chemical Analysis of Water and Wastes. EPA 600/4-79-020 (Revised, March 1983). EPA/EMSL, Cincinnati, Ohio.

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