FINAL

REMEDIAL INVESTIGATION REPORT

FOR

SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

MARCH 1991

BCM PROJECT NO. 00-6018-03

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EXECUTIVE SUMMARY

The Sealand Limited, Inc, (Site) site is located in Mt. Pleasant, New Castle County, Delaware, near the intersection of Routes 896 and 71/301. The rectangular shaped Site consists of approximately 2 acres and is currently owned by the Consolidated Railroad Corporation (Conrail). The Site is bordered on the west by an active Conrail track and on the north and east by a 15-acre parcel of land owned by Tilcon Minerals, Inc.

In August 1982, Conrail leased the Site to Sealand Ltd. for the stated purpose of waste oil recycling. The Site was operated by Sealand Ltd. from August 1982 until August 1983. During that period, the operations consisted of the treatment and/or processing of coal tars and other similar materials referred to as No. 4 and No. 6 oil, oil gas tar, off-spec creosote, ink oil waste, and oil cuff (an oil and water mixture). The operators allegedly accepted the various materials, separated the water, and transferred the liquid materials by tank truck to Burke-Parsons-Bowlby Corporation. Sealand Ltd. abandoned the Site in August 1983. At that time, it was reported that the Site contained 21 steel tanks or hoppers, one 8,000-gallon wooden storage tank, approximately 300 55-gallon steel drums, a boiler house, and various mixing chambers and pressure vessels. An investigation of the Site conducted by the DNREC concluded that the wooden storage tank and numerous 55-gallon drums were leaking their contents onto the ground surface. In December 1983, the DNREC and EPA initiated an Emergency Removal Action under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The action consisted of the removal of 240,800 gallons of coal tar, 320 drums and 80 cubic yards of solid waste. In addition, storage tanks were cleaned and moved, and the tank and drum storage area was clay capped. Six groundwater monitoring wells were also installed during the Emergency Removal Action. Available information indicated that there were two wells existing onsite prior to the emergency action. The removal action by EPA was concluded in June 1984.

Several investigations of the Site soils and groundwater have been conducted since 1983 by both the EPA and DNREC. In addition, two groundwater sampling events were conducted by R. E. Wright Associates, Inc. (REWAI) on behalf of the Sealand Ltd. Potentially Responsible Parties.

A formal report of the soil sampling and extent of contamination was never developed as part of the Emergency Response Action. Though considerable sampling and analysis were conducted, the data were used primarily for qualitative evaluation of Site conditions and waste disposal classification. Groundwater sampling results were not consistent from one sampling event to another.

The RI field investigation was initiated in March 1990. A soil investigation was conducted at the Site for the purpose of delineating the vertical and horizontal extent of soil contamination left at the conclusion of the 1983/1984 Emergency Removal Action. The soil investigation consisted of collecting soil samples from nine locations within the former drum and storage tank area. Soil samples were also collected from four other Site locations for the purpose of collecting data to be used in the risk assessment. One additional surface soil sample was collected from a location adjacent to the east side of the concrete pad as requested by EPA. In addition, split samples from four boring locations were retained for the EPA by their oversight contractor. Twenty-four soil samples were submitted to CompuChem Laboratories in North Carolina for TCL volatile and semivolatile organic analysis plus tentatively identified compounds, TCL pesticides, TCL PCBs, TAL metals and Total Petroleum Hydrocarbons (TPH). One soil sample was analyzed for TCL semivolatile organics plus tentatively identified compounds, TAL metals, Total Organic Carbon and TPH. The analyses were performed in accordance with the procedures contained in the approved Site Work Plan and Quality Assurance Project Plan.

The RI hydrogeological investigation included the evaluation of all existing onsite monitoring wells, installation of four new monitoring wells, installation of three new well points, and sampling and analysis of groundwater from eight onsite monitoring wells and four offsite residential wells. In addition, a 24-hour water level monitoring program was conducted. Groundwater samples were collected for laboratory analysis from four residential wells, DW-1, -2, -3, and -4 on April 25, 1990, and from eight onsite monitoring wells, MW-1, -2, -5, -6, -7N, -8N, -9 and -10 on April 26 and 27, 1990. Split samples were obtained by EPA's contractor from Wells MW-5, -6, -7N, and -8N. The samplings were selected to provide groundwater quality data in areas located both hydraulically upgradient and downgradient of the Site, from shallow and deep aquifer zones, and from sources of residential water surrounding the Site. Groundwater samples were analyzed for TCL semivolatile organics plus 20 tentatively identified compounds, TAL metals including mercury, total dissolved solids and total organic carbon. In addition, samples from five onsite wells and the four selected domestic wells were also analyzed for TCL volatile organics plus tentatively identified compounds.

Volatile organic compounds were found in onsite soil samples in concentrations ranging from non-detect to 220 ug/kg. Samples from the borings with the highest volatile organic concentrations were S-09, S-10, and S-13. Samples S-09 and S-10 were collected beneath the clay cap. Semivolatile organic compounds were found in onsite soil samples at concentrations ranging from non-detect to 23,000 micrograms per kilogram (ug/kg). The compounds found most frequently and at the highest concentrations include naphthalene (8 of 24 samples, with the highest concentration of 20,000 ug/kg), 2-Methylnapthalene (8 of 24 samples, up to 14,000 ug/kg), phenanthrene (11 of 24 samples, up to 22,000 ug/kg), fluoranthene (9 of 24 samples, up to 23,000 ug/kg), pyrene (10 of 24 samples, up to 22,000 ug/kg), and other isomers of fluoranthene and pyrenes ranging up to 20,000 ug/kg. In terms of total semivolatile organic compounds (excluding TLCs), the borings with the highest concentration were installed through the clay cap. Total semivolatile organic compound concentrations of up to 169,840 ug/kg were detected in S-03 at 2-3 feet, between the clay cap and the water table. TPH were present in onsite soil boring samples at concentrations ranging from non-detect to a maximum 3,000 mg/kg. With the exception of S-01 (the background sample), TPH was found at the highest concentrations beneath the southeastern quadrant of the capped area. The distribution of TPH was somewhat sporadic with high and low concentrations found in different samples from the same boring in several instances. Of the 19 TAL metals analyzed, only antimony was absent from any of the soil samples.

The groundwater sampling program exhibited no significant detected compounds or levels. Methylene chloride and acetone were detected at low concentrations in two different samples, one onsite and one offsite. No tentatively identified volatile organic compounds were identified. Few semivolatile organic compounds were detected in the groundwater samples. bis (2-ethylhexyl) phthalate was detected at an estimated concentration of 2.0 ug/l in offsite well sample DW-4. Napthalene was detected at estimated concentrations of 4.0 ug/l in onsite well samples S-06 and S-07N. No other wells showed the presence of semivolatile organic compounds. Few tentatively identified semivolatile organic compounds were detected in either onsite or offsite groundwater samples. No TPH were detected in any offsite or onsite groundwater samples. Of the 20 TAL metals analyzed for, only antimony, barium, beryllium, chromium and mercury were not present above their respective detection limits in any sample.

As part of the RI, a human health and environmental risk assessment was conducted to determine the potential for adverse health effects due to exposure to chemicals found at the Site. A review of the compounds detected during the soil and groundwater investigations indicates that the chemicals of potential concern are the semivolatile organic compounds and two metals, nickel and mercury in soil. The remaining compounds in soil and all the compounds in groundwater were omitted because they were detected at low frequencies and concentrations, at isolated locations or at concentrations within the range of background. The potential receptors, both current and future, were evaluated for current exposure, the most likely potential receptors are children exposed to shallow soils while trespassing on the Site on an infrequent basis. For the future use of the Site, the potential receptors are workers that may be exposed to soil from all depths during construction activities. The exposure pathways identified are (1) ingestion of soil and (2) dermal absorption of contaminants.

The risk assessment conclusions included the following:

- In the current exposure pathways the cancer risk estimates are below the range suggested for Superfund Sites. The reason for the low risk estimates is that currently there is no exposure to the chemicals in soil beneath the Site.
- The future risk scenario is based on short term exposure by construction workers because the presence of an active rail line bordering the Site and local zoning ordinances preclude development of the property for residential use.
- There is negligible potential for noncarcinogenic effects either currently or in the future. The highest estimate of noncarcinogenic risk is a HI value of 0.007 which is more than two orders of magnitude below the trigger level for HI values of 1.
- The environmental risk assessment conducted for the Site concluded that there are no completed exposure pathways. The contaminated soils are capped and there are no chemicals of potential concern in the groundwater. The nearest environmental receptor of concern, Joy Run, is impacted by multiple sources of contamination (not related to Site activities) including tar spills, numerous piles of asphalt and highway debris between the site and the creek, and road bed materials dumped along the creek banks.

Based on the evaluation of the results of the remedial investigation and the data collected at the Site, the following conclusions can be drawn:

- The direction of groundwater flow (north-northeast) is consistent with previous findings. Water level fluctuations measured in onsite wells for 24 hours did not indicate a potential impact on onsite groundwater flow as a result of offsite groundwater pumping.
- Groundwater can be eliminated from consideration as a source of risk or an exposure pathway. Three volatile organic compounds were detected, but based on low frequency of detection and low concentrations of these compounds they were not considered chemicals of potential concern. Two semi-volatile organic compounds (Naphthalene and bis(2-ethylhexyl) phthalate) were present above the detection limit in samples from two onsite wells. Based on low frequency of detection and low concentrations, these compounds were not considered chemicals of potential concern. Inorganic parameters detected are within the range of Site-related background concentrations and, therefore, were not considered chemicals of potential concern.

- Elevated concentrations of contaminants, particularly semivolatile organic compounds, are present in soil beneath the clay cap. Isolated areas of detectable concentrations of contaminants are also present outside the capped area, but their distribution is sporadic and less concentrated than beneath the capped area.

- The risk assessment indicates that onsite soils do not pose a health risk. The highest concentration of soil contamination is found beneath the clay cap and there is no evidence that the cap has been disturbed. Except for periodic refuse dumping, there is no evidence that the Site is used for recreational or other purposes by nearby residents.

- The total cancer risk for current use exposure via ingestion and dermal contact is 3 x 10^{-7}. As stated in Section 300.430 (3) of the National Oil and Hazardous Substances Pollution Contingency Plan acceptable exposure levels to known or suspected carcinogens are generally concentration levels that represent an excess upper bound lifetime cancer risk between 10^{-4} and 10^{-6}. The cancer risk associated with future use is 1 x 10^{-7} onsite and 6 x 10^{-8} background.

- Chronic hazard indices (HI) are also very low for both current and future use scenarios. An HI value above 1.0 is considered cause for concern. The value for current exposure at the Site totals 0.007. The total future value is 0.006 for ingestion and dermal exposure to soil.

Based on the conclusions presented in the RI, no additional Site characterization is necessary. The groundwater and soil pathways have been sufficiently characterized and the risks for human exposure and environmental impacts are within acceptable levels. No additional remedial investigation activities are proposed.

1.0 INTRODUCTION

1.1 SITE BACKGROUND

1.1.1 Site Description

The Sealand Limited, Inc. (Site) site is located in Mt. Pleasant, New Castle County, Delaware, several hundred feet east of the intersection of Routes 896 and 71/301 (Figure 1-1). The Chesapeake and Delaware Canal is approximately 2 miles north of the Site. The Site consists of approximately 2 acres and is currently owned by the Consolidated Railroad Corporation (Conrail).

The Site is rectangular in shape and is bordered on the west by an active Conrail track and on the north and east by a 15-acre parcel of land owned by Tilcon Minerals, Inc. On the south, the Site is bordered by Routes 71/301. Private residences and light industrial and commercial establishments are also located to the south and west of the Site. Figure 1-2 indicates the location of the Site and adjacent site property boundaries. Figure 1-3 indicates site-specific features.

The Site is presently inactive and unoccupied following an U.S. Environmental Protection Agency (EPA) Emergency Removal Action conducted in late 1983 and early 1984. Current Site features include a concrete slab, a one-story building, an abandoned rail spur, a gravel road, and miscellaneous debris.

1.1.2 Site History

Various investigations and reports have been completed for the Site since 1983. The following discussion is a summary of the Site history compiled from BCM Engineers Inc.'s (BCM) review of the following reports: R.E. Wright Associates, Inc., 1987a; NUS Corporation, 1987; EPA Onsite Coordinator's (OSC) Report, 1984; and miscellaneous Site characterization reports prepared in 1983 and 1984 by the Delaware Department of Natural Resources and Environmental Control (DNREC).

According to certain of the above records, industrial activity at the Site began in 1971 when Adams Laboratory operated an animal fat rendering plant. Sometime prior to 1976, Adams Laboratory ceased operations at the facility. In 1976, Conrail acquired the property. A contractor hired by Conrail cleaned up the Site to DNREC satisfaction in 1979.

In August 1982, Conrail leased the Site to Sealand Ltd. for the stated purpose of waste oil recycling. The Site was operated by Sealand Ltd. from August 1982 until August 1983. During that period, the operations consisted of the treatment and/or processing of coal tars and other

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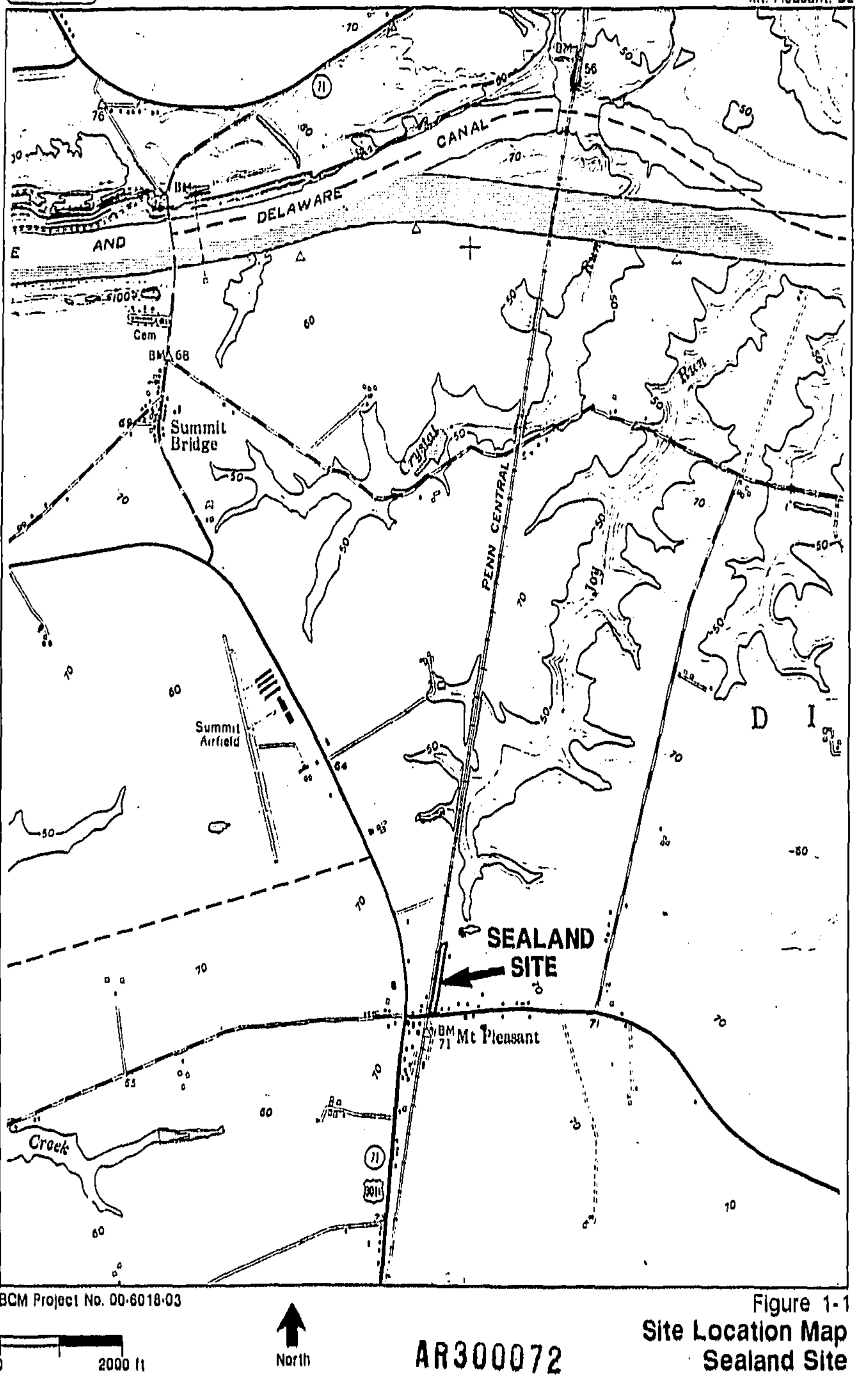
SEALAND LTD. SITE
Mt. Pleasant, DE



SOURCE: USGS 7.5 Min Topo Map/Saint Georges, DE

BCM Project No. 00-6018-03

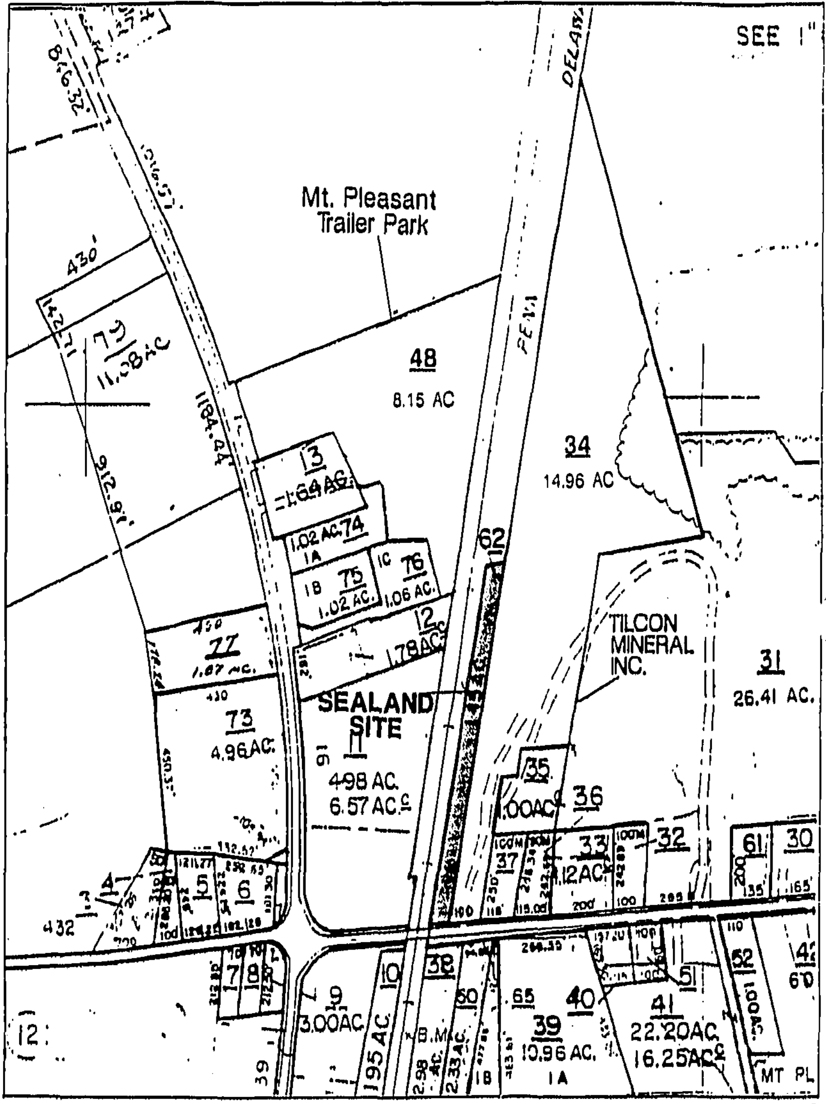
0 2000 ft

North

Figure 1-1
Site Location Map
Sealand Site

BCM

SEALAND LTD. SITE
Mt. Pleasant, DE



Source: New Castle County Delaware Tax Assessor

BCM Project No. 00-6081-03

0 400 Ft.
(Approximate)

NORTH

Figure 1-2
Property Boundaries
Sealand Site

BCM

SEALAND LTD. SITE
Mt Pleasant, DE

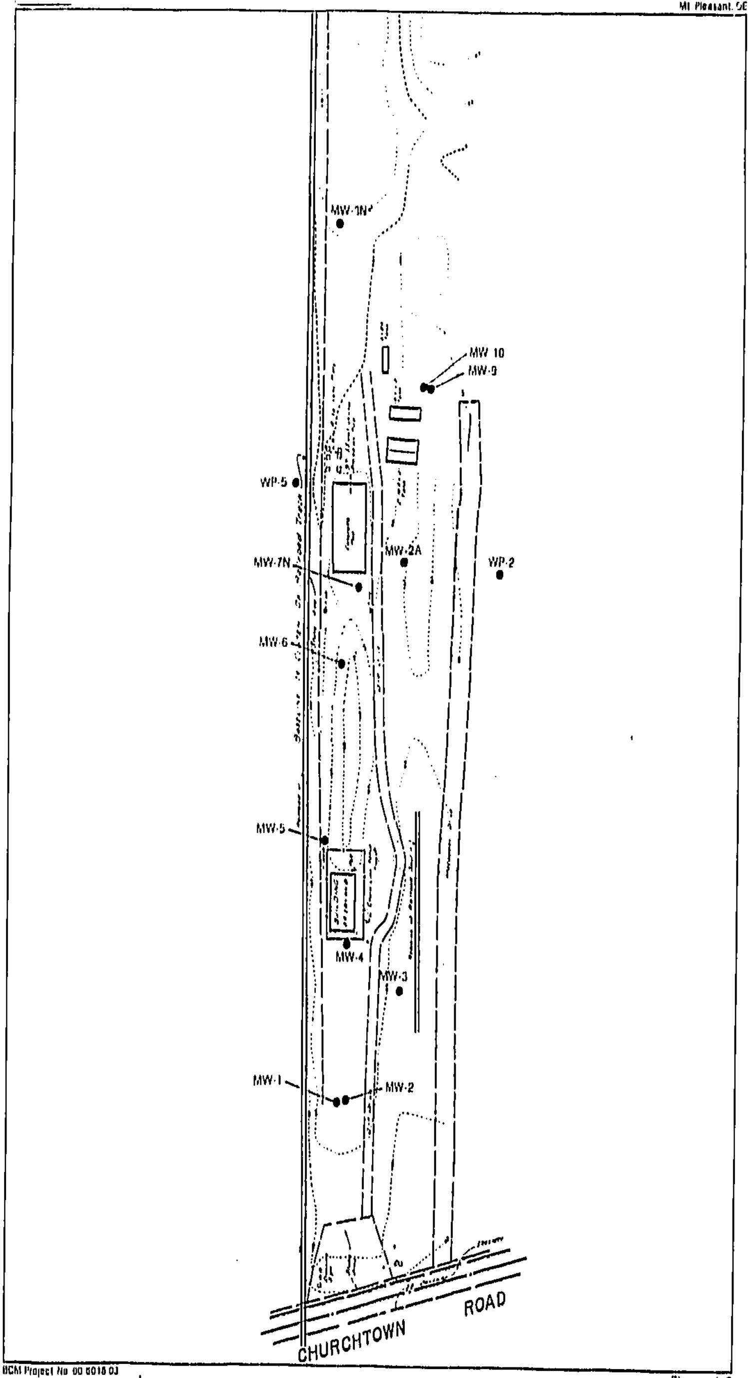


Figure 1-3
Site Features
Sealand Site

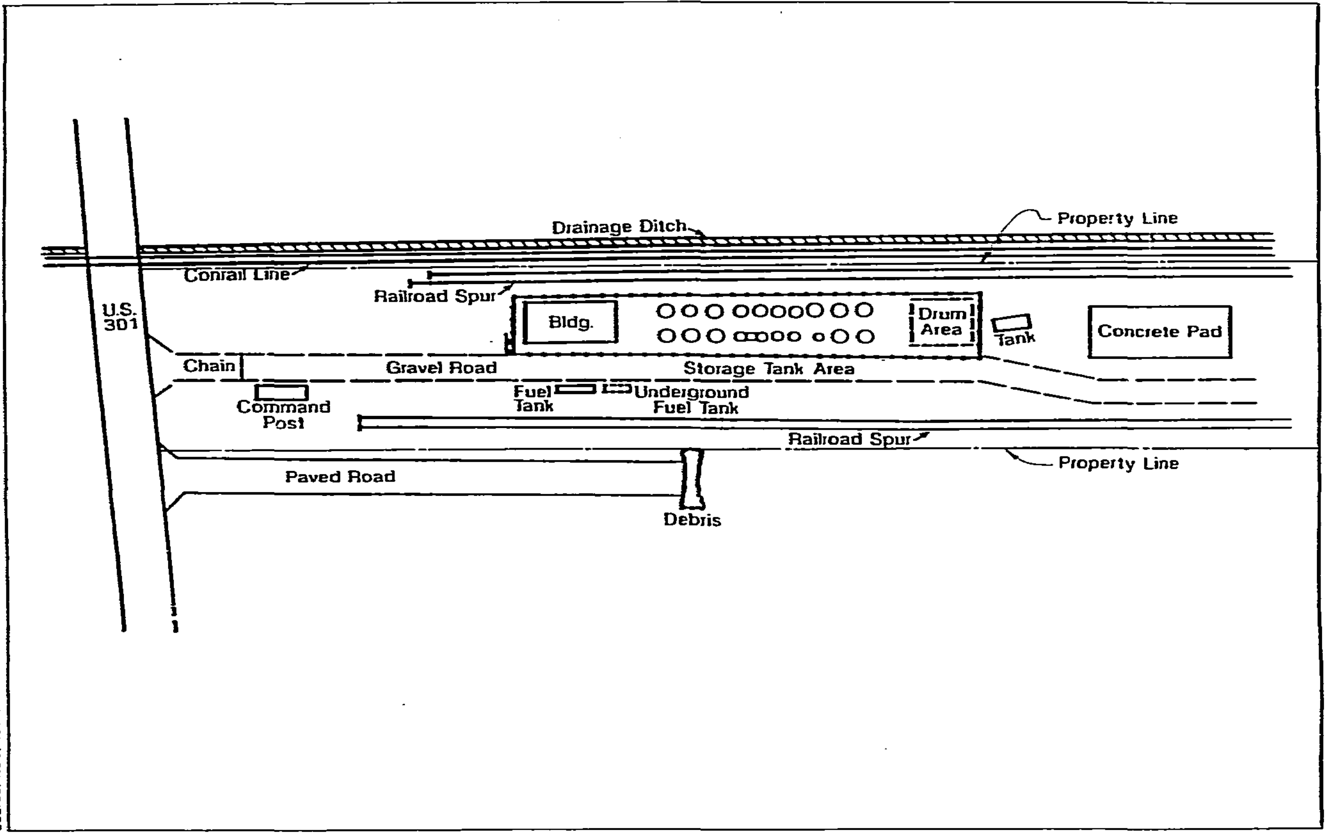
similar materials referred to as No. 4 and No. 6 oil, oil gas tar, off-spec creosote, ink oil waste, and oil cuff (an oil and water mixture). The operators allegedly accepted the various materials, separated the water, and transferred the liquid materials by tank truck to Burke-Parsons-Bowlby Corporation.

Sealand Ltd. abandoned the Site in August 1983. At that time, it was reported that the Site contained 21 steel tanks or hoppers, one 8,000-gallon wooden storage tank, approximately 300 55-gallon steel drums, a boiler house, and various mixing chambers and pressure vessels. Figure 1-4 shows the general layout of the previous Site operations, and Table 1-1 is a summary of the equipment which existed onsite when operations ceased.

An investigation of the Site conducted by the DNREC concluded that the wooden storage tank and numerous 55-gallon drums were leaking their contents onto the ground surface. The observed leaking liquids were described by DNREC representatives as black, viscous, tar-like substances. Laboratory analysis of samples collected in October 1983 by the DNREC and EPA from tanks, drums, and soils reported the presence of polynuclear aromatic organic compounds, creosols, solvents, and other organic compounds.

In December 1983, the DNREC and EPA initiated an Emergency Removal Action under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The action consisted of the removal of 240,800 gallons of coal tar which had been contained in the wooden and steel tanks, 320 drums, and approximately 80 cubic yards of solid waste. The solid waste consisted of 30 yd^3 of the wooden tank debris and anywhere from 50 to 92 cubic yards of sludge and contaminated material. Farboil Company voluntarily removed 239 drums of off-spec product (EPA OSC report mentions two quantities, 238 and 239) from the site in December 1983. In addition, storage tanks were cleaned and moved, and the tank and drum storage area was clay capped. However, none of the allegedly contaminated soil located within the storage tank area was removed from the Site. Soil, from the excavation of an L-shaped trench along the southern and western boundaries of the storage tank area, was also left onsite within the subsequently capped former tank area. According to EPA records, the trench was constructed along the railroad side of the Site to aid in minimizing any horizontal movement of contaminants. The trench was filled with clay, and it and soil within the storage tank area were then covered with 1 foot of clay and 6 inches of topsoil. Six groundwater monitoring wells were also installed during the Emergency Removal Action. Available information indicates that there were two wells existing onsite prior to the emergency action. The removal action by EPA was concluded in June 1984.

SEALAND LTD. SITE
Mt. Pleasant, DE



Source: NUS, 1986/Weston

BCM Project No. 00-5081-03

Figure 1-4
Previous Site Op tions
Seal Site

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TABLE 1-1

SUMMARY OF EQUIPMENT
AT TIME OF
1983/1984 EPA EMERGENCY REMOVAL ACTION
SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

- 10 Steel Tanks - 20,000 gallons each, 10'-6" diameter x 31'H, vertical, flat bottom for storage of finished product.

- 6 Steel Tanks - 12,500 gallons each, 10'-6" diameter x 19'-3"H, vertical, flat bottom (3 for incoming product storage and 2 for blending).

- 2 Steel Enclosed Hoppers - above sludge tanks about 7,500-gallon capacity.

- 1 Wood Tank - about 8,000-gallon capacity.

- 1 Steel Tank - painted red, about 5,000-gallon capacity.

- 2 Steel Tanks - open, sludge, 5,500 gallons each, filled with unidentified putrified sludge.

Boiler - Orr and Sembower, oil fired, 50-HP, high pressure type package unit.

- 1-Story Metal Building

- Concrete Pad

Note: The text in the 1984 EPA Federal On-Scene Coordinator's Report routinely cites that there were twenty-two (22) steel tanks onsite; however, the above list numbers only 21 steel tanks (including hoppers) and describes only 20 steel tanks and hoppers. For purposes of this RI, 21 steel tanks (including hoppers) are listed as being onsite in 1983.

Source: EPA On-Scene Coordinator's Report (Attachment A), 1984.

Compiled by: BCM Engineers, Inc. (Project No. 00-6018-03)

The following is a chronology of EPA and DNREC regulatory actions with regards to the Sealand Ltd. operations:

August 1983	DNREC Site Visit following abandonment of Sealand Ltd. operations
September 1983	DNREC request to EPA to perform CERCLA preliminary assessment
September 1983	EPA performs visual site inspection
October 1983	EPA site assessment
November 1983 - June 1984	EPA Emergency Removal Action
June 28, 1988	Sealand Limited Site proposed for National Priorities List (NPL), Fed. Reg. 23988
December 30, 1988	EPA and Sealand Respondents sign Administrative Order on Consent for RI/FS (Docket No. III-89-08-DC)
August 30, 1990	Sealand Limited formally added to NPL, Site No. 838, 55 Fed. Reg. 35502-35525

1.2 PREVIOUS INVESTIGATIONS

1.2.1 Source/Soil Investigation

Previous investigations of contamination sources and Site soils were conducted by both the EPA and DNREC. DNREC first identified the Site as a potential hazard in September 1983. At that time, DNREC determined that soils contamination may have occurred due to a release of a tar-like substance from the 8,000-gallon tank and overflow from various 55-gallon drums onsite.

In October 1983, the EPA and DNREC implemented an Emergency Response Site characterization sampling investigation at the Site. The purpose of the investigation was to assess the potential threat to human health and the environment presented by the Site. Samples were collected from the tanks, drums, stained soils, and soils in areas offsite. Tables 1-2 and 1-3 present a summary of the previous sampling activities. The analytical results indicated that Site soils may have been contaminated with various base/neutral organic chemicals including polynuclear aromatic hydrocarbons (PAHs). The vertical and horizontal extent of the contamination, however, was not fully determined.

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TABLE 1-2

SUMMARY OF WASTE CHARACTERIZATION ANALYSIS
OCTOBER 1983 TANK AND DRUM SAMPLES - DETECTED COMPOUNDS
SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Analytical Parameters (mg/l)	Sample Identification					
	Drum 4	Tank 2	Tank 4	Tank 18	Tank 19	Tank 17
Naphthalene	35,000	1,300	48,800	124,000	29,200	15,700
Acenaphthalylene	2,000	95	2,100	2,600		1,900
Acenaphthene	15,700	42	1,540	2,100	2,400	
Fluorene	28,100	95	2,620	3,300	2,750	1,150
Phenanthrene	106,000	230	6,850	1,900	5,400	4,500
Anthracene	133,000	53	1,790	2,400	1,250	550
Fluoranthene	33,200	68	2,100	2,600	1,650	950
Pyrene	24,400	99	3,010	3,100	1,400	1,800
Benzo(a)Anthracene	6,800	29				
Chrysene	1,070	26				550
Benzo(a)Pyrene	3,900					
Benzo(b,k)Fluoranthene	6,500					
Toluene			900	6,400	720	14,300
Benzene						4,410
Ethylbenzene						717
Phenol (Total)	560	1,360	3,300	24,000	5,220	380
Nickel (Total)				136	184	
Chromium (Total)						70
Phenol	3,050	1,200	1,470	15,600	3,440	1,040
Corrosivity pH	7.9	6.1	6.5	8.2	5.1	6.0
Flash Point	>200	>200	>200	145	>200	160
Reactivity	neg	neg	neg	neg	neg	neg

Source: EPA File Information, 1984 Report.

Compiled by: BCM Engineers, Inc. (Project No. 00-6018-03)

TABLE 1-3

SUMMARY OF 1983-1984 SAMPLING ACTIVITIES
ONSITE SOIL
SEALAND LIMITED RI
MT. PLEASANT, DELAWARE

Sample Date	Media Sampled/Locations	Parameters Analyzed	Compounds Detected	QA/QC Completed	Misc. Observations and Comments
10/83	Soils: Miscellaneous locations on site including spills, leaks, and stained soils	Acid Extractables, Base Neutrals:	Acenaphthene 0-290 mg/kg Acenaphthylene 0-920 mg/kg Anthracene 0-710 mg/kg Benzo(a) Anthracene 0-110 mg/kg Benzo(b) Fluoranthene 0-300 mg/kg Benzo(k) Fluoranthene 0-530 mg/kg Benzo(a) Pyrene 0-530 mg/kg Bis(2-Ethylhexyl) Phthalate ND Chrysene 0-380 mg/kg Fluoranthene 0-1,190 mg/kg Fluorene 0-960 mg/kg Naphthalene 0-1,820 mg/kg Phenanthrene 0-4,260 mg/kg Pyrene 0-2,080 mg/kg	Limited	- Samples collected by EPA Contractor. - Samples analyzed by EPA Central Regional Lab. - Source: EPA Files.
		PCBs:	None Detected		
		o-cresol:	None Detected		
		p-cresol:	0.30 - 162 mg/kg		
12/83	Soil: Miscellaneous locations on site	Phenol:	Range: 0.03 ug/g to 0.69 ug/g	Unknown	- Samples collected by EPA. - Samples analyzed by DNREC. - Source: EPA Files.
		Chromium:	Range: 3.8 ug/g to 53 ug/g		
		Lead:	Range: 13 ug/g to 960 ug/g		
		Nickel:	Range: 14 ug/g to 462 ug/g		
		Benzene:	Range: 0-0.017 ug/g		
		Toluene:	Range: 0-0.081 ug/g		
		Ethylbenzene:	Range: 0-0.14 ug/g		
		PCBs:	Range <1.0 to 21.8 ug/g		

TABLE 1-3 (Continued)

Sample Date	Media Sampled/Locations	Parameters Analyzed	Compounds Detected	QA/QC Completed	Misc. Observations and Comments
		Base Neutrals:	2-Chloronaphthalene 0-120 ug/g Acenaphthylene 0-46 ug/g Acenaphthene 0-1.4 ug/g 2,6-Dinitrotoluene 0-110 ug/g Fluorene 0-3.1 ug/g 2,4-Dinitrotoluene 0-52 ug/g Fluoranthene 0-6.4 ug/g Pyrene 0-13 ug/g Chrysene 0-6 ug/g Benzo(a) Anthracene 0-9.2 ug/g Benzo(b) Fluoranthene 0-8.9 ug/g Benzo(a) Pyrene 0-24 ug/g Naphthalene 0-62 mg/g		
		Acid Extractables:	o-xylene 0-0.45 ug/g m-xylene 0-0.54 ug/g p-xylene 0-0.2 ug/g		
4/84	Soils: 8 onsite soil samples	Phenols:	None Detected	Unknown	- Samples collected by EPA Contractor. - Samples analyzed by DNREC. - Source: EPA Files.
		Chromium:	Range: 18.82 ug/g - 33.52 ug/g		
		Lead:	Range: 17.11 ug/g - 203 ug/g		
		Nickel:	Range: 15.29 ug/g - 532.33 ug/g		
		"Halogenated Synthetic Compounds":	None Detected		
		Benzene:	Range: <0.01 ug/g - 0.35 ug/g		
		Toluene:	Range: <0.01 ug/g - 1.6 ug/g		
		Base Neutrals:	Acenaphthylene 43-59 ug/g Napthalene 67-79 ug/g Fluorene 25-41 ug/g Anthracene 20-58 ug/g Fluoranthene 20-35 ug/g Pyrene 49-96 ug/g Chrysene 30-45 ug/g Benzo(a) Anthracene 59 ug/g		

Compiled By: BCM Engineers Inc. (Project No. 00-6018-03)

1.2.1.1 Emergency Removal Action - Site Investigation

Additional sampling and analyses were conducted during the 1983/1984 EPA Emergency Removal Action. During December 1983, the waste materials were sampled and analyzed for hazardous waste characteristics; soils at the base of storage tanks and adjacent to the storage tank area were sampled and analyzed; monitoring wells were installed, and groundwater samples were obtained and analyzed. The additional Site investigation was conducted by and/or under the direct supervision of the EPA and the DNREC.

The waste characterization analysis indicated that the bulk of the materials onsite consisted of various flammable and combustible hazardous waste liquids. Two 55-gallon drums of PCB wastes and approximately 27 drums of creosote wastes were also identified and removed from the Site. Further investigation by the EPA indicated that the materials onsite consisted of waste No. 4 and No. 6 oil, off-spec creosote, coal tar, oil gas tar, and ink oil wastes.

Additional soil sampling was conducted to identify significantly contaminated soils which may have required immediate removal as part of the emergency response actions. Table 1-3 is a summary of these soil sampling activities. The analytical results indicated a wide range and concentrations of various base/neutral organic compounds. In addition, trace concentrations of volatile organic compounds (VOCs), phenols, chromium, lead, nickel, and PCBs were also detected.

A final round of soil samples was collected by the EPA contractor from the Site in April 1984. According to the OSC Report, these samples were obtained from areas within the tank farm which were to be clay capped. The purpose of this sampling was not stated in the OSC Report. Table 1-3 includes a summary of these sampling activities.

It should be noted that a formal report of soil sampling and extent of soil contamination was never developed as part of the Emergency Response Action. Though considerable sampling and analysis were conducted, the data were used primarily for qualitative evaluation of site conditions and waste disposal classification. Information regarding sampling depth, methodology of composite sample collection and quality assurance/quality control (QA/QC) criteria or standards were not documented and/or available.

1.2.2 Hydrogeologic Investigation

Several groundwater investigations were undertaken at the Site between 1983 and 1987. These investigations have been conducted by both DNREC and EPA and private consultants (R.E. Wright Associates, Inc. [REWAI]) on behalf of the Sealand Ltd. Potentially Responsible Parties (PRPs). Table 1-4 is a summary of the results of all groundwater sampling events conducted from 1983 through 1987. No groundwater sampling was conducted during 1988 or 1989.

TABLE 1-4

SUMMARY OF 1983-1987 SAMPLING ACTIVITIES
ONSITE MONITORING WELLS
SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Sample Date	Media Sampled/Locations(1)	Parameters Analyzed(2)	Compounds Detected(3)	QA/QC Completed	Misc. Observations and Comments
12/9/83	Groundwater: "MW-1" "MW-8"	Acid Extractables, Base Neutrals: Phenol: Chromium: Lead: Nickel:	None Detected MW-1 MW-8 0.09 ug/l 0.05 ug/l 17.2 ug/l 15.5 ug/l 33 ug/l 42 ug/l 17 ug/l 37 ug/l	Blanks included for inorganic analyses only.	- Samples collected by DNREC/EPA - Pre-emergency removal site conditions. - Sample/well locations not verified. - Source: EPA File Information
12/12/83	Groundwater "Onsite Well"	Acid Extractables, Base Neutrals: Metals: Halogenated Organics: Aromatic Organics:	None Detected None Detected None Detected None Detected	Blanks included	- Sample collected by DNREC. - Sample/well location is not verified. - Pre-emergency removal site conditions. - Source: EPA File Information
12/15/83	Groundwater: "DH-1" "MW-1" "MW-3" "MW-4" "MW-7" "MW-8" DUPMW-4"	Acid Extractables, Base Neutrals: Phenol: Range - <5-63 ug/l Chromium: Range - <100-3,930 ug/l Lead: Range - <100-1,240 ug/l Nickel: Range - <100-1,240 ug/l Toluene: Benzene:	None Detected None Detected None Detected	Unknown	- Samples collected by DNREC/EPA - Sample/well locations are not verified. - Pre-emergency removal site conditions. - Source: EPA File Information
5/16/84	Groundwater: "DH-1" "MW-8" "MW-5" "Dup of "MW-5" "Dup of "MW-1" "MW-3" "MW-4" "MW-7"	Acid Extractables, Base Neutrals: Selected Metals:	MW-5: 2 Chloronaphthalene: 17 ug/l Acenaphthalene: 16 ug/l Pyrene: 10 ug/l Detected in all samples: Chromium: Range - 40-70 ug/l Lead: <30 ug/l Nickel: <100 ug/l	Blanks Included	- Samples collected by DNREC/EPA - Sample/well locations not verified. - Post emergency removal site conditions. - Source: EPA File Information

TABLE 1-4 (Continued)

Sample Date	Media Sampled/Locations(1)	Parameters Analyzed(2)	Compounds Detected(3)		QA/QC Completed	Misc. Observations and Comments
6/19/84	Groundwater: "MW-2" "MW-2" Dup		MW-2	MW-2	No Blank	- Sample/well location not verified. - Sampled by DNREC. - Source: EPA File Information.
		Phenol:	16 ug/l	19 ug/l		
		Chromium:	48 ug/l	71 ug/l		
		Lead:	300 ug/l	560 ug/l		
		Nickel:	2,490 ug/l	3,360 ug/l		
		Acid Extractables, Base Neutrals:	None Detected			
		Benzene:	5.5 ug/l	3.7 ug/l		
		Toluene:	5.5 ug/l	3.8 ug/l		
3/27/86	Groundwater: Eight on site wells identified as "MW-1 through "MW-8"	Acid Extractables, Base Neutrals:	MW-6		Yes, field blanks and duplicates collected. Validated according to 1986 protocol.	- Samples collected by EPA Contractor (NUS Corporation). - Samples analyzed by EPA Contract Lab Program - Inorganic samples filtered in field; unfiltered samples also analyzed - MW-6 not locked prior to sampling; all other wells were locked - Samples collected for HRS documentation. - Source: EPA File Information.
		Naphthalene	39 ug/l			
		2 Methylnapthaline	30 ug/l			
		Acenaphthylene	11 ug/l			
		Phenanthrene	24 ug/l			
		Volatiles:	None Detected			
		Metals:	Fil(ug/l)	Unfil(ug/l)		
			Aluminum - ND	7,460-203,000		
			Arsenic - ND	50-55		
			Barium - 51-158	203-2,440		
			Beryllium - ND	33		
			Cadmium - ND	5-34		
			Calcium - 21,100-80,000	2,030-116,000		
			Chromium - ND	84-1,310		
			Cobalt - 27	42-605		
			Copper - ND	151-341		
			Iron - 3,860-8,560	12,200-813,000		
			Lead - ND	4.6-833		
			Manganese - 83-818	203-18,700		
			Magnesium - 4,210-14,300	4,210-28,100		
			Mercury - ND	0.54-1.54		
			Nickel 81-5,700	144-5,700		
			Potassium - 3,730-18,100	3,730-20,700		
			Sodium - 6,340-29,600	7,810-23,100		
			Vanadium - ND	148-1,800		
			Zinc - 152	146-2,050		
		Cyanide Not Reported	None Detected			

TABLE 1-4 (Continued)

Sample Date	Media Sampled/Locations(1)	Parameters Analyzed(2)	Compounds Detected(3)		QA/QC Completed	Misc. Observations and Comments
10/14/86	Groundwater: Eight on site wells identified as MW-1 through MW-8	Acid Extractables, Base Neutrals: (for selected onsite wells and home wells)	<u>MW-6</u>	<u>MW-6A</u>	Field blank collected; no duplicate samples; no data validation	- Samples collected by EPA Contractor (NUS Corporation) - Analyzed by EPA Central Contractor (NUS Corporation) - MW-6: Sample obtained from middle of well No. 6 - MW-6A: Sample obtained from bottom of well No. 6 - Inorganic samples filtered in field. Unfiltered samples also analyzed. - Source: EPA File Information.
		Naphthalene	19.6 ug/l	18.1 ug/l		
		Phenanthrene	26.6 ug/l	30.9 ug/l		
		Fluoranthene	17.5 ug/l	17.6 ug/l		
		Pyrene	26.8 ug/l	28.9 ug/l		
		Benzo(a)-anthracene	11.2 ug/l	10.7 ug/l		
		Benzo(a)-pyrene	11.7 ug/l	10.3 ug/l		
		2-Methyl-Naphthalene	18.4 ug/l	18.2 ug/l		
		Anthracene	ND	10.1 ug/l		
		Chlorides, TOC, Nitrates (all wells) Selected metals for wells MW-5, MW-8, MW-6, MW-7, MW-6A only	Range of Metals Detected: Chromium – all samples – <10 ug/l Copper – all samples – <25 ug/l Lead – all samples – <5 ug/l Nickel – <50 ug/l – 1,200 ug/l Zinc – <25 ug/l – 125 ug/l			
1/12/87	Groundwater: Eight on site wells identified as "MW-1" through "MW-8"	Base Neutrals:	None Detected		No data validation; not analyzed per CLP protocol	- Sampled and analyzed by private consultant. - Source: R.E. Wright Associates, Inc.
8/27/87	Groundwater: Eight on site wells identified as "MW-1" through "MW-8"	Base Neutrals: Volatile Organics: PCBs: Metals:	None Detected None Detected None Detected Nickel: 1.3 mg/l in MW-6 Zinc: Range: 0.02-0.23 mg/l		No data validation; not analyzed per CLP protocol	- Sampled and analyzed by private consultant. - Source: R.E. Wright Associates, Inc.

Notes:

1. Sample locations are based on information presented in sample reports as observed in available EPA Files. Monitoring well nomenclature varies from sampling event to sampling event for 1983 and 1984 sample dates.

2. Parameters analyzed are variable depending on sample data and sampling organization.

3. This column is included to provide qualitative information for general review. To determine specific levels of compounds detected, sample reports should be reviewed.

Compiled by: BCM Engineers Inc. (BCM Project No. 00-6018-03)

Available information indicates that two wells existed onsite prior to the 1983/1984 EPA Emergency Removal Action. During the removal action, the EPA contractor installed six additional onsite groundwater monitoring wells. Limited records exist, however, that provide information related to the well numbering or nomenclature systems used for those sampling events conducted in 1983 and 1984. For those sampling events conducted in 1986 and 1987, documentation regarding well location and well numbers are available.

During the 1983/1984 EPA Emergency Removal Action, selected wells were sampled over the course of five sampling dates. The data reported the presence of phenol, chromium, lead, nickel, and some base/neutral organic compounds in the groundwater beneath the Site. Toluene and benzene were also reportedly detected in the Site groundwater on one sampling event. However, field and laboratory QA/QC data for each sampling event were incomplete or unavailable.

In March 1986, NUS Corporation (NUS), under contract to EPA, collected groundwater samples from eight onsite monitoring wells and from four nearby domestic wells. The purpose of the NUS Site investigation was to develop support documentation for subsequent Hazard Ranking System (HRS) calculations for inclusion of the Site on the EPA National Priorities List (NPL). Results of that sampling indicated the presence of several PAHs in one onsite well. Potassium and manganese were also reportedly detected in a number of the samples. Results of the NUS study are found in the NUS Field Trip Report of March 1986 (NUS, 1986a).

A second round of sampling was conducted by NUS in October 1986 (NUS, 1986b). The analytical results indicated that nickel and several PAHs were present at elevated concentrations in the same onsite well as reported during the March 1986 sampling event.

In January 1987, under contract to certain Sealand PRPs, REWAI conducted a reconnaissance that included a visual inspection of the Site and surrounding area, measurement of groundwater levels in all existing onsite monitoring wells (MW-1 to MW-8) and nearby home wells and groundwater sampling for base/neutral organic compounds from onsite monitoring wells and selected nearby home wells. The results of this investigation, presented in REWAI, 1987b, reported no detectable levels of any base/neutral organic compounds.

In August and September 1987, REWAI conducted a second evaluation of the Site. This investigation entailed redevelopment of all onsite wells; collection of a second round of groundwater samples from all onsite wells, analysis of groundwater samples for heavy metals, PCBs, VOCs and base/neutral organic compounds; installation of seven new well points for additional water level monitoring; collection of a complete set of groundwater monitoring levels; and construction of a new groundwater contour map. Data generated by this investigation presented in REWAI, 1987a, indicated that no detectable levels of any base/neutral organic compounds were found in the groundwater on or offsite. In addition, no VOCs or polychlorinated biphenyls (PCBs) were detected in either onsite or offsite wells.

Concerns regarding the validity and usefulness of data collected from the above sampling events are as follows:

1. Field and laboratory QA/QC samples and/or standards were not collected, are inadequate, or information is not available for the majority of sampling events.

2. Lack of detailed documentation on purging of wells prior to sampling. It is suspected that some of the wells may not have been purged prior to sampling. Lack of purging can result in sampling of water which is not representative of aquifer conditions.

3. Problems with the well numbering system. Inconsistencies in sample identification and location indicate that the well numbering system may have been changed from one sampling event to the next. For example, MW-5, which is located immediately adjacent to the capped tank area, is listed as an upgradient well for one of the sampling events. MW-7 is also located incorrectly on several sampling location maps.

1.2.2.1 Offsite Groundwater Investigation

Table 1-5 is a summary of previous groundwater sampling of offsite wells located near the Site. All sampling to date has indicated that no base/neutral organic compounds have been detected in any offsite wells. Phenol, at low concentrations, was reportedly detected in two wells during a 1983 sampling event. However, these data are not usable for risk assessment purposes as CLP QA/QC protocol were not followed.

1.3 REMEDIAL INVESTIGATION OBJECTIVES

Sections 1.1.1 and 1.1.2 detailed that the Site had been used for the treatment and/or processing of coal tars and other similar materials referred to as No. 4 and No. 6 oil, oil gas tar, off-spec creosote, ink oil waste, and oil cuff (an oil and water mixture). The Site operators allegedly accepted the various materials, separated the water, and transferred the liquid materials by tank truck. An investigation of the Site conducted by the DNREC in 1983 concluded that the waste materials had leaked onto the ground surface.

TABLE 1-5

SUMMARY OF 1983-1987 SAMPLING ACTIVITIES
OFFSITE DOMESTIC WELLS
SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Sample Date	Media Sampled Locations(1)	Parameters Analyzed(2)	Compounds Detected(3)	QA/QC Completed	Misc. Observations and Comments
12/2/83	Groundwater: 5 private wells within 2,000 ft. offsite – "Loving", "Stewart", "Schafer," "Trailer Ct," "Townsend"	Base Neutrals, Acid Extractables Benzene, Toluene Cr, Pb, Ni Phenols:	None Detected None Detected None Detected Range <5 to 5 ug/l	Field Blanks included	– Samples collected by DNREC. – Level of QA/QC review is unknown. – Samples analyzed by DNREC. – Source: EPA File Information.
3/27/86	Groundwater: 4 Private Wells within 2,000 ft. offsite – "Trailer Park" "Loving," Townsend Shop", "Unknown"	Volatile Organic Compounds: Acid Extractables, Base Neutrals Metals: Cyanide:	None Detected(4) None Detected(4) Barium: Range – 52 ug/l to 55 ug/l Magnesium: Range – 2,040 ug/l to 6,390 ug/l Zinc: Range – 72 ug/l to 674 ug/l None Detected	Sampling event included collection of field blanks and duplicates; validated according to 1986 protocol	– Samples collected by EPA Contractor (NUS Corporation). – Samples analyzed by EPA Contract Labs. – Source: EPA File Information.
10/14/86	Groundwater: 4 Private Wells within 2,000 ft. offsite – "Schafer", "Stewart", "Townsend Shop" "Trailer Park"	Base Neutrals, Acid Extractables (Trailer Park well only) TOC, Chlorides ("Townsend", "Schafer" and "Stewart" wells) Cr, Cu, Pb, Ni, and Zn (Trailer Park well only)	None Detected TOC: Range 0 to 3.2 mg/l Chlorides: Range – 17 mg/l to 149 mg/l None Detected	Field Blank included	– Samples collected by EPA Con- – tractor. – Samples analyzed by EPA Central Regional Labs. – Source: EPA File Information.
1/1[illegible]87	Groundwater: One Private Well located approximately 400 ft. northwest of site	Base Neutrals, Acid Extractables	None Detected	Field Blank included	– Samples collected and analyzed by private consultant. – Source: R.E. Wright Associates, Inc.

Notes:

1. Sample locations are based on information presented in available sample reports as observed in available EPA Files.
2. Parameters analyzed are variable depending on sample data and sampling organization.
3. This column is included to provide qualitative information for general review. To determine specific levels of compounds detected, sample reports should be reviewed.
4. Compounds were detected at trace levels. However, QA/QC review of lab data indicated questionable analytical data.

Source: Compiled by BCM Engineers Inc. (BCM Project No. 00-6018-03)

As outlined in the approved Site Work Plan, a number of soil and groundwater sampling events have been conducted at the Site. A review of this data has resulted in questions concerning sample location, field and laboratory quality control and sampling methodology. Data which has been collected, analyzed and reported in a manner consistent with current EPA protocols conflicts with earlier data. Thus data generated during the RI will be used to characterize the soil and groundwater in the immediate vicinity of the Sealand site and assess the risks to public health and the environment. The specific sampling objectives of the Remedial Investigation as presented in the approved RI/FS Site Operations Plan were as follows:

1. A soil investigation will be conducted at the Site for the purpose of delineating the vertical and horizontal extent, if any, of residual soil contamination left in the former drum and storage tank area at the conclusion of the EPA Emergency Removal Action conducted during 1983 and 1984. The soil investigation will focus on volatile organic compounds (VOCs), semivolatile organics (semi-VOCs), metals, and PCBs.

2. The objectives of the RI hydrogeological investigation are to determine whether groundwater contamination exists at the Site from operations of Sealand, Ltd., and if so, whether the contaminants present in the groundwater have migrated offsite, and if they have impacted the drinking water supply or surface water quality in the vicinity of the Site. This investigation will also attempt to characterize the groundwater flow regime and estimate flow rates within the aquifer.

1.4 REMEDIAL INVESTIGATION REPORT ORGANIZATION

This RI report has been organized in a manner similar to the proposed format outlined in the October 1988 Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. Section 1.0 provides a description of the Site, its history, and previous investigations conducted by EPA, DNREC, or the Potentially Responsible Parties. Section 2.0, Remedial Investigation Methodology, details all field activities conducted as part of the RI. Section 3.0, Environmental Setting, summarizes the results of the RI as they relate to physical characteristics of the Site. All analytical data as a result of the RI sampling activities are presented and summarized in Section 4.0, Nature and Extent of Contamination. Section 5.0, Human Health and Environmental Risk Assessment, identifies any potential chemicals of concern and exposure pathways and presents the findings of the risk analysis. Section 6.0 presents the RI summary and conclusions. Recommendations for any additional investigative activities are outlined in Section 7.0.

2.0 REMEDIAL INVESTIGATION METHODOLOGY

2.1 SURFACE FEATURES

Surface features were investigated through visual Site inspections, analysis of topographic survey maps and available air photographs, and analysis of a topographic survey prepared by a registered surveyor. Figure 2-1 shows the topography of the Site.

Analysis of available maps and photographs indicates that the surface topography in the vicinity of the Site is generally flat with a very slight slope to the northeast. The Site itself has a more varied topographic expression due to the presence of the elevated mound (the clay cap), mounds of soil, and ditches present on the eastern and western edges of the Site.

2.2 AIR INVESTIGATION

Air sampling was not conducted at the Site as an individual task during the RI. Historical data indicated that contaminants likely to be released to the atmosphere were present onsite at relatively low concentrations. Previous soil sampling conducted at the Site by EPA/DNREC during the 1983/1984 Emergency Removal Action reportedly indicated the presence of benzene, toluene, and ethylbenzene at a maximum concentration of 1.6 milligrams per kilogram (mg/kg). In addition, base/neutral organic compounds, phenol, chromium, lead, nickel, and PCBs were detected in Site soils. However, contaminated Site soils were reportedly capped by the EPA during the Emergency Removal Action with 1 foot of clay, 6 inches of topsoil, and then vegetated.

Air monitoring was conducted as an integral part of all phases of the RI. Air monitoring was conducted primarily with a photoionization organic vapor detector (HNu). Air monitoring was also conducted during several tasks (e.g., drilling) with a flame ionization organic vapor analyzer (OVA) and a combustible gas indicator (CGI) which measures percent oxygen (O_2), lower explosive limits, and the concentration of H_2S in parts per million (ppm).

Air monitoring instrument readings are presented in the Test Boring Logs (Appendix I), Well Drilling Logs (Appendix II), and the BCM Field Services - Groundwater Sampling Field Data Sheets for the well development and well sampling events (Appendices III and IV, respectively).

EPA REGION III
SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOC ID 152789
PAGE # AR 300091

IMAGERY COVER SHEET
UNSCANNABLE ITEM

SITE NAME Sealand Limited

OPERABLE UNIT 00

ADMINISTRATIVE RECORDS- SECTION III **VOLUME**

REPORT OR DOCUMENT TITLE Final Remedial Investigation (RI) Report - Vol 1 of 2

DATE OF DOCUMENT 3/1/91

DESCRIPTON OF IMAGERY Topography Plan, Sealand Site

NUMBER AND TYPE OF IMAGERY ITEM(S) 1 Oversized Map

Although air monitoring instruments (OVA and HNu) did detect elevated levels of organic vapors in some soil samples and in one case within the confined space inside the hollow-stem augers no elevated instrument readings were noted in worker breathing zones. No elevated or unusual CGI readings were noted.

2.3 SURFACE WATER/SEDIMENT INVESTIGATION

The 2-acre Site may be topographically characterized as flat, with little natural slope. Vegetative growth is present over the Site surface except where structures or gravel roads are located. No visible signs of any surface water runoff routes are present.

A review of the United States Geological Survey (USGS) quadrangle that includes the Site (Saint Georges Quadrangle) indicates that Joy Run is the nearest surface water body to the Site. Joy Run, which discharges to the Chesapeake and Delaware (C&D) Canal, is located approximately 1,000 to 1,500 feet northeast of the Site (Figure 2-2).

Based on the Approved RI/FS Work Plan, no surface water or sediment sampling of Joy Run was conducted during the RI. This is due to the relatively flat Site topography, vegetative cover, and soil type. Because of these factors surface water runoff is minimal, if any. Furthermore, miscellaneous equipment and debris are located between the Sealand Ltd. Site and Joy Run, including abandoned tanks and numerous piles of excavated roadbed construction materials (i.e., asphalt, concrete, gravel).

In addition, a survey (Figure 2-1) of the site provides evidence that topographic high points between the Site and Joy Run inhibit overland flow from the Site toward Joy Run.

2.4 SOILS/SOURCE INVESTIGATION

A soil investigation was conducted at the Site for the purpose of delineating the vertical and horizontal extent of soil contamination left at the conclusion of the EPA Emergency Removal Action conducted during 1983 and 1984. As detailed in the Approved RI/FS Work Plan, the soil investigation consisted of collecting soil samples from nine locations within the former drum and storage tank area. Soil samples were also collected from four other Site locations for the purpose of collecting data to be used in the risk assessment. One additional surface soil sample was collected from a location adjacent to the east side of the concrete pad as requested by the EPA. In addition, split samples from four boring locations were retained for the EPA by their oversight contractor.

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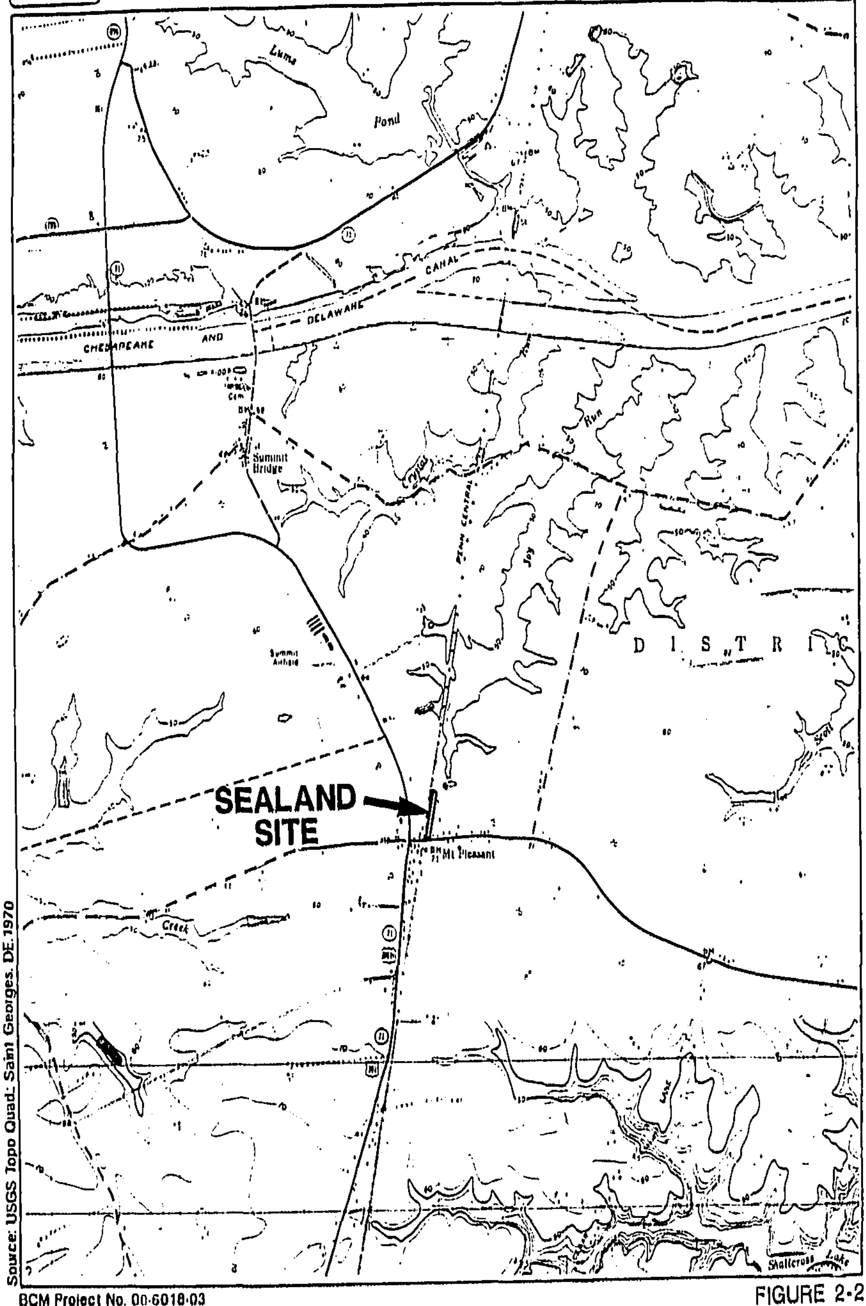
SEALAND LTD. SITE
Mt. Pleasant, DE.



Source: USGS Topo Quad: Saint Georges, DE 1970

BCM Project No. 00-6018-03

1" 3000 FT

NORTH

FIGURE 2-2
Surface Water Location Map
Sealand Site

Soil sampling, as proposed in the Work Plan, was conducted from March 20 through March 22, 1990. An additional soil sampling event was conducted on June 21, 1990, as requested by the EPA in a meeting on June 13, 1990.

Field activities were generally conducted in accordance with the Work Plan. However, some modifications to the Work Plan were necessary due to field conditions encountered during the investigation; these modifications are detailed in the following sections.

2.4.1 Sample Locations

Fourteen borings (S-01 through S-14) were located within the Site boundaries (Figure 2-3). Boring logs are contained in Appendix I.

The soil investigation was designed to characterize and delineate contaminants, if any, located in the unsaturated zone above the water table. Therefore, all soil samples submitted for laboratory analysis were collected at or above the water table. A description of the boring locations and the objective of drilling and sampling at these locations is provided below.

Boring Identification	Location Description	Objectives
S-01	South end of Site	Obtain background data for soil from hydraulically upgradient location
S-02	Between east side of building and abandoned railroad spur	Investigate shallow soils in vicinity of former fuel tanks
S-03 through S-11	Within former drum and aboveground storage tank area	Characterize and delineate contaminants in soil beneath the clay cap
S-12	North of cap and south of concrete pad	Investigate soil in vicinity of cap and impact by runoff from concrete pad
S-13	North end of concrete pad	Investigate soil impacted by concrete pad runoff
S-14	East side of concrete pad	Investigate soil impacted by runoff from concrete pad

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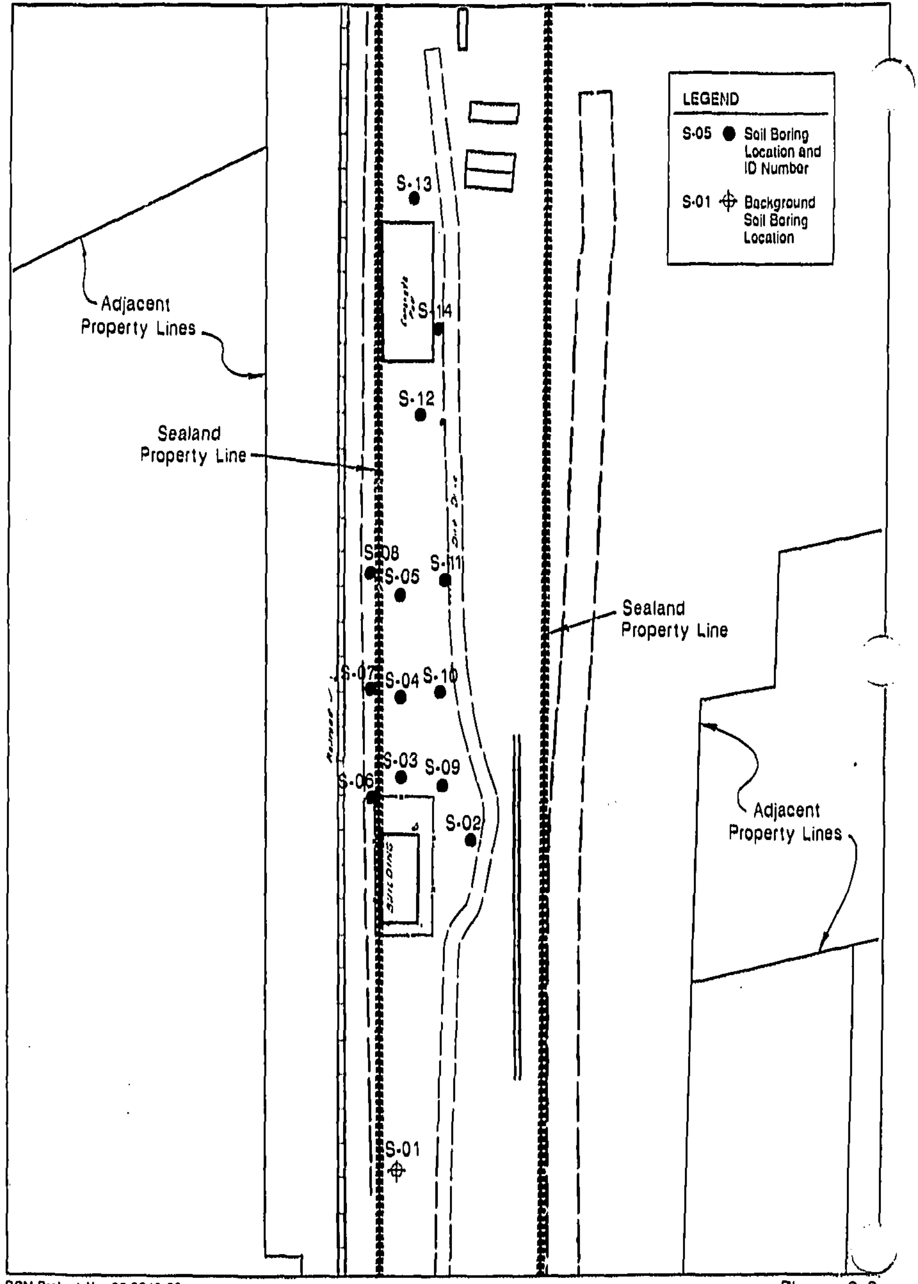

BCM Project No. 00-6018-03

Figure 2-3
Soil Boring Locations Map
Sealand Site

Continuous soil samples were collected from ground surface to the water table in borings S-01, S-02, S-12, and S-13. Two soil samples were collected and submitted for analysis from each of these borings. One sample was collected from 0 to 2 feet and another from 2 to 4 feet below ground surface (bgs) in each of these borings.

In borings S-03, S-04, S-05, S-06, S-08, S-09, S-10, and S-11 soil samples submitted for analysis were collected continuously from the bottom of the existing clay cap to the water table. One to two soil samples were collected from each of these borings. The clay cap extended to a maximum of 4.1 feet bgs and groundwater was generally encountered at approximately 4 to 6 feet bgs (Figure 2-4). Table 2-1 provides clay cap thickness data from each boring location. In soil boring S-07, groundwater was encountered at the bottom of the clay cap, and, therefore, no soil sample was collected for analysis.

In soil boring S-14, one soil sample was collected from 0 to 1 foot bgs as requested by the EPA. Table 2-2 provides a summary of the depth at which soil samples were collected for analysis in each boring.

2.4.2 Soil Sampling Methodology

2.4.2.1 Soil Samples

At soil sampling locations S-01 through S-13, soil borings were drilled using a truck-mounted drill rig and hollow-stem auger drilling techniques. Four-and-one-quarter-inch inside diameter (I.D.) hollow-stem augers were used to advance the borings, with 3-inch outside diameter (O.D.) by 1.5-foot long and 2-inch O.D. by 2-foot long high carbon steel split-barrel samplers used to collect the soil samples. All soils were visually classified in the field by the onsite geologist.

At soil sampling location S-14, soil boring and sampling was conducted with a hand-auger. Soil samples collected for chemical analysis from borings S-01 through S-13 were obtained in accordance with the following procedure. The split-barrel sampling device sampled the selected interval and was withdrawn to the surface and opened. Upon opening the split-barrel sampler, the Site geologist split the sample perpendicular to its total length and monitored soil pore space vapors with either an OVA or an HNu. The soil sample was then logged by the geologist and placed into the appropriately labeled and laboratory-prepared sample container. Two to 3 inches of soil at the upper end of the split-barrel sampler was discarded for proper disposal. Soil to be analyzed for volatile organic compounds was containerized first, as soon after opening the split-barrel as possible. The volatile samples from the 0- to 2-foot sample intervals were collected from the 18- to 24-inch depth interval. The remaining soil from the split-barrel was put into a stainless steel bowl and homogenized with a stainless steel hand-trowel prior to being placed in the sample containers.

SEALAND LTD. SITE
Mt. Pleasant, DE

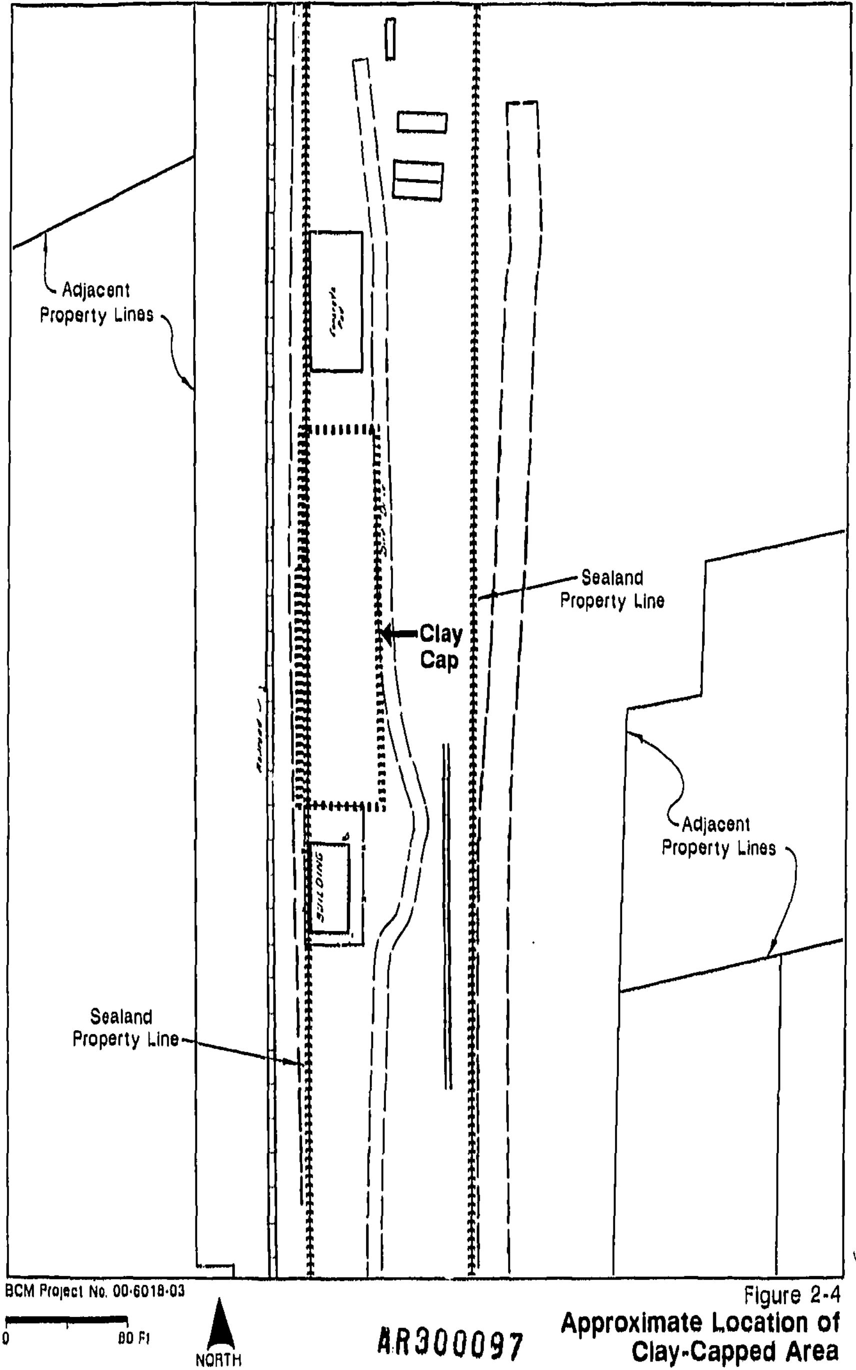

Figure 2-4
Approximate Location of Clay-Capped Area Sealand Site

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TABLE 2-1

CLAY CAP THICKNESS
SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Boring I.D.	Thickness Top Soil (ft)	Thickness Clay (ft)	Thickness of Cap (ft)
S-03	0-Trace	2	2
S-04	0.5	1.8	2.3
S-05	0.3	1.6	1.9
S-06	0.4	2.6	3.0
S-07	0.3	3.8	4.1
S-08	0.3	3.3	3.6
S-09	0.3	0.4	0.7
S-10	0-Trace	1.5	1.5
S-11	0.2	0.9	1.1

Source: BCM Engineers Inc. (BCM Project No. 00-6018-03)

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TABLE 2-2

SOIL SAMPLE DEPTH INTERVALS
SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Soil Boring Number	Sample Depth (feet)
S-01	0-2
	2-4
S-02	0-2
	2-4
S-03	2-3
	3.5-5.5
S-04	2.6-4.6
	4.6-6.0
S-05	3.4-5.2
S-06	3-4
S-07	No Sample
S-08	3.7-4
S-09	0-1.6
	2.5-4.2
S-10	2.5-4.5
	1-2
S-11	2-4
S-12	0-2
	2-4
S-13	0-2
	2-4
S-14	0-1

Source: BCM Engineers Inc. (BCM Project No. 00-6018-03)

Soil collected for analysis from boring S-14 was removed from the hand-auger with a stainless steel hand-trowel and placed into a stainless steel mixing bowl and homogenized with the hand-trowel. The sample was then placed into the appropriate laboratory-prepared sample containers. An HNu was used to scan the interior of the 1-foot deep boring. All HNu and OVA readings are provided on the boring logs.

Soil borings S-01 through S-13 were pressure-grouted to ground surface using a tremie hose and a 95-percent neat cement/5-percent bentonite grout. Soil boring S-14 was backfilled with hand-auger cuttings and nearby surface soil.

2.4.2.2 Field Quality Control Samples

Field rinsate blanks, trip blanks, and field duplicate samples were submitted for chemical analyses with the soil samples in accordance with the protocol detailed in Section 9.2 of the Quality Assurance Project Plan (QAPjP).

2.4.3 Soil Sample Designation

Soil sample designations were made according to the following scheme, S-XX-XX-S. The letter S denotes the "Sealand" Site. The first set of Xs denotes the boring number, with borings numbered sequentially 01 through 14. The second set of Xs denotes the depth interval from which the sample was collected. The final S indicates a soil matrix. Each sample, when logged into the analytical laboratory, was also assigned a laboratory identification number. The QAPjP outlines this procedure.

2.4.4 Analytical Parameters

Twenty-four soil samples were submitted for laboratory analysis. Of these 24 soil samples, three were field duplicate samples. All soil samples, except sample S-14-(0-1)-S, were analyzed for the following:

- TCL volatile organic analysis plus 10 tentatively identified compounds
- TCL semivolatile organic analysis plus 20 tentatively identified compounds
- TCL pesticides
- TCL PCBs
- TAL metals
- Total petroleum hydrocarbons

In addition, soil samples S-01-(2-4)-S and S-05-(3.4-5.2)-S were analyzed for total organic carbon (TOC).

Soil sample S-14-(0-1)-S was analyzed for the following:

- TCL semivolatile organic analysis plus 20 tentatively identified compounds
- TAL metals
- TOC
- Total petroleum hydrocarbons

All samples were submitted to and analyzed by Compuchem Laboratories located in Research Triangle Park, North Carolina. Compuchem is a laboratory participating in the EPA Contract Laboratory Program (CLP). Analyses were performed in accordance with the procedures contained in the Work Plan and QAPjP.

2.5 GROUNDWATER INVESTIGATION

The groundwater investigation included the evaluation of all existing onsite monitoring wells, installation of four new monitoring wells, installation of three new well points, and sampling and analysis of groundwater from eight onsite monitoring wells and four offsite residential wells. In addition, a 24-hour water level monitoring program was conducted.

2.5.1 Monitoring Well Designations

Well identification numbers (e.g., MW-10 or MW-7N) consist of two to three components. The first component ("MW") designates a monitoring well. The second component is a number from 1 through 10 indicating the location designation of the well. The third component ("N") which only appears in well identification numbers MW-7N and MW-8N identifies the well as a new replacement well for a well installed during an earlier investigation program.

2.5.2 Existing Well Evaluation

The well evaluation was conducted on December 15, 1989. Figure 2-5 details the location of all onsite monitoring wells. The existing eight onsite monitoring wells were evaluated for the purpose of reuse in water quality sampling and water level measurements. Each well was investigated to determine its completed depth and to check for obstructions, floating product, sediment buildup, and damage. A water/product interface probe was first lowered into the well to test for the presence

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Mt. Pleasant, DE

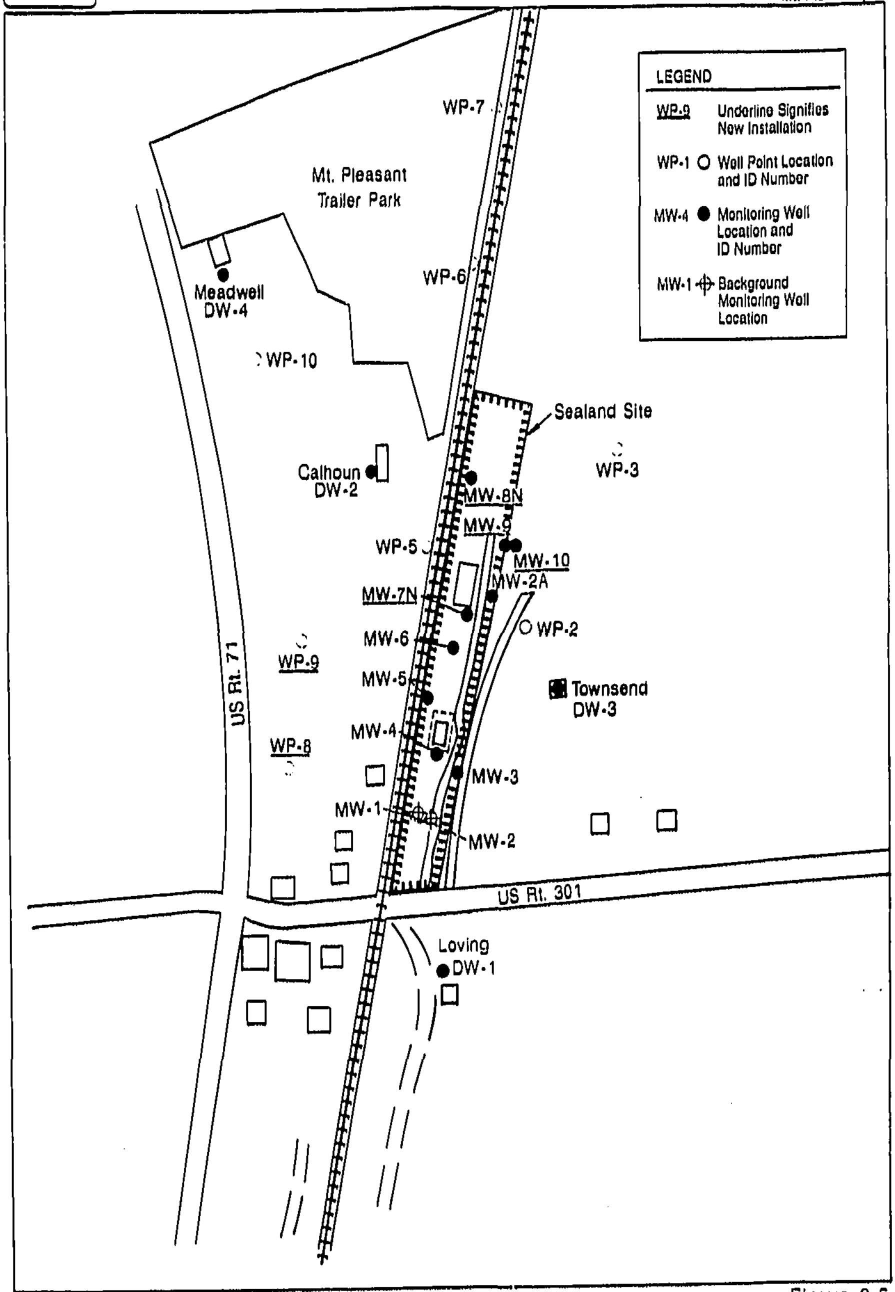

Figure 2-5
Monitoring Well and Well Point Location Map-Sealand Site

of floating product. A depth-to-groundwater measurement was then made with a depth-to-water meter. Checking for obstructions was conducted by first lowering a depth-to-water probe to the bottom of the well and then by inserting a cylindrical object (hand-auger bucket), slightly smaller than the diameter of the well and attached to steel rod, into the well. Finally, the total depth of each well was determined by lowering a depth-to-water probe to the bottom of the well. The results of the well evaluation are presented in Table 2-3.

Monitoring well MW-7 could not be found at the location described in reports on earlier Site investigations. However, several recently deposited soil piles were present in the vicinity of the reported location of well MW-7 and on March 19, 1990, a backhoe was used to move these piles to determine if the well had been buried. No well was uncovered. One well labeled as 2A on the well casing was discovered approximately 100 feet northeast of the reported location of MW-7 during the well evaluation but does not appear on any of the earlier Site investigation report maps, and BCM suspects that this well may in fact be well MW-7.

Monitoring well MW-8 had been badly damaged. The lock had been removed, the protective steel casing had been knocked loose, the PVC well casing had been broken off at ground surface, and debris had been inserted in the well causing a blockage at approximately 2 feet bgs.

Many of the existing wells contained several inches to several feet of sediment inside the well screen.

Based on the well evaluation data, a decision was made to abandon well MW-8 and replace wells MW-7 and MW-8 with new wells designated as MW-7N and MW-8N, respectively.

All other existing onsite wells were deemed usable for water level monitoring and groundwater sampling following redevelopment.

2.5.3 Domestic Well Survey

In attempting to gain access to and acquire data on nearby domestic wells, access agreements were obtained from several residences surrounding the Site. Several property owners were contacted in early to mid-March 1990. On March 19, 23, 28, and 30, 1990, BCM personnel visited residences surrounding the Site in order to gain access to and gather information on the domestic wells and to obtain permission to install four well points on properties to the west of the Site. Access to four domestic wells was eventually obtained. The four wells are shown on Figure 2-5 and are identified as the Loving, Calhoun, Townsend, and Meadwell wells, DW1, DW2, DW3 and DW4, respectively.

The owner of the trailer park located to the north of the Site would not allow access to wells that supply the trailer park with water.

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TABLE 2-3

WELL EVALUATION DATA
SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Well Number	Total Depth from Top of PVC (feet)	Depth to Water from Top of PVC (feet)	OVA Reading (ppm)	Floating Product
MW-1	89.85	3.99	ND	ND
MW-2	28.39	3.78	ND	ND
MW-3	18.11	4.77	ND	ND
MW-4	14.61	3.79	ND	ND
MW-5	12.70	4.48	ND	ND
MW-6	21.93	6.60	ND	ND
MW-7	--- Does Not Exist ---			
MW-2A	17.03	5.89	NT	NT
MW-8	Could not be determined due to blockage	NT	ND	Could not be determined

ND - None Detected
NT - Not Tested

Evaluation survey conducted on December 15, 1989.

Source: BCM Engineers Inc. (BCM Project No. 00-6018-03)

Permission to install well points was obtained from only two property owners with land located in areas deemed appropriate for well points. Based on these conditions, only three of the four well points proposed in the Work Plan were installed. Approval for installing only three well points was granted by the EPA.

2.5.4 Monitoring Well Installation

Four onsite groundwater monitoring wells were installed as part of the remedial investigation (Figure 2-5). The wells were installed to fill potential groundwater quality data gaps along the downgradient side of onsite areas of environmental concern.

Well MW-7N was installed immediately adjacent to the north end (downgradient) of the clay capped area. Well MW-8N was installed adjacent to damaged well MW-8 near the northwest corner of the Site and wells MW-9 and MW-10 were installed as a two-well cluster (shallow and deep wells) near the northeast corner of the Site and downgradient of storage tank and drum storage areas. Well MW-10 was installed to test a deeper portion of the aquifer and to provide data that could be compared to data gathered from the upgradient deep well MW-1. Upgradient wells MW-1 and MW-2 represent background groundwater quality. Well installation was conducted from March 26 through March 29, 1990.

The number and location of all new monitoring wells were approved by the EPA.

2.5.4.1 Monitoring Well Construction

Monitoring well borings were drilled with a truck-mounted drill rig utilizing 4.25-inch I.D. hollow-stem augers. The auger center plug and drag bit were used at all times during auger drilling. Split-barrel soil samples were collected at 5-foot intervals. Immediately upon opening the split-barrel, each soil sample was scanned with an HNu and the soil lithology logged. Soil lithology was also interpreted from auger cuttings. Well drilling logs are presented in Appendix II.

The boring for deep monitoring well MW-10 was drilled through the Columbia Formation and the Mount Laurel Formation to the top of the Marshalltown Formation. The Marshalltown Formation was encountered at a depth of approximately 93 feet bgs. The total depth of the boring was 96 feet bgs.

As outlined in the Work Plan, one soil sample, labeled MW-10 (69-71), was collected from the lower section of the Mount Laurel Formation (69 to 71 feet bgs) and analyzed for the following physical soil parameters:

- Water content
- Liquid and plastic limits

- Specific gravity
- Grain size distribution
- Coefficient of permeability

The analytical work was conducted by Woodward-Clyde Consultants located in Plymouth Meeting, Pennsylvania. Results from the testing for each of the above parameters is presented in Appendix V.

Because no clay layers were encountered in the boring, no thin-walled tube (shelby tube) sampling was conducted.

To satisfy the objective of setting the well screen in a productive zone of the lower Mount Laurel Formation, the 96-foot deep boring was plugged back to a depth of 84.3 feet bgs with Hole Plug bentonite. The use of Hole Plug bentonite was approved by the EPA. The screened interval in well MW-10 is from 69 to 84 feet bgs.

Shallow wells MW-7N, MW-8N, and MW-9 were drilled to approximately 11 to 14 feet below the water table (a total depth of 18.5 to 19.0 feet bgs).

The 15 feet of well screen installed in all three shallow wells straddled the water table, with 1.5 to 4.0 feet of screen extending above the water table.

All monitoring wells were constructed with 2-inch I.D., Schedule 40, PVC casing and factory-slotted screen connected by flush-joint, threaded couplings. Figure 2-6 is a schematic of the well construction details. Table 2-4 provides monitoring well and well point construction details. All well screens were 15 feet in length with a slot size of 0.01-inch. Threaded PVC bottom plugs were used to seal the bottoms of the screens.

The annular space between the PVC screen and boring wall was packed to at least 6 inches above the well screen with a Jessie Morie No. 0 uniformly-graded, clean, silica sand. Bringing the sand pack up to 2 to 3 feet above the well screen as proposed in the Work Plan was not possible in the shallow wells because of the shallow depth to groundwater.

A pelletal bentonite seal was placed on top of the sand pack. Because the bentonite seal extended above the water table in the shallow wells, 5 gallons of potable water was poured over the seal to swell the bentonite. After a 5- to 10-minute wait, a 95-percent (by weight) neat cement/5-percent granular bentonite grout was pressure-tremied to ground surface.

A locking steel protective casing was inserted into the grouted annulus to a minimum of 2 feet bgs. Inserting the steel casings deeper than 2 feet bgs was not possible in the shallow wells because of the shallow depth to groundwater.

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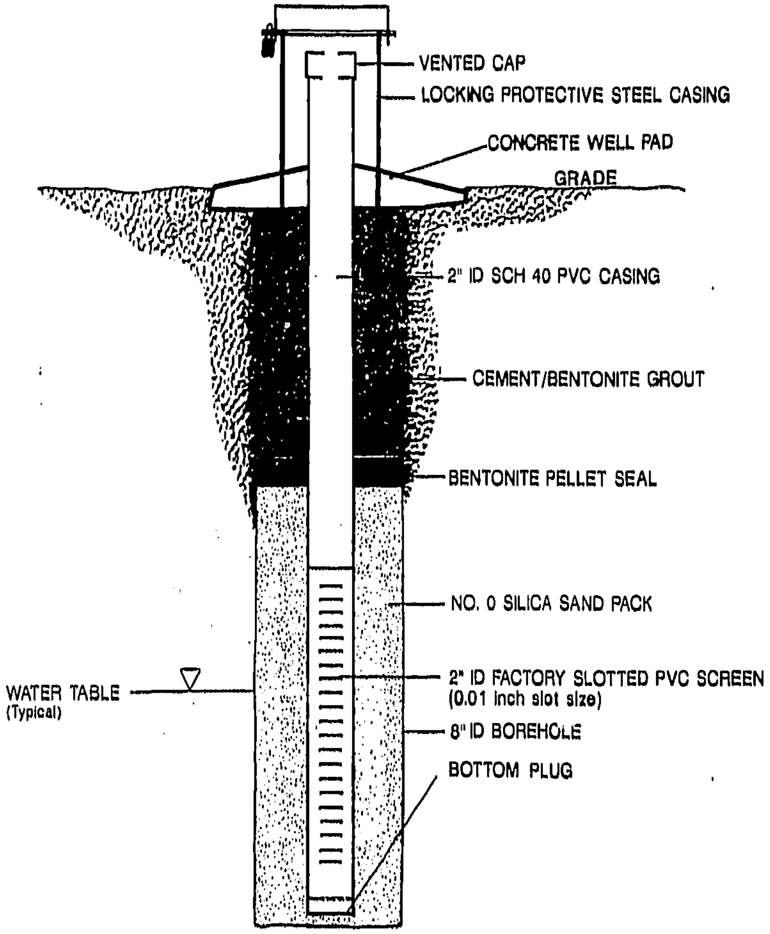

NOT TO SCALE

BCM Project No. 00-6018-03

Figure 2-6
New Monitoring Well Construction Diagram Sealand Site

TABLE 2-4

MONITORING WELL AND WELL POINT CONSTRUCTION DETAILS
SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Well I.D.	Screened Interval (ft, bgs)	Total Depth (Top PVC) (ft, bgs)	Top PVC Elevation (ft, AMSL)	Ground Elevation (ft, AMSL)	Inside Diameter (inches)	Date Installed
MW-1	N/A	89.85	67.67	66.54	4	12/8/87
MW-2	N/A	28.39	67.65	66.54	2	N/A
MW-2A**	5.0-20.0	17.03	N/A	N/A	2	12/6/83
MW-3	5.0-20.0	18.11*	68.39	67.74	2	12/12/83
MW-4	5.0-20.0	14.61*	67.35	66.64	2	12/13/83
MW-5	N/A	12.70	67.64	66.64	2	N/A
MW-6	N/A	21.93	68.87	67.88	2	N/A
MW-7N	3.5-18.5	18.5	68.68	66.18	2	3/29/90
MW-8N	3.0-18.0	18.0	66.42	64.08	2	3/28/90
MW-9	3.0-18.0	18.0	69.48	66.39	2	3/28/90
MW-10	69.0-84.0	84.0	67.71	66.79	2	3/27/90
WP-2	0.6-10.9	11.6	67.62	65.38	2	9/1/83
WP-3	1.3-6.3	7.2	59.73	58.49	2	9/1/83
WP-5	0.8-11.1	11.9	66.93	64.49	2	9/1/83
WP-6	2.1-12.4	12.9	62.68	62.04	2	9/1/83
WP-7	1.9-12.2	13.1	60.04	59.66	2	9/1/83
WP-8	6.0-11.0	11.0	72.78	N/A	2	3/23/90
WP-9	6.2-11.2	11.2	72.42	72.40	2	3/23/90
WP-10	9.5-14.5	14.5	72.31	70.85	2	3/29/90

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* Total depth less than bottom of screened interval due to silt build-up.
** Thought to be original MW-7: well construction specification from MW-7 used.

N/A: Data not available

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An approximately 2-foot square, pre-mixed concrete well pad was constructed around each steel well casing. The top of the PVC well casing was covered with a vented PVC slip cap.

All soil cuttings from the soil boring program and from the well drilling program were containerized in labeled 55-gallon steel drums and sealed. All drums of soil cuttings were staged together on the existing concrete pad.

2.5.4.2 Monitoring Well Development

All monitoring wells from which groundwater samples were collected for laboratory analysis (MW-1, -2, -5, -6, -7N, -8N, -9, and -10) were developed with a centrifugal (suction) pump. All wells were developed for a maximum of 1 hour or until sediment free flow was obtained.

Data collected from each well during well development included the following:

- Depth to groundwater
- OVA readings
- Total well depth
- Well diameter
- Volume of groundwater within well
- Length of development
- Volume of water purged from well
- pH
- Specific conductivity
- Groundwater temperature
- Visual description of purged water
- Well yield
- Weather conditions

All data are provided in the Well Development Field Data sheets contained in Appendix III.

All development water was discharged into labeled 55-gallon steel drums and sealed. All drums of development water were left at each well location until analytical results of groundwater sampling had been received and validated.

All tubing used in well development was 1-inch I.D. polyethylene. All downhole (suction) tubing was dedicated to each well and used only once during the RI. After use, all tubing was staged and covered with plastic sheeting on the existing concrete pad.

2.5.4.3 Monitoring Well Abandonment

Old (damaged) monitoring well MW-8 was closed in accordance with State of Delaware regulations. The old PVC well casing and screen could not be removed. A blockage at approximately 3 feet bgs within the well, caused by either bridged debris or the well's being filled with debris, prevented the insertion of tools into the well to open the bottom of the well screen. Therefore, the PVC riser was cut off below ground surface and the open section of the well filled with a 95-percent neat cement/ 5-percent bentonite grout.

2.5.5 Well Point Designations

Well point identification numbers (e.g., WP-8) consist of two components. The first component ("WP") designates a well point. The second component is a number from 2 through 10 indicating the location designation of the well.

2.5.5.1 Well Point Installation

Three new offsite well points (WP-8, WP-9, and WP-10) for water level measurements were installed on March 23 and 29, 1990 (Figure 2-5). Well point location was approved prior to installation by EPA. The well points were installed to obtain data on water table characteristics (e.g., water table elevations and water table reaction to domestic pumping) to the west of the Site for the purpose of constructing groundwater contour maps.

Well points WP-1 through WP-7 were installed by REWAI in 1987. Of these seven well points, well points WP-1 and WP-4 could not be found by BCM and are assumed to have been destroyed.

The protective covers and upper sections of the PVC casings were broken off of well points WP-6 and WP-7, and well point WP-6 appears to have been partially filled with debris.

2.5.5.2 Well Point Construction

Well point borings were drilled with a truck-mounted drill rig utilizing 4.25-inch I.D. hollow-stem augers. The auger center plug and drag bit were used at all times during auger drilling. Split-barrel soil sampling was not conducted. Soil lithology was interpreted from the drill cuttings. Well drilling logs are provided in Appendix II.

Each well point is constructed of 2-inch I.D., Schedule 40, PVC riser attached to a 5-foot long continuous slot, 0.01-inch slot, Schedule 40, stainless steel well point. The well screens were installed with approximately 1 foot of screen above the water table and 4 feet of screen below the water table. The bottom of each well screen was sealed with a threaded PVC bottom cap. The top of each PVC riser was covered with a vented PVC slip cap.

A Jessie Morie No. 0 uniformly graded clean silica sand was packed into the annular space between the well screen and riser, and the boring wall to a minimum of approximately 3.5 feet above the well screen and a minimum of 6 inches below the well screen. In well point WP-10, a pelletal bentonite seal was installed above the sand pack. No bentonite seal was installed in well points WP-8 or WP-9.

A locking steel protective casing was inserted to a minimum of 2.5 feet bgs at each well point and cemented in place with a pre-mix concrete. An approximately 2-foot square well pad was constructed around each steel protective casing with pre-mix concrete.

New keyed-alike locks were installed on all new and previously installed monitoring wells and well points with the exception of damaged well points WP-6 and WP-7.

State of Delaware well permit tags were attached to the protective steel casings on all newly installed monitoring wells and well points.

2.5.6 Domestic Well Designations

As depicted on Figure 2-5, the domestic wells were designated as follows:

Loving property	DW-1
Calhoun property	DW-2
Townsend property	DW-3
Meadwell property	DW-4

The prefix DW stands for domestic well.

2.5.7 Groundwater Sampling

Groundwater samples were collected for laboratory analysis from four residential wells on April 25, 1990, and from eight onsite monitoring wells on April 26 and 27, 1990. A groundwater sample summary, including well I.D., sample I.D., and analyses performed is presented in Table 2-5.

Several minor modifications were made to the groundwater sampling protocol as presented in the QAPjP and Section 5.2.7 of the Field Sampling Plan (FSP). A detailed description of the modifications is presented in Section 4.0 of the Field Audit Report dated May 1990. The field audit was conducted on April 25 and 26, 1990, for the purpose of evaluating whether field personnel were complying with the sampling procedures specified in the approved QAPjP and FSP.

2.5.7.1 Sampling Locations

Groundwater samples were collected from four offsite domestic wells (DW-1, -2, -3, and -4), two onsite deep wells (MW-1 and MW-10), and six onsite shallow wells (MW-2, -5, -6, -7N, -8N, and -9). In addition,

TABLE 2-5

GROUNDWATER SAMPLING SUMMARY
SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Well I.D.	Sample I.D.	Analytical Parameters
DW-1	S-DW1-01	TAL metals + cyanide minus mercury (dissolved), TCL SVOC+20, TDS, TCL VOC+10, TAL metals + cyanide (total), TSS
DW-2	S-DW2-01	TAL metals + cyanide minus mercury (dissolved), TCL SVOC+20, TDS, TCL VOC+10, TAL metals + cyanide (total), TSS
DW-3	S-DW3-01 S-DW33-01*	TAL metals + cyanide minus mercury (dissolved), TCL SVOC+20, TDS, TCL VOC+10, TAL metals + cyanide (total), TSS
DW-4	S-DW4-01	TAL metals + cyanide minus mercury (dissolved), TCL SVOC+20, TDS, TCL VOC+10, TAL metals + cyanide (total), TSS
MW-1	S-01-01	TAL metals + cyanide minus mercury (dissolved), TCL SVOC+20, TDS, TCL VOC+10, TAL metals + cyanide (total), TSS
MW-2	S-02-01 S-22-01*	TAL metals + cyanide minus mercury (dissolved), TCL SVOC+20, TDS, TCL VOC+10, TAL metals + cyanide (total), TSS
MW-5	S-05-01	TAL metals + cyanide minus mercury (dissolved), TCL SVOC+20, TDS, TSS
MW-6	S-06-01	TAL metals + cyanide minus mercury (dissolved), TCL SVOC+20, TDS, TCL VOC+10, TAL metals + cyanide (total), TSS
MW-7N	S-07N-01	TAL metals + cyanide minus mercury (dissolved), TCL SVOC+20, TDS, TCL VOC+10, TAL metals + cyanide (total), TSS
MW-8N	S-08N-01	TAL metals + cyanide minus mercury (dissolved), TCL SVOC+20, TDS, TSS
MW-9	S-09-01	TAL metals + cyanide minus mercury (dissolved), TCL SVOC+20, TDS, TCL VOC+10, TAL metals + cyanide (total), TSS
MW-10	S-10-01	TAL metals + cyanide minus mercury (dissolved), TCL SVOC+20, TDS, TCL VOC+10, TAL metals + cyanide (total), TSS

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* Duplicate of previous sample. Same analytical parameters.

Compiled By: BCM Engineers Inc. (BCM Project No. 00-6018-03)

field duplicate samples were collected from wells DW-3 and MW-2. Split samples were obtained by Dynamac personnel for the EPA from wells MW-5, MW-6, MW-7N, and MW-8N.

These sampling locations were selected to provide groundwater quality data in areas located both hydraulically upgradient and downgradient of the Site, from shallow and deep aquifer zones, and from sources of residential water surrounding the Site. A description of the well locations and the objective of sampling at these locations is provided below.

Well Identification	Location Description	Objectives
MW-1	Deep well, south of former tank area shallow well, south of former tank area	Characterize deeper zone of aquifer; background conditions
MW-2	Shallow well, south of former tank area	Characterize shallow zone of aquifer; background conditions
MW-5	Shallow well, southwest corner of former tank area	Characterize shallow upgradient groundwater
MW-6	Shallow well, immediately north of former tank area	Characterize shallow downgradient groundwater
MW-7N	Shallow well, immediately south of concrete pad	Characterize shallow groundwater upgradient of pad
MW-8N	Shallow well, north of concrete pad	Characterize shallow downgradient groundwater
MW-9	Shallow well, northeast of former tank area	Characterize shallow downgradient groundwater
MW-10	Deep well, northeast of former tank area	Characterize deeper zone of aquifer downgradient of site
DW-1	Deep well, upgradient (south) of site	Upgradient domestic well
DW-2	Domestic well, west of site	Sidegradient domestic well

Well Identification	Location Description	Objectives
DW-3	Domestic well, east of site	Sidegradient domestic well
DW-4	Domestic well, northwest of site	Sidegradient domestic well near trailer park

2.5.7.2 Sampling Protocol

Following a 2-week stabilization period after the well development was completed, groundwater samples were collected from the four newly-installed wells, the four existing monitoring wells, and the four domestic wells.

Prior to collecting the groundwater samples, the static water level in each well was measured. The volume of standing water contained in each well was then calculated. A minimum of approximately three times the volume of water contained in the well was purged from the onsite wells with a gasoline-powered suction pump. During pumping, the dedicated polyethylene suction hose inlet was kept near the top of the water column.

Monitoring well MW-5 was pumped dry after purging approximately 12 well volumes of water. Care was taken not to disturb sediment at the bottom of the well. This and all other wells were allowed to recharge to at least 80 percent of total well volume prior to sample collection.

Purging of the selected offsite domestic water wells was conducted by running water from the tap for a minimum of 15 minutes. All domestic well purge water was discharged to the ground surface. All purge water from onsite wells was discharged to labeled 55-gallon steel drums that were sealed and left at each well location. Field data collected during the purging of the sampled wells was recorded on the groundwater sampling field data sheets provided as Appendix IV. Data recorded includes the following:

- Sample and/or well I.D.
- Depth to groundwater
- Total depth of well
- Well diameter
- Well volume
- Date and time of purging
- Volume purged
- Method of purging
- Groundwater pH
- Groundwater conductivity
- Groundwater temperature
- Method of sampling
- HNu and/or OVA readings
- Visual description of purged water
- Site weather conditions

All groundwater samples were collected from the onsite wells using dedicated Teflon-coated stainless steel bailer rope, and dedicated laboratory-cleaned and foil wrapped, 1-inch I.D. bottom fill Teflon bailers.

Groundwater samples collected for analysis from domestic wells were collected directly from the water tap with the appropriate laboratory-prepared sample jars.

Samples to be analyzed for dissolved inorganics were filtered in the field with a compressed nitrogen pressure filtering unit utilizing a fiber pre-filter and a final 0.45-micron filter.

All required sample preservatives were added to the samples immediately following sample collection. All samples were immediately placed into a chilled environment for overnight shipment (Federal Express) to Compuchem Laboratories. Proper chain-of-custody documentation was maintained at all times.

2.5.7.3 Field Quality Control Samples

Field rinsate blanks, trip blanks, and field duplicate samples were retained and submitted for analyses in accordance with the procedures detailed in Section 9.2 of the QAPjP.

2.5.8 Well Elevation Survey

A survey to determine the horizontal location and vertical reference elevations of the new and existing onsite monitoring wells and new and existing well points was conducted by J.G. Park Associates, Inc. (J.G. Park) of Washington Crossing, Pennsylvania. The survey was performed on June 12 and 13, 1990. Results of the survey are presented in Table 2-4.

In addition to locating the monitoring wells and well points, J.G. Park delineated Site topography. A topographic contour map, with 1-foot topographic contours, was provided. J.G. Park also surveyed the existing onsite buildings, fences, roads, utilities, railroad tracks, and the location of Route 301 (Churchtown Road). These locations have been incorporated into the Site map. The topographical survey is provided as Figure 2-1.

2.5.9 Water Level Monitoring

Two rounds of water level measurements were taken as described in Section 4.3.5 of the Work Plan and Section 5.2.6 of the Field Sampling Plan. Water level measurements were made on April 25, 1990, and August 3 and 4, 1990. In addition, water level measurements were collected from existing onsite monitoring wells during the well evaluation on December 15, 1989. A summary of water level measurement procedures is outlined below:

- The well cap was opened and well head organic vapor readings were recorded using an HNu and/or OVA.

- Depth-to-water measurements were recorded from the top of the inner casing (or from the top of the outer casing if only one casing was present) using an electronic water level indicator.

- As the probe and cable of the electronic water level recording instrument were removed from the well, they were rinsed with deionized water to prevent cross contamination between the wells.

- All data was recorded on groundwater sampling field data sheets or in a bound field notebook.

Water level measurements were collected for all wells and well points at 1-hour intervals during the August 3 and 4, 1990, water level monitoring program. Water level monitoring was conducted over a 24-hour period of consistent weather conditions for the purpose of evaluating water level fluctuations, if any, during peak pumping periods of adjacent domestic wells. The purpose of the monitoring event was to determine if pumping of adjacent domestic wells could alter the groundwater flow gradient in the vicinity of the Site.

Water table elevation fluctuations for each well and well point as recorded during the 24-hour monitoring event are provided in Appendix VI. Groundwater contour maps generated from water level data gathered during the well evaluation, well development, and well sampling programs are presented as Figures 2-7, 2-8, and 2-9.

2.5.10 Equipment Decontamination

All downhole drilling equipment was pressure-cleaned with a high pressure clean steam-hot water wash prior to drilling each soil boring, well point, and monitoring well. The split-barrel samplers, stainless steel hand trowels, and compositing bowls were cleaned prior to each use as follows:

- Distilled/deionized water and non-phosphate detergent brush wash

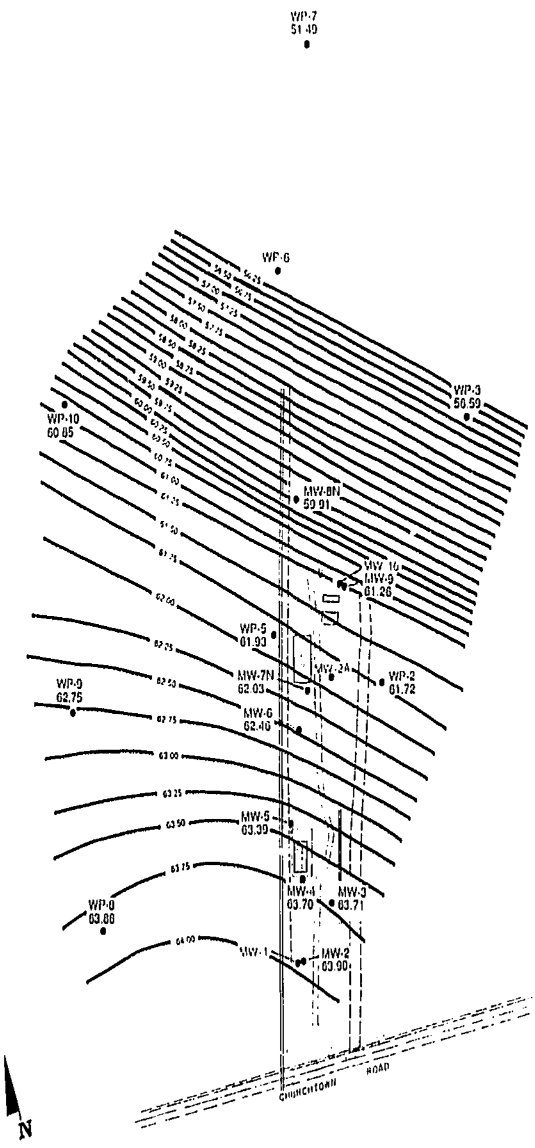
- Distilled/deionized water rinse

- Nitric acid (10 percent) rinse

- Distilled deionized water rinse

- Pesticide grade methanol rinse followed by pesticide grade hexane rinse

- Distilled/deionized water rinse

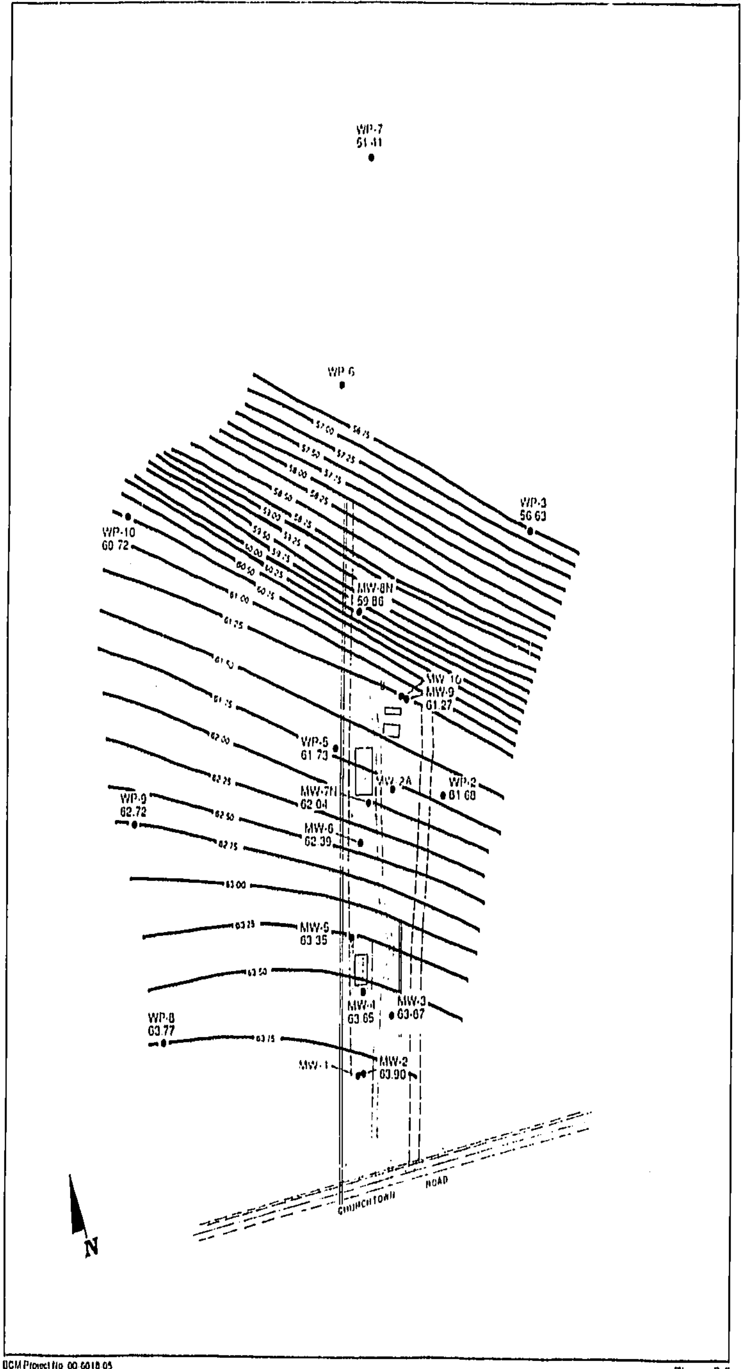


BCM Project No. 00-6010-05

Figure 2-7
Groundwater Table Contour Map
For August 4, 1990 - 2100 Hours

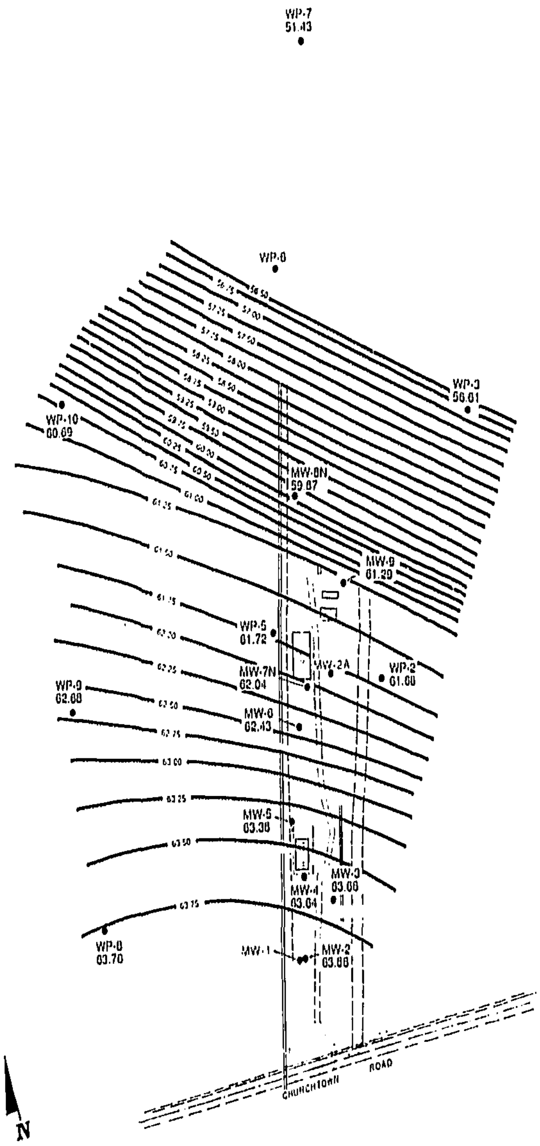
BCM

SEALAND LTD SITE
Mt Pleasant DE



BCM Project No 00 6018 05

Figure 2-8
Groundwater Table Contour Map
For August 4, 1990 - 0500 Hours



BCM Project No 00 6016 05

Figure 2-9
Groundwater Table Contour Map
For August 4, 1990 - 1300 Hours

The QAPjP also outlines, in detail, all decontamination procedures followed.

A decontamination pad was constructed for decontaminating all vehicles and downhole drilling equipment. The pad was designed to prevent the discharge of decontamination fluids to ground surface. The pad's main components included a fluid collection trench, sheet plastic lining, and soil berming.

All decontamination fluids were pumped from the collection trench into labeled 55-gallon steel drums. All plastic sheeting was also containerized in similar drums as was all disposable health and safety equipment/clothing. All drums were sealed and staged (segregated by waste type) on the existing onsite concrete pad.

3.0 ENVIRONMENTAL SETTING

3.1 REGIONAL SETTING

3.1.1 Physiography

The Site is located within the Coastal Plain Physiographic Province which is characterized as a series of unconsolidated or partially consolidated sand, gravel, silt, and clay layers. These sediments form a wedge which dips and thickens to the southeast. According to Sundstrom and Pickett (1971), the thickness of the coastal plain sediments is approximately 700 feet in the vicinity of the Site.

The geologic formations in the vicinity of the Site are, from youngest to oldest: Columbia, Mt. Laurel, Marshalltown, Englishtown, and Merchantville Formations. Figure 3-1 is a geologic map showing the outcrops of the pre-Pleistocene deposits. The Pleistocene Columbia Formation occurs as a thin cover over the majority of the area shown on Figure 3-1. Regional geologic information is addressed with the local geologic setting in Section 3.2.

3.1.2 Climate

Climatological data for the region is available from the Dover, Delaware, weather station. Long-term climatological data are available from the National Oceanic and Atmospheric Administration's (NOAA) Dover, Delaware, observation station. A monthly summary of average temperature, precipitation, and wind data for 1989 and 1990 are provided in Table 3-1.

3.1.3 Demographics

The total population of New Castle County, Delaware, is 435,300, based on 1988 U.S. Census data. With a land area of 435 square miles, the number of people per square mile averages 1000.6. The ratio of males to females in the county in 1990 was 92.3:100. Per capita personal income was $13,891 in 1987.

3.1.4 Land Use

The Site is located at the intersection of Routes 896 and 71/301. The C&D Canal is approximately 2 miles north of the Site. The Site is bounded on the west by an active Conrail track and on the north by a 15-acre parcel of land owned by Tilcon Mineral Inc. On the east, the Site is bounded by private residences and on the south by Routes 71/301. Private residences, light industrial and commercial establishments, and farmland are also located to the south and west of the Site. The location of the nearest private well is the Townsend shop, approximately 200 feet east.

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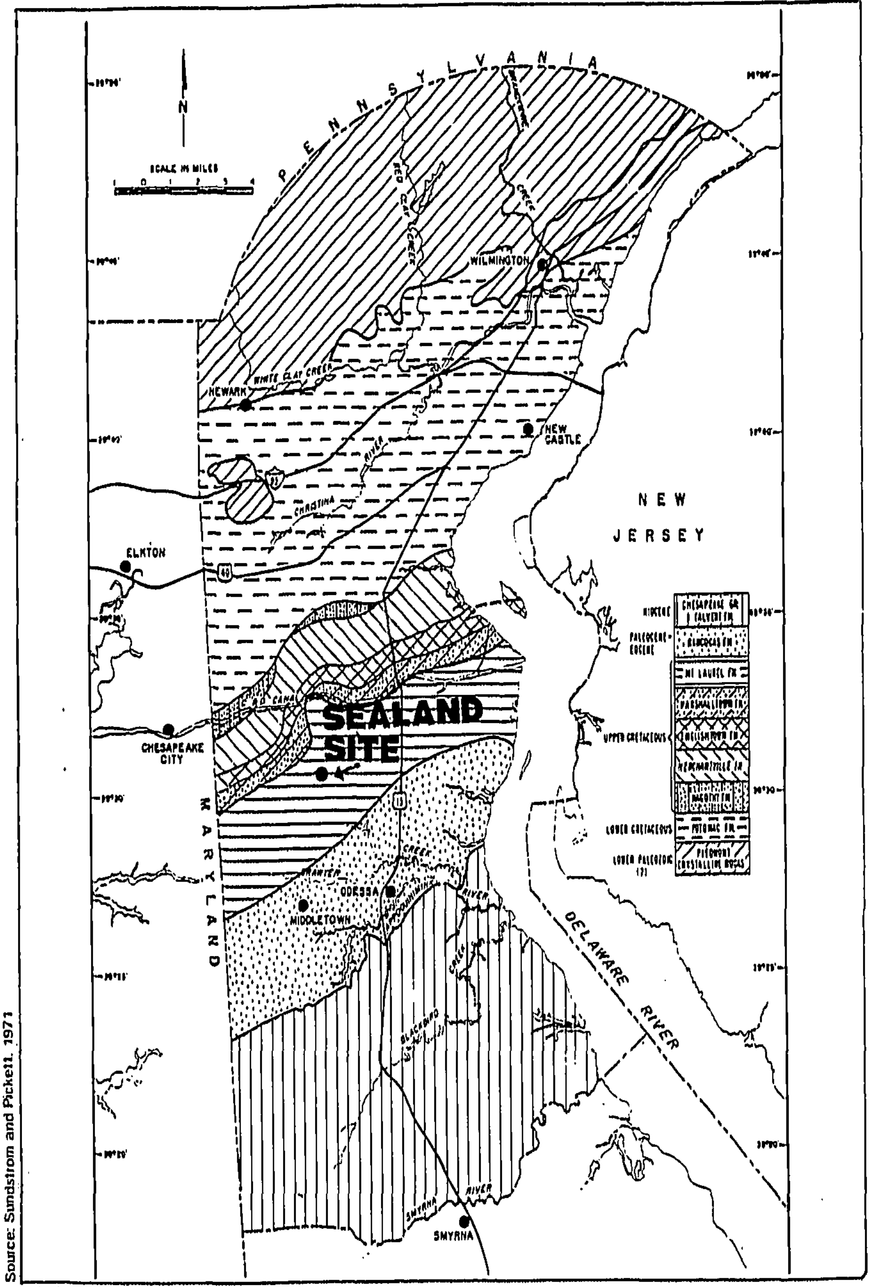
SEALAND LTD. SITE
Mt. Pleasant, DE



Source: Sundstrom and Pickett, 1971

BCM Project No. 6018-03

Figure 3-1
Geologic Map of New Castle County, DE
(Pleistocene Removed)
Sealand Site

BCM

TABLE 3-1

CLIMATOLOGICAL DATA
AIRPORT TERMINAL BUILDING
WILMINGTON, DELAWARE

SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Date	Temperature (°F) Avg. Max.	Temperature (°F) Avg. Min.	Temperature (°F) Avg.	Total Precipitation (inches)	Average Wind Speed (mph)	Wind Peak Gust Speed (mph)	Predominant Direction
1987	64.0	45.3	54.7	35.98	8.7	66	N/A
1988	63.4	44.3	53.9	35.62	8.5	69	N/A
1989	62.7	45.0	53.9	49.77	8.4	59	N/A
1/87	38.1	24.7	31.4	4.35	10.2	43	NW
2/87	39.9	23.9	31.9	1.52	9.2	51	NW
3/87	55.4	33.7	44.6	1.16	10.6	44	N
4/87	61.5	43.0	52.3	2.63	11.3	45	NE
5/87	73.3	52.8	63.1	3.15	8.3	31	NE
6/87	83.4	63.5	73.5	2.31	8.5	35	SW
7/87	88.8	69.4	79.1	4.09	7.5	66	W
8/87	83.5	65.0	74.3	4.21	7.5	32	SE
9/87	76.9	59.7	68.3	4.85	6.3	28	W
10/87	63.1	40.2	51.7	2.31	6.9	58	W
11/87	57.1	37.6	47.4	3.50	9.3	44	NW
12/87	46.6	30.6	38.6	1.90	8.5	41	W
1/88	35.9	18.8	27.4	2.46	7.3	48	NW
2/88	43.1	26.4	34.8	4.14	10.4	43	W
3/88	54.6	33.7	44.2	1.82	10.5	43	W
4/88	59.6	41.9	50.8	2.59	11.4	40	NW
5/88	72.3	53.5	62.9	4.95	8.4	37	SE
6/88	83.0	60.1	71.6	0.21	8.8	44	NW
7/88	89.2	69.5	79.4	8.29	7.6	58	SW
8/88	86.0	68.6	77.3	3.03	6.9	48	SW
9/88	75.3	56.2	65.8	0.00	6.6	36	NW
10/88	61.4	40.5	51.0	1.94	7.3	33	N/A
11/88	56.7	36.7	46.7	5.29	8.9	40	W
12/88	44.2	25.9	35.1	0.90	8.6	69	W
1/89	44.0	28.0	36.0	2.48	8.4	41	NW
2/89	41.6	26.9	34.3	2.75	9.0	37	NW
3/89	51.2	32.9	42.1	3.69	10.7	55	NW
4/89	62.3	40.8	51.6	2.76	9.7	44	SW
5/89	71.6	52.6	62.1	6.57	9.7	43	S
6/89	82.5	66.1	74.3	5.43	7.4	52	NW
7/89	84.2	67.5	75.9	12.63	6.6	28	SW
8/89	82.3	66.4	74.4	1.97	6.7	26	SW
9/89	77.7	59.1	68.4	4.31	7.2	37	SE
10/89	68.8	46.4	57.6	3.92	7.2	37	NE
11/89	53.6	35.6	44.6	1.99	9.2	59	NW
12/89	32.5	17.5	25.0	1.27	8.6	43	NW
1/90	49.1	31.9	40.5	3.56	7.7	46	NW
2/90	51.4	30.8	41.1	1.35	9.4	N/A	N/A

NA = Not available

Compiled By: BCM Engineers Inc. (Project No. 00-6018-03)

3.2 SITE SETTING

3.2.1 Geology

As previously stated, the Site is located within the Coastal Plain Physiographic Province which is characterized as a series of unconsolidated or partially consolidated sands, gravels, silts, and clays. These sediments form a wedge which dips and thickens to the southeast. According to Sundstrom and Pickett (1971), the thickness of the coastal plain sediments is approximately 700 feet in the vicinity of the Site.

The geologic formations in the vicinity of the Site are, from youngest to oldest: Columbia, Mt. Laurel, Marshalltown, Englishtown, and Merchantville Formations. The Pleistocene Columbia Formation occurs as a thin cover over the majority of the area in the vicinity of the Site.

The Pleistocene-age Columbia Formation, a non-marine fluvial deposit, is the youngest deposit at the Site. It consists primarily of unconsolidated, brown, fine to coarse (0.1 to 1.0 mm) sand. Minor components include silt and fine gravel. The estimated porosity of the Columbia Formation is approximately 25 to 30 percent. Split-barrel samples and auger cuttings from the new onsite wells indicate the Columbia Formation/Mt. Laurel Formation contact to be at approximately 9.2 feet, 5.3 feet, and 6.5 feet bgs, respectively, at the locations of wells MW-7N, -8N, and -10. The boring log for DH-1 (MW-1) drilled in December 1983 shows the contact at 15 feet bgs.

Directly underlying the Columbia Formation are the late Cretaceous-age Mt. Laurel, Marshalltown, and Englishtown Formations. The Mt. Laurel Formation, which subcrops at the Site under the thin veneer of Columbia sediments, consists of grayish, greenish, and reddish-brown, glauconitic, fossiliferous, fine to medium (0.15 to 0.5 mm) quartz sand containing some silt. The porosity of the Mt. Laurel Formation at the Site is approximately 20 to 25 percent. According to a geophysical well log of DH-1 by the Delaware Geological Survey, the Mt. Laurel Formation is approximately 80 feet thick and extends to a depth of 93 feet below the ground surface (Woodruff, 1988). This depth was confirmed during the drilling of new onsite well MW-10. The Marshalltown Formation consists of very dark, massive, highly glauconitic, micaceous, very silty, fine (0.1 to 0.25 mm) sand. Sundstrom and Pickett (1971) report the Marshalltown Formation to be at least 40 feet thick in the vicinity of the Site.

The Englishtown Formation consists chiefly of light gray and rust brown, well-sorted micaceous fine sand interbedded with dark gray silty sand (Pickett, 1980). It is reported to be between 20 and 40 feet thick and probably occurs at the Site below the Marshalltown Formation. Underlying these deposits is the Merchantville Formation consisting of dark gray to black, very fine, silty and clayey sand. Owens et al. (1970) reports the Merchantville thickness to be approximately 50 feet in the C&D Canal area.

3.2.2 Top Soil and Vadose Zone Characteristics

The composition and appearance of the top soils at and adjacent to the site consisted primarily of a dark brown, very fine to fine sand with some silt and little to some natural organic matter. Trace amounts of mica and fine subround gravel were frequently noted. Top soils penetrated during the drilling program generally ranged from 0.2 to 1.7 feet in thickness. There were no visible B or C soil horizon characteristics noted during the drilling program.

The vadose zone at the Site is comprised of sediments of the Columbia formation. The Columbia Formation consists primarily of unconsolidated brown, fine to coarse (0.1 to 1.0 mm), subround, moderately to poorly sorted sand. Minor components include silt and fine gravel. The porosity of the Columbia Formation, as estimated from field observations, is approximately 25 to 30 percent.

In some areas, the vadose zone sediments consisted of fill containing trace amounts of coal and/or cinders which may be attributable to the adjacent rail lines. These minor constituents caused the sediments to appear grey to dark grey. All vadose zone sediments were damp. The vadose zone was generally 4 to 5 feet thick onsite.

3.2.3 Hydrogeology

3.2.3.1 Groundwater Characteristics

Based on water level measurements obtained from onsite monitoring wells, the average depth to groundwater is approximately 4.1 feet (elevation 63.7 feet mean sea level). Groundwater level measurements were obtained on December 15, 1989, April 10 to 11, 1990, and April 25, 1990. Water level measurements and the resulting groundwater elevations are shown in Table 3-2. Contour maps of the water table are provided in Figures 2-7, 2-8, and 2-9. These contour maps are based on wells which are screened across the water table; hence, wells MW-1 and MW-10 were not included because their screens are placed deeper and measure the potentiometric head at those depths only.

Water table contour maps indicate that the horizontal direction of groundwater flow is to the northeast. This generally conforms with the topographic contours present at the Site.

The aquifer beneath the Site consists of the Columbia, Mt. Laurel, Marshalltown, and additional underlying formations. These formations are generally hydraulically interconnected and are usually referred to as the water table aquifer (Groot, et al., 1983). As discussed in Section 3.2.1, no laterally continuous confining layers are in evidence within the depth encountered by onsite wells. This indicates that there are no

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TABLE 3-2

WATER TABLE ELEVATIONS
SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

	Water Table Elevation (Feet AMSL)		
Well I.D.	Well Evaluation 12/15/89	Well Development 4/10-11/90	Well Sampling 4/25/90
MW-1	63.68	65.50	65.17
MW-2	63.87	65.62	65.25
MW-2A	ND	ND	ND
MW-3	63.62	ND	65.11
MW-4	63.56	ND	65.20
MW-5	63.85	65.16	64.83
MW-6	62.27	64.24	63.71
MW-7N	NC	63.57	63.24
MW-8N	NC	61.02	60.74
MW-9	NC	62.59	62.31
MW-10	NC	61.36	61.08
WP-1	ND	ND	ND
WP-2	ND	ND	62.88
WP-3	ND	ND	57.41
WP-5	ND	ND	63.82
WP-6*	ND	ND	57.78
WP-7*	ND	ND	51.27
WP-8	NC	ND	64.89
WP-9	NC	ND	63.58
WP-10	NC	ND	61.21

* - Damaged
ND - Not Determined
NC - Not Constructed

Compiled By: BCM Engineer Inc. (BCM Project No. 00-6018-03) confining layers separating the water table aquifer from deeper water-bearing zones. However, the Marshalltown Formation, encountered at approximately 93 feet below grade, contains significant amounts of fine-grained materials (silt and clay) which would impede groundwater flow and is thus considered an aquitard in this setting. Sundstrom and Pickett (1971) do not consider the Marshalltown Formation to be an aquifer and it is not generally mapped as such. For the purposes of this investigation, the water table aquifer is considered to extend from the surface of the water table to a depth of 93 feet below natural grade.

Typical characteristics for the water table aquifer are reported by Johnson (1973), Groot, et al. (1983), and Pickett (1971). These published values are as follows:

Formation	Hydraulic Conductivity (ft/day)	Specific Capacity (gpm/ft)	Transmissivity (gpd/ft)	Storativity (unitless)
Columbia	90	14.8 (average)	40,000	0.15
Englishtown-Mt. Laurel	2.6	1 to 2	1,800	0.1

These data indicate that the Columbia Formation, which comprises only the upper 5 to 9 feet of material at the Site, is a much more potentially productive zone than the Mt. Laurel, which occupies the interval between the Columbia and the Marshalltown Formations.

The vertical hydraulic gradient was evaluated by comparing the well couplet MW-9 and MW-10. The shallow well, MW-9, is screened from elevation 63.59 to 45.59 feet and had a water table elevation of 62.31 feet on April 25, 1990. The deeper well, MW-10, is screened from elevation -2.21 to -17.21 and had a water table elevation of 61.08 feet on the same date. Using the mid-point of the screened interval as a head reference point, there is a difference of 1.23 feet over a vertical interval of 64.3 feet between the two wells, with the deeper well having the lower water elevation. This indicates a downward hydraulic gradient of 0.019 feet/foot at this location.

Shallow wells screened across the water table at opposite ends of the Site were used to evaluate the horizontal hydraulic gradient. Well MW-3 had a water elevation of 65.11 feet. Well MW-9, located at the northern end of the Site had a water elevation of 62.31 feet. This represents a difference in water elevations of 2.8 feet over a horizontal distance of 545 feet for a horizontal hydraulic gradient of 0.0051 feet/foot to the northeast.

Because the water table aquifer is present within two separate formations possessing different hydrogeological properties, the approximate horizontal groundwater velocity was calculated for each of the formations separately and is presented below. Data used in determining the approximate velocity values are the published hydrogeologic characteristics presented above and the estimated porosity values as determined by field observations and published porosity values for similar lithologies.

Groundwater velocities are based on the equation $V = KI/n$, where:

V = velocity in feet per day
K = hydraulic conductivity in feet per day
I = hydraulic gradient in feet per foot
n = effective porosity

Across the horizontal interval from well MW-3 to well MW-9, the approximate horizontal velocity of groundwater in the Columbian Formation is calculated as follows where:

$K = 90$ ft/day
$I = 0.0051$ ft/ft
$n = 0.30$

$V = (90 \text{ ft/day})(0.0051 \text{ ft/ft})/0.30$
$V = 1.53$ ft/day

Across the horizontal interval from well MW-3 to well MW-9, the approximate horizontal velocity of groundwater in the Englishtown/Mt. Laurel Formation is calculated as follows where:

$K = 2.6$ ft/day
$I = 0.0057$ ft/ft
$n = 0.25$

$V = (2.6 \text{ ft/day})(0.0057 \text{ ft/ft})/0.25$
$V = 0.059$ ft/day

Groundwater movement at the Site has a downward component of flow indicating that the Site is in a groundwater recharge area. Flow is considered to move toward Joy Run to the northeast where it probably discharges locally to Joy Run northeast of the Site and regionally to the C&D Canal approximately 2 miles north of the Site (REWAI, 1987a).

The effect of nearby domestic well use on water levels at the Site was evaluated by conducting a 24-hour water level measurement program on wells and well points. This program is described in Section 2.5.7 and the water level graphs and data for each well and well point is contained in Appendix VI. The purpose of this program was to ascertain whether the pumping of nearby wells would show measurable effects in the monitoring wells and well points which might signify a deflection of the normal direction of groundwater flow.

An evaluation of the data and graphs contained in Appendix VI reveals that fluctuations do in fact exist; however, they are typically of low magnitude (0.05 feet or less) and occur in a random pattern. This suggests that if offsite pumping is impacting onsite groundwater conditions the impacts are insignificant and not a consideration in groundwater flow processes.

3.2.3.2 Surface Water Hydrology

The Site is characterized as topographically flat except where the clay cap contributes a minor amount of relief. Due to a slight slope to the northeast, any surface water drainage that might occur would flow towards Joy Run, a minor tributary to the C&D Canal. Joy Run originates as a marshy area northeast of the northeastern corner of the Site. During dry periods, its flow is maintained by groundwater discharge to the streambed.

Surface water drainage that might originate on the Site is not likely to reach Joy Run due to the highly porous nature of the surface soil which causes runoff to infiltrate into the ground long before it reaches Joy Run. This is supported by the fact that no visible surface water drainage pathways are evident.

4.0 NATURE AND EXTENT OF CONTAMINATION

4.1 SOURCE CHARACTERIZATION

4.1.1 EPA/DNREC and Their Contractors

Source characterization was initiated in October 1983 when EPA and DNREC jointly implemented an Emergency Response Characterization sampling investigation of the Sealand Site. A detailed description of this investigation is contained in Section 1.2. Samples were collected from tanks, drums and stained soils onsite to characterize the source of contamination. Table 1-2 presents a summary of the compounds detected in the tanks and drums found onsite. Table 4-1 is a detailed listing of the results of all soil sampling conducted in 1983 and 1984. The analytical data from which these summary tables were prepared is contained in EPA files.

Results from the drum samples collected in 1983 indicated detectable levels of various base/neutral organic compounds, including polycyclic aromatic hydrocarbons (PAHs), VOCs, heavy metals and phenol. The analytical results from onsite soil samples indicated detectable levels of base/neutrals, and acid extractable organic compounds. VOCs and metals were not analyzed.

Additional samples were collected during the 1983/1984 EPA Emergency Removal Action. In December 1983, the drummed and tanked materials were sampled and analyzed for hazardous waste characteristics. Isolated areas of stained soils at the base of the storage tanks and adjacent to the storage tank and concrete pad were also sampled and analyzed.

The December 1983 waste characterization analysis indicated that the bulk of the materials onsite consisted of various flammable and combustible liquids. Further investigation indicated that the materials consisted of waste No. 4 and No. 6 oil, off-spec creosote, coal tar, oil gas tar, and ink oil wastes.

Additional soil sampling was conducted to identify contaminated soils which may have required immediate removal as part of the emergency response actions. Table 4-1 summarizes these soil sampling activities. The analytical results indicated a wide range of concentrations of various base/neutral organic compounds and trace concentrations of VOCs, phenols, chromium, lead, nickel, and PCBs.

A third round of soil samples were collected from the Site in April 1984. According to the EPA On Scene Coordinator Report (EPA Files, 1984) eight samples were obtained from areas within the tank farm where the clay cap was to be placed. Results from this sampling event are presented in Table 4-1. Base/neutrals, volatile organics, chromium, lead, and nickel were detected.

TABLE 4-1
SUMMARY OF EPA/DNREC ANALYTICAL RESULTS IN SOIL
1983-1984
SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Sample Name:	831011-02	831011-03	831011-04	831011-05	831011-06	831011-07	831011-08	831011-09
Sampler:	EPA	EPA	EPA	EPA	EPA	EPA	EPA	EPA
Date Sampled:	10/20/83	10/20/83	10/20/83	10/20/83	10/20/83	10/20/83	10/20/83	10/20/83
Parameters, units								
Metals, ug/g								
Aluminum								
Antimony								
Arsenic								
Barium								
Beryllium								
Calcium								
Chromium								
Cobalt								
Copper								
Iron								
Lead								
Magnesium								
Manganese								
Mercury								
Nickel								
Potassium								
Sodium								
Vanadium								
Zinc								
Cyanide								

**** ACID EXTRACTABLES NOT DETECTED

Sample Name: Date Sampled:	831011-02 10/20/83	831011-03 10/20/83	831011-04 10/20/83	831011-05 10/20/83	831011-06 10/20/83	831011-07 10/20/83	831011-08 10/20/83	831011-09 10/20/83
Parameters, units								
Semivolatile Organic Compounds,ug/g								
Phenol								
4-Methylphenol								
2,4-Dimethylphenol								
2,4-Dinitrotoluene								
2,6-Dinitrotoluene								
Benzoic Acid								
Naphthalene		96 J				1820		
Di-n-Butyl phthalate		*	*	*	*	*		
2-Methylnaphthalene								
Acenaphthylene		778				920		
Acenaphthene						290		
Dibenzofuran								
Fluorene		32.5				960		
Phenanthrene		756				4260		
Anthracene		94 J				710		
Fluoranthene		372		6.3 J		1190		
Pyrene		802		14.2		2080		
Benzo(a)Anthracene		169				420		
Chrysene		190				380		
bis(2-Ethylhexyl)Phthalate		*	*	*	*	*		
Benzo(b)Fluoranthene						110		
Benzo(k)Fluoranthene						300		
Benzo(a)Pyrene						530		
Ideno(1,2,3,-cd)Pyrene						380		
Dibenz(a,h)Anthracene								
Benzo(g,h,i)Perylene								
Dimethyl Phthalate								

**** ACID EXTRACTABLES NOT DETECTED

Sample Name:	831011-10	831011-11	831011-12	831011-13	831011-14	831011-15	831011-16	831011-17
Sampler:	EPA	EPA	EPA	EPA	EPA	EPA	EPA	EPA
Date Sampled:	10/20/83	10/20/83	10/20/83	10/20/83	10/20/83	10/20/83	10/20/83	10/20/83
Parameters, units								
Metals, ug/g								
Aluminum								
Antimony								
Arsenic								
Barium								
Beryllium								
Calcium								
Chromium								
Cobalt								
Copper								
Iron								
Lead								
Magnesium								
Manganese								
Mercury								
Nickel								
Potassium								
Sodium								
Vanadium								
Zinc								
Cyanide								

•••• ACID EXTRACTABLES NOT DETECTED

Sample Name:	831011-10	831011-11	831011-12	831011-13	831011-14	831011-15	831011-16	831011-17
Date Sampled:	10/20/83	10/20/83	10/20/83	10/20/83	10/20/83	10/20/83	10/20/83	10/20/83
Parameters, units								
Semivolatile Organics, ug/g								
Phenol								
4-Methylphenol								
2,4-Dimethylphenol								
Benzoic Acid								
Naphthalene		1930						
2-Methylnaphthalene								
Acenaphthylene		270						
Acenaphthene								
Dibenzofuran								
Fluorene		150						
Phenanthrene		625						
Anthracene								
Fluoranthene		159						
Pyrene		350						
Benzo(a)Anthracene								
Chrysene								
bis(2-Ethylhexyl)Phthalate								
Benzo(b)Fluoranthene								
Benzo(k)Fluoranthene								
Benzo(a)Pyrene								
Ideno(1,2,3,-cd)Pyrene								
Dibenz(a,h)Anthracene								
Benzo(g,h,i)Perylene								
Dimethyl Phthalate								

**** ACID EXTRACTABLES NOT DETECTED

Sample Name:	831011-18	831011-19	831011-19 duplicate	831011-20
Sampler:	EPA	EPA	EPA	EPA
Date Sampled:	10/20/83	10/20/83	10/20/83	10/20/83
Parameters, units				
Metals ug/g				
Aluminum				
Antimony				
Arsenic				
Barium				
Beryllium				
Calcium				
Chromium				
Cobalt				
Copper				
Iron				
Lead				
Magnesium				
Manganese				
Mercury				
Nickel				
Potassium				
Sodium				
Vanadium				
Zinc				
Cyanide				

**** ACID EXTRACTABLES NOT DETECTED

Sample Name: Date Sampled:	831011-18 10/20/83	831011-19 10/20/83	831011-19 10/20/83	831011-20 10/20/83
Parameters, units				
Semivolatile Organic Compounds,ug/g				
Phenol				
Hexachlorocyclopentadiene				
4-Methylphenol				
2,4-Dimethylphenol				
2,4-Dinitrotoluene				
2,6-Dinitrotoluene				
Benzoic Acid				
Naphthalene	521			
2-Chloronaphthalene				
2-Methylnaphthalene				
Acenaphthylene	71.7	72.1	73.7	
Acenaphthene	12.8	31.2	30.8	
Dibenzofuran				
Fluorene	55.4	81.1	81.6	8.1 J
Phenanthrene	169	185	189	12.8
Anthracene	32.7	41.6	43	1.7 J
Fluoranthene	37.3	56.2	59.6	2.0 J
Pyrene	71	93.5	93.5	8.3 J
Benzo(a)Anthracene	13.6	23	22.4	
Chrysene	12.2	17.7	17.6	
bis(2-Ethylhexyl)Phthalate				
Benzo(b)Fluoranthene		4.8 J	5.4 J	
Benzo(k)Fluoranthene		7.0 J	4.4 J	
Benzo(a)Pyrene		15.5	13.5	
Ideno(1,2,3,-cd)Pyrene				
Dibenz(a,h)Anthracene				
Benzo(g,h,i)Perylene				
Dimethyl Phthalate				

**** ACID EXTRACTABLES NOT DETECTED

Sample Name:	4658	4659	4660	4661	4662	4663	4664	4665	4666	4667
Sampler:	EPA	EPA	EPA	EPA	EPA	EPA	EPA	EPA	EPA	EPA
Date Sampled:	12/5/83	12/5/83	12/5/83	12/5/83	12/5/83	12/5/83	12/5/83	12/5/83	12/5/83	12/5/83
Parameters, units										
Metals, ug/g										
Aluminum										
Antimony										
Arsenic										
Barium										
Beryllium										
Calcium										
Chromium	18.5	24.1	4.2	19.6	3.8	15.3	27.1	53	9.7	17.7
Cobalt										
Copper										
Iron										
Lead	88	204	16	63	13	960	115	140	188	124
Magnesium										
Manganese										
Mercury										
Nickel	96	182	16	93	14	115	434	399	32	462
Potassium										
Sodium										
Vanadium										
Zinc										
Cyanide										

Sample Name: Date Sampled:	4658 12/5/83	4659 12/5/83	4660 12/5/83	4661 12/5/83	4662 12/5/83	4663 12/5/83	4664 12/5/83	4665 12/5/83	4666 12/5/83	4667 12/5/83
Parameters, units										
Semivolatile Organic Compounds,ug/g										
Phenol	0.16	0.69	0.02	0.07	0.03	0.42	0.05	0.21	0.26	0.06
4-Methylphenol										
2,4-Dimethylphenol										
2,4-Dinitrotoluene						4.7				
2,6-Dinitrotoluene						3500			325	
Benzoic Acid										
Naphthalene										
2-Chloronaphthalene									144	
2-Methylnaphthalene										
Acenaphthylene									20	
Acenaphthene								9.5		
Dibenzofuran										
Fluorene									163	
Phenanthrene										
Anthracene										
Fluoranthene									355	
Pyrene									935	
Benzo(a)Anthracene									560	
Chrysene									560	
bis(2-Ethylhexyl)Phthalate										
Benzo(b)Fluoranthene										
Benzo(k)Fluoranthene										
Benzo(a)Pyrene										
Ideno(1,2,3,-cd)Pyrene										
Dibenz(a,h)Anthracene										
Benzo(g,h,i)Perylene										
Dimethyl Phthalate										

Sample Name:	4668	4703	4704	4705	4707	4708	4710
Sampler:	EPA	DNREC	DNREC	DNREC	DNREC	DNREC	DNREC
Date Sampled:	12/5/83	12/6/83	12/6/83	12/6/83	12/6/83	12/6/83	12/6/83
Parameters, units							
Metals, ug/g							
Aluminum							
Antimony							
Arsenic							
Barium							
Beryllium							
Calcium							
Chromium	< 100 ug/l	< 100 ug/l	81.8	89.9	13	7.1	6.3
Cobalt							
Copper							
Iron							
Lead	< 100 ug/l	< 100 ug/l	65	52	42	12	23
Magnesium							
Manganese							
Mercury							
Nickel	< 100 ug/l	< 100 ug/l	9	13	8	13	14
Potassium							
Sodium							
Vanadium							
Zinc							
Cyanide							
Semivolatile Organic Compounds,ug/g							
Phenol	< 5 ug/l		0.03	0.01	0.01	0.03	0.03
4-Methylphenol							
2,4-Dimethylphenol							
2,4-Dinitrotoluene							
2,6-Dinitrotoluene							

Sample Name:	4711	4713	4714	4716	4717	4719	4720
Sampler:	DNREC	DNREC	DNREC	DNREC	DNREC	DNREC	DNREC
Date Sampled:	12/6/83	12/6/83	12/6/83	12/6/83	12/6/83	12/6/83	12/6/83
Parameters, units							
Metals, ug/g							
Aluminum							
Antimony							
Arsenic							
Barium							
Beryllium							
Calcium							
Chromium	13.5	11	11.1	8.6	8.9	13.1	11.2
Cobalt							
Copper							
Iron							
Lead	34	32	18	14	13	70	43
Magnesium							
Manganese							
Mercury							
Nickel	12	9	9	12	9	36	30
Potassium							
Sodium							
Vanadium							
Zinc							
Cyanide							

Sample Name: Date Sampled:	4711 12/6/83	4713 12/6/83	4714 12/6/83	4716 12/6/83	4717 12/6/83	4719 12/6/83	4720 12/6/83
Parameters, units							
Semivolatile Organic Compounds,ug/g							
Phenol	0.04	0.04	0.01	0.03	0.03	0.05	0.03
4-Methylphenol							
2,4-Dimethylphenol							
2,4-Dinitrotoluene							
2,6-Dinitrotoluene							

J = Estimated quantity, concentration below the level for accurate quantitation

* = Not detected after correction for reagent blank

Sample Name:	831222-10	831222-10 Dup.	831222-11	831222-12	831222-13	831222-14	831222-15
Sampler:	EPA	EPA	EPA	EPA	EPA	EPA	EPA
Date Sampled:	12/6/83	12/6/83	12/6/83	12/6/83	12/6/83	12/6/83	12/6/83
Parameters, units							
Volatile Organic Compounds, ug/g							
Benzo(a)Anthracene					0.8 J		
Chrysene					1.3 J		
bis(2-Ethylhexyl)Phthalate	•	•	•	•	•	•	•
Phenanthrene					1.0 J		
Anthracene							
Fluoranthene		0.9 J			1.6 J		0.49 J
Pyrene		0.9 J			2.0		
1,3-Dichlorobenzene							1.0 J

Sample Name:	4742	4743	4744	4746	4747	4749
Sampler:	DNREC	DNREC	DNREC	DNREC	DNREC	DNREC
Date Sampled:	12/9/83	12/9/83	12/9/83	12/9/83	12/9/83	12/9/83
Parameters, units						
Metals, ug/g						
Aluminum						
Antimony						
Arsenic						
Barium						
Beryllium						
Calcium						
Chromium	< 100 ug/l	17.2	8.8	15.5	12.3	19
Cobalt						
Copper						
Iron						
Lead	< 100 ug/l	33	15	42	73	44
Magnesium						
Manganese						
Mercury						
Nickel	< 100 ug/l	17	10	37	14	383
Potassium						
Sodium						
Vanadium						
Zinc						
Cyanide						
Semivolatile Organics, ug/g						
Phenol	< 5 ug/l	0.09	0.06	0.05	0.05	0.07

Sample Name:	4750	4751	4752	4753	4754	4789	4790
Sampler:	DNREC	DNREC	DNREC	DNREC	DNREC	DNREC	DNREC
Date Sampled:	12/9/83	12/9/83	12/9/83	12/9/83	12/9/83	12/12/83	12/12/83
Parameters, units							
Metals, ug/g							
Aluminum							
Antimony							
Arsenic							
Barium							
Beryllium							
Calcium							
Chromium		15.5		20.8		< 3.3	46.1
Cobalt							
Copper							
Iron							
Lead		55		79		16	18
Magnesium							
Manganese							
Mercury							
Nickel		8		61		6	35
Potassium							
Sodium							
Vanadium							
Zinc							
Cyanide							

Sample Name: Date Sampled:	4750 12/9/83	4751 12/9/83	4752 12/9/83	4753 12/9/83	4754 12/9/83	4789 12/12/83	4790 12/12/83
Parameters, units							
Semivolatile Organics, ug/g							
Phenol		0.02		0.01		0.04	0.04
4-Methylphenol							
2,4-Dinitrotoluene							
2,6-Dinitrotoluene							
2,4-Dimethylphenol							
Benzoic Acid							
Naphthalene							
2-Chloronaphthalene							
2-Methylnaphthalene							
Acenaphthylene							
Acenaphthene							
Dibenzofuran							
Fluorene							
Phenanthrene							
Anthracene							
Fluoranthene							
Pyrene							
Benzo(a)Anthracene							
Chrysene							
bis(2-Ethylhexyl)Phthalate							
Benzo(b)Fluoranthene							
Benzo(k)Fluoranthene							
Benzo(a)Pyrene							
Ideno(1,2,3,-cd)Pyrene							

Sample Name:	4894	4895	4896	4897	4898	4899	4900	4901	4902	4903
Sampler:	DNREC	DNREC	DNREC	DNREC	DNREC	DNREC	DNREC	DNREC	DNREC	DNREC
Date Sampled:	12/21/83	12/21/83	12/21/83	12/21/83	12/21/83	12/21/83	12/21/83	12/21/83	12/21/83	12/21/83
Parameters, units										
Metals, ug/g										
Aluminum										
Antimony										
Arsenic										
Barium										
Beryllium										
Calcium										
Chromium	< 100 ug/l	13.5		6.4	11	30.6	15.8	17.5	12	10.5
Cobalt										
Copper										
Iron										
Lead	< 100 ug/l	80		12	24	21	26	20	20	15
Magnesium										
Manganese										
Mercury										
Nickel	< 100 ug/l	39		13	49	2770	2918	73	16	18
Potassium										
Sodium										
Vanadium										
Zinc										
Cyanide										
Volatile Organic Compounds, ug/g										
Benzene								0.017		
Toluene								0.081		
Ethylbenzene								0.14		
o-Xylene								0.45		
m-Xylene								0.54		
p-Xylene										

Sample Name:	4894	4895	4896	4897	4898	4899	4900	4901	4902	4903
Date Sampled:	12/21/83	12/21/83	12/21/83	12/21/83	12/21/83	12/21/83	12/21/83	12/21/83	12/21/83	12/21/83
Parameters, units										
Semivolatile Organics, ug/g										
Phenol	< 5 ug/l	0.02		0.05	0.14	0.78	0.83	0.13	0.1	0.12
4-Methylphenol										
2,4-Dimethylphenol										
Benzoic Acid										
Naphthalene								3.8	3.8	
2-Methylnaphthalene										
Acenaphthylene									1.4	
Acenaphthene								1.4		
Dibenzofuran										
Fluorene								3.1	3.1	
Phenanthrene										
Anthracene										
Fluoranthene										
Pyrene								7	7	
Benzo(a)Anthracene								7.3	7.3	
Chrysene								5.6	5.6	
bis(2-Ethylhexyl)Phthalate										
Benzo(b)Fluoranthene								8.9	8.9	
Benzo(k)Fluoranthene										
Benzo(a)Pyrene										
Ideno(1,2,3,-cd)Pyrene										
Dibenz(a,h)Anthracene										
Benzo(g,h,i)Perylene										
Dimethyl Phthalate										

Sample Name:	4904	4905	4906	4907	4908	4909	4910	4911
Sampler:	DNREC	DNREC	DNREC	DNREC	DNREC	DNREC	DNREC	DNREC
Date Sampled:	12/21/83	12/21/83	12/21/83	12/21/83	12/21/83	12/21/83	12/21/83	12/21/83
Parameters, units								
Metals ug/g								
Aluminum								
Antimony								
Arsenic								
Barium								
Beryllium								
Calcium								
Chromium	7.6	9	36.1		10.9	8.5	25.9	19
Cobalt								
Copper								
Iron								
Lead	< 12	61	15		50	12	95	40
Magnesium								
Manganese								
Mercury								
Nickel	14	14	20		12	12	13	23
Potassium								
Sodium								
Vanadium								
Zinc								
Cyanide								
Volatile Organic Compounds ug/g								
Methylene Chloride								
Acetone								
Benzene								
2-Hexanone								
Toluene								
Ethylbenzene							0.03	
o-Xylene							0.01	
m-Xylene							0.05	
p-Xylene							0.02	

Sample Name: Date Sampled:	4904 12/21/83	4905 12/21/83	4906 12/21/83	4907 12/21/83	4908 12/21/83	4909 12/21/83	4910 12/21/83	4911 12/21/83
Parameters, units								
Semivolatile Organic Compounds,ug/g								
Phenol	0.05	0.11	0.12			0.07	0.08	0.04
Hexachlorocyclopentadiene							120	
4-Methylphenol								
2,4-Dimethylphenol								
2,4-Dinitrotoluene							110	
2,6-Dinitrotoluene							52	
Benzoic Acid								
Naphthalene							62	
2-Chloronaphthalene							91	
2-Methylnaphthalene								
Acenaphthylene							46	
Acenaphthene								
Dibenzofuran								
Fluorene								
Phenanthrene								
Anthracene								
Fluoranthene					6.9			5.7
Pyrene					13			8.4
Benzo(a)Anthracene					9.2			3
Chrysene					6			3
bis(2-Ethylhexyl)Phthalate								
Benzo(b)Fluoranthene					5.7			1.5
Benzo(k)Fluoranthene								
Benzo(a)Pyrene					24			5.4
Ideno(1,2,3,-cd)Pyrene								
Dibenz(a,h)Anthracene								
Benzo(g,h,i)Perylene								
Dimethyl Phthalate								

Sample Name:	1224	1225	1226	1227	1228	1229	1230	1231	1232
Sampler:	EPA	EPA	EPA	EPA	EPA	EPA	EPA	EPA	EPA
Date Sampled:	4/25/84	4/25/84	4/25/84	4/25/84	4/25/84	4/25/84	4/25/84	4/25/84	4/25/84
Parameters, units									
Metals, ug/g									
Aluminum									
Antimony									
Arsenic									
Barium									
Beryllium									
Calcium									
Chromium	< 100 ug/l	31.13	33.52	22.71	26.36	19.76	20.54	29.91	18.82
Cobalt									
Copper									
Iron									
Lead	< 100 ug/l	88.42	89.38	84.92	102.95	27.44	17.11	203.74	28.23
Magnesium									
Manganese									
Mercury									
Nickel	< 100 ug/l	343.71	79.45	77.02	532.33	23.05	20.54	48.95	15.29
Potassium									
Sodium									
Vanadium									
Zinc									
Cyanide									
Volatile Organic Compounds, ug/g									
Methylene Chloride									
Acetone									
Benzene		0.21	0.35	0.045	0.086	< 0.01	< 0.01	< 0.01	< 0.01
2-Hexanone									
Toluene		1.6	1.6	0.62	0.82	< 0.01	< 0.01	< 0.01	< 0.01

Sample Name:	1224	1225	1226	1227	1228	1229	1230	1231	1232
Date Sampled:	4/25/84	4/25/84	4/25/84	4/25/84	4/25/84	4/25/84	4/25/84	4/25/84	4/25/84
Parameters, units									
Volatile Organic Compounds, ug/g									
Ethylbenzene									
Total Xylenes									
o-Xylene									
m-Xylene									
p-Xylene									
Carbon Disulfide									
Chloroform									
Semivolatile Organics, ug/g									
Phenol	< 5 ug / 1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
4-Methylphenol									
2,4-Dinitrotoluene									
2,6-Dinitrotoluene									
2,4-Dimethylphenol									
Benzoic Acid									
Naphthalene		67	79		69				
2-Chloronaphthalene									
2-Methylnaphthalene									
Acenaphthylene			43		59				
Acenaphthene									
Dibenzofuran									
Fluorene			41	25	41				
Phenanthrene									
Anthracene		20	26	58	33				
Fluoranthene		20	35						
Pyrene		50	66	49	96				
Benzo(a)Anthracene			59		71				
Chrysene			30		45				
bis(2-Ethylhexyl)Phthalate									

Sample Name:	831208-10	831208-11	831208-12
Sample Date:	12/6/83	12/6/83	12/6/83
Parameters, units			
PCB's, ug/gm			
Arochlor	21.8	6.3	< 1.0

J = Estimated quantity,concentration below the level for accurate quantitation.
* = Not detected after correction for reagent blank

TABLE 4-1 (CONTINUED)
SUMMARY OF EPA/DNREC ANALYTICAL RESULTS IN SOIL
1983 - 1984
TENTATIVELY IDENTIFIED COMPOUNDS
SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Sample No.: 831011-02		Sample No.: 831011-03		Sample No.: 831011-07		Sample No.: 831011-07 (continued)	
Sample Date: 10/5/83		Sample Date: 10/5/83		Sample Date: 10/5/83		Sample Date: 10/5/83	
Tentative ID	Est. Conc.	Tentative ID	Est. Conc.	Tentative ID	Est. Conc.	Tentative ID	Est. Conc.
1H-Indene	580	2,4,6-Trimethyloctane	trace	C8,H8 isomer(best match		Dibenzothiophene	trace
3-Methyl-1H-indene	150	Methylphenanthrene isomer	200	1,3,5,7-Cyclooctatetraene)	170	C16,H12 isomer(best match	
(1-Methyl-2-cyclopen-1-yl)	150	Methylphenanthrene isomer	220	C9,H8 isomer(best match		(Phenylnethylene)-1H-indene	140
Methylnaphthalene isomer	2500	2,4,6-Trimethyloctane	trace	1-Ethynyl-4-methyl benzene)	trace	Methylphenanthrene isomer	310
Mehylnaphthalene isomer	1500	Dimethylphenanthrene isome	130	C11,H10 isomer(best match		Methylphenanthrene isomer	320
1,1'-Biphenyl	570	Methylpyrene isomer	trace	1-Ethylidene-1H-indene)	1100	Methylphenanthrene isomer	trace
Unknown	trace			C11,H10 isomer(best match		C16,H12 isomer(best match	
Dimethylnaphthalene isomer	240			1-Ethylidene-1H-indene)	730	(Phenylnethylene)-1H-indene	390
Unknown	trace			C12,H10 isomer(best match		Dimethylphenanthrene isome	trace
Dimethylnaphthalene isomer	520			1,1'-Biphenyl)	390	C16,H10 compound similar to:	
1,1'-Biphenyl	390			C12,H12 isomer(best match		Pyrene	180
Dimethylnaphthalene isomer	130			1-Ethylnaphthalene)	trace	11H-Benzofluorene isomer	trace
Methyl-1,1'-biphenyl isomer	trace			Dimethylnaphthalene isomer	250	11H-Benzofluorene isomer	240
Unknown	trace			Dimethylnaphthalene isomer	530	11H-Benzofluorene isomer	130
1H-phenalene	trace			C12,H12 isomer(best match		Mehtylpyrene isomer	trace
1-Phenyl-naphthalene	trace			2-Ethenylnaphthalene)	310	Mehtylpyrene isomer	110
Methylphenanthrene isomer	110			Dimethylnaphthalene isomer	150	Methyl-9H-Fluorene isomer	trace
Methylphenanthrene isomer	120			Methyl-1,1'-biphenyl isomer	110		
Unknown	400			Debenzofuran	290		
C-16,H-10 Aromatic Base	trace			Trimethylnaphthalene isomer	trace		
11-H-Benzo[A] fluorene	trace			Methyl-1,1'-biphenyl isomer	trace		
Triphenylene	120			C13,H10 isomer(best match			
				1H-Phenalene)	trace		
				C13,H10 isomer(best match			
				1H-Phenalene)	140		
				C14,H12 isomer(best match			
				4-Methyl-9H-Fluorene)	170		
				Methyl-9H-Fluorene isomer	trace		

Sample No.: 831011-11

Sample Date: 10/5/83

Tentative ID	Est. Conc.
1H-indene	220
1-Methyl-1Hindene	trace
1-Butynylbenzene	trace
Methylnaphthalene isomer	1100
Methylnaphthalene isomer	640
3,3-Dimethylhexane	trace
1,1'-Biphenyl	trace
Dimethylnaphthalene isomer	180
Dimethylnaphthalene isomer	
2-Ethenyl-naphthalene	120
Dimethylnaphthalene isomer	trace
2,4,6-Trimethyloctane	trace
Dedecane	170
2,4,6-Trimethyloctane	110
2,4,6-Trimethyloctane	trace
Methylphenahthrene isomer	trace
Methylphenanthrene isomer	110

Sample No.: 831011-15

Sample Date: 10/5/83

Tentative ID	Est. Conc.
2,4-Dimethylpentane	1.5
Unknown	1.5
Unknown	110
Unknown	trace
Unknown	trace
Unknown	trace
Unknown	trace
1-Methyl-3-(1-methylethyl) cyclopentane	trace
Unknown	trace
Unknown	trace
2,7,10-Trimethyldodecane	2.2
Unknown	3.2
Unknown	1.4
Dimethylnaphthalene isomer	2
Unknown	1.4
trans-Octahydro-2,2,4,4,7,7-hexamethyl-1H-indene	2.6
4,6-Dimethyldodecane	2.5
Unknown	trace
Unknown	1.1
Unknown	trace
Unknown	trace
Unknown	trace
Trimethylnapthalene	trace
Trimethylnapthalene	1.3

Sample No.: 831011-15 (continued)

Sample Date: 10/5/83

Tentative ID	Est. Conc.
Trimethylnapthalene	1
Unknown	2.2
3,6-Dimethylundecane	1.5
2,4,6-Trimethyloctane	trace
2,7,10-Trimethyldodecane	1.4

Sample No.: 831011-16

Sample Date: 10/5/83

Tentative ID	Est. Conc.
Hydrocarbon	2.7
C-6,H-12,O isomer	45
C-7,H-14,O isomer	3.3
2-Pentylfuran	7.5
Unknown	3.1
Unknown	3.3
Unknown	1.3
Fatty acid(best match hexanoic acid)	5.3
Unknown	6.8
Nonanal	3.6
Unknown	6.7
Octanoic Acid	5
2-Decanone or 2-Octanone	1.8
Unknown	1
Unknown	1.7
Fatty acid(best match Nonanoic acid)	2.8
Unknown	3.3
Unknown	5.7
Unknown	5.4
Unknown	2.3
Unknown	2.9
Unknown	16
Unknown	3.2
Unknown	2.2
Nonanedioic acid	7

Sample No.: 831011-16 (continued) Sample Date: 10/5/83		Sample No.: 831011-16 (continued) Sample Date: 10/5/83		Sample No.: 831011-18 Sample Date: 10/5/83		Sample No.: 831011-19 Sample Date: 10/5/83	
Tentative ID	Est. Conc.	Tentative ID	Est. Conc.	Tentative ID	Est. Conc.	Tentative ID	Est. Conc.
Unknown	3.3	Fatty acid(best match		1H-indene	42	1-Ethenyl-3,5-dimethyl-benze	trace
Unknown	2.1	Decanoic acid)	trace	3-Methyl-aH-indene	13	(1-Methyl-2-cyclopropen-1yl)	
Unknown	1.2	Hexadecanoic acid	61	(1-Methy-2-cyclopropen-1-yl)		benzene	12
Tetradecanoic acid	3.4	Unknown	30	benzene	17	Methylnaphthalene isomer	46
		Unknown	2.3	Methylnaphthalene isomer	310	Methylnaphthalene isomer	110
		Unknown	1.3	Methylnaphthalene isomer	180	Isooctanol	trace
		Unknown	1.6	1,1'-Biphenyl	41	4,7-Dimethylundecane	trace
		Octadecanal	5.4	Ethylnaphthalene isomer	trace	Dimethylnaphthalene isomer	140
		1-Heptadecanol	1.8	Dimethylnaphthalene	53	Dimethylnaphthalene isomer	230
		Octadecanal	2.2	Ethylnaphthalene isomer	25	2-Ethenylnaphthalene	31
		Unknown	5.3	Dimethylnaphthalene isomer	22	Dimethylnaphthalene isomer	53
		Unknown	2.9	Methyl-1,2'-biphehyl isomer	trace	2-(1-Methylethyl) naphthalen	10
		Unknown	58	Methylphenanthrene isomer	17	Trimethylnaphthalene isomer	40
				Methylphenanthrene isomer	18	Trimethylnaphthalene isomer	29
				Methylphenanthrene isomer	52	Methyl-1,1'-biphenyl isomer	18
				Phenylnaphthalene isomer	trace	1H-Phenalene	24
				Dimethylphenanthrene isome	trace	4-Methyldibenzofuran	trace
				11H-Benzo [a] fluorene	trace	1H-Phenalene	11
						1,1,3-Trimethylcyclopentane	trace
						Methyl-9H-flourene isomer	21
						Methyl-9H-flourene isomer	12
						Methyl-9H-flourene isomer	trace
						Methyl-9H-flourene isomer	trace
						Methylphenanthrene isomer	51
						Methylphenanthrene isomer	51
						Methylphenanthrene isomer	10
						2-Phenyl-naphthalene	trace
						Dimethylphenanthrene isome	trace

Sample No.: 831011-19 (continued) Sample Date: 10/5/83		Sample No.: 831011-19 Dup. Sample Date: 10/5/83		Sample No.: 831011-21 Sample Date: 10/5/83		Sample No.: 831011-21 (continued) Sample Date: 10/5/83	
Tentative ID	Est. Conc.	Tentative ID	Est. Conc.	Tentative ID	Est. Conc.	Tentative ID	Est. Conc.
1,1'-(1,3-butadiyne-1,4-diyl)		1-Butnylbenzene	11	3-Methyl-heptane	2.2	Unknown	trace
bis-benzene	13	Methylnaphthalene isomer	44	Hexanal	7.4	Unknown	trace
2,3,5-Trimethylphenanthrene	trace	Methylnaphthalene isomer	110	Unknown	trace	Unknown	trace
11H-Benzo [A] fluorene	trace	Isooctanol	trace	Hexanoic acid	2	Nonadecanol	1.3
11H-Benzo [A] fluorene	25	Dimethylnaphthalene isomer	140	2-Pentylfuran	trace	Octadecane	2.7
Methylpyrene isomer	13	Dimethylnaphthalene isomer	170	Unknown	trace	Undecane	trace
Methylpyrene isomer	13	1,1'-Biphenyl	30	Unknown	1.1	Unknown	trace
Dimethylphenanthrene isome	33	Dimethylnaphthalene isomer	51	Nonanal	trace	1-Undecanol	trace
Dimethylphenanthrene isome	15	Trimethylnaphthalene isomer	38	Unknown	trace	Tetradecanoic acid	42
		Trimethylnaphthalene isomer	28	Unknown	trace	Unknown	trace
		Methyl-1,1'-biphenyl isomer	15	Undecane	1.3	Unknown	1.5
		Trimethylnaphthalene isomer	40	Unknown	trace	Unknown	trace
		Trimethylnaphthalene isomer	25	Undecane	1.5	Unknown	trace
		1H-Phenalene	22	Methylnaphthalene isomer	6.5	Unknown	560
		Methyl-9H-flourene isomer	18	Methylnaphthalene isomer	4.7	Unknown	2.3
		Methyl-9H-flourene isomer	trace	2,4-Dimethylhexane	trace	Unknown	4.1
		Methyl-9H-flourene isomer	trace	Unknown	trace	Unknown	trace
		Methyl-9H-flourene isomer	trace	1,1'-Biphenyl	trace		
		Methylphenanthrene isomer	50	Ethylnaphthalene	trace		
		Methylphenanthrene isomer	52	Dimethylnaphthalene isomer	2.3		
		Methylphenanthrene isomer	trace	Dimethylnaphthalene isomer	5		
		Methylphenanthrene isomer	100	Dimethylnaphthalene isomer	1.2		
		Dimethylphenanthrene isome	14	Octadecane	5.6		
		Dimethylphenanthrene isome	33	Methyl-1,1'-biphenyl isomer	trace		
		11H-Benzo [A] fluorene	22	Methylethylnaphthalene isom	trace		
		Methylpyrene isomer	11	Unknown	trace		
		Methylpyrene isomer	trace	Unknown	6		
				Trimethylnaphthalene isomer	trace		

Sample No.: 831011-21 (continued) Sample Date: 10/5/83		Sample No.: 831222-10 Dup. Sample Date: 12/6/1983		Sample No.: 831222-11 Sample Date: 12/6/1983		Sample No.: 831222-12 Sample Date: 12/6/1983	
Tentative ID	Est. Conc.	Tentative ID	Est. Conc.	Tentative ID	Est. Conc.	Tentative ID	Est. Conc.
Unknown	1.8	3-Methyl-heptane	trace	(E)-2-Methyl-3-heptene	0.4	2-Methylheptane	5.9
1-Methylpyrene	4.5	3,4-dimethyldecane	trace	2,6-Dimethylheptane	trace	2,5-Dimethyl-1-hexene	11
Unknown	2.1						
Unknown	2.5						
1-Methylpyrene	1.7						
Unknown	1.5						
Unknown	3						
Unknown	1.4						
Unknown	trace						
Unknown	trace						
Unknown	1.7						
Unknown	16						
Methylbenz/A/anthracene is	1.2						
Unknown	trace						
Perylene	3.1						
Unknown	2.9						

Sample No.: 831222-13

Sample Date: 12/6/1983

Tentative ID	Est. Conc.
2-Methyl-1-heptene	8
1,1,2,3-Tetramethycyclopropa	6.4
2,3,3-Trimethylpentane	2
(E)-6-Nonen-1-ol	trace
O-decylhydroxylamine	trace
Hydrocarbon(best match	
2,5,9-Trimethydodecane)	trace
Hydrocarbon(best match	
2,7,10-trimethyldodecane)	trace
Hydrocarbon(best match	
2,4,6-Trimethyloctane)	trace
Hydrocarbon(best match	
2,4,6-Trimethyloctane)	trace
Hydrocarbon(best match	
2,7,10-trimethyldodecane)	trace
Hydrocarbon(best match	
2,7,10-trimethyldodecane)	trace
Hydrocarbon(best match	
2,6,11-Trimethyldodecane)	trace
Hydrocarbon(best match	
2,4,6-Trimethyloctane)	trace

Sample No.: 831222-14

Sample Date: 12/6/1983

Tentative ID	Est. Conc.
Methylbenzene	6.2
Hydrocarbon(best match	
Ethylcyclobutane)	14
Hydrocarbon(best match	
2,3,7-Trimethyloctane)	6
Hydrocarbon(best match	
2,6,11-Trimethyldodecane)	8.6
Hydrocarbon(best match	
3,5,5-Trimethyl-1-hexene)	3.4
Hydrocarbon(best match	
2,2,4,4,7,7-Hexamethyl	
octahydro-1H-indene	3.4
Hydrocarbon(best match	
2,6-Dimethylnonane)	11
Hydrocarbon(best match	
2-Propyl-1-heptanol)	2.8
Hydrocarbon(best match	
2,6,8-Trimethyldecane	7.9
Hydrocarbon(best match	
2,7,10-trimethyldodecane)	31
Hydrocarbon(best match	
2,4,6-Trimethyloctane)	11

Sample No.: 831222-15

Sample Date: 12/6/1983

Tentative ID	Est. Conc.
Hydrocarbon(best match	
3-Ethyl-4-methylhexane)	8.8
Methylbenzene	2.4
Hydrocarbon(best match	
Undecane)	7.7
Hydrocarbon(best match	
3,7-Dimethyl-1-octene)	4.7
Hydrocarbon(best match	
1-Ethyl-1-methlcyclopentene)	3.1
Hydrocarbon(best match	
2,3,7-Trimethyloctane)	22
Hydrocarbon(best match	
3,5,5-Trimethyl-1-hexene)	5.5
Hydrocarbon(best match	
6-Ethyl-2-methyldecane	5.9
Hydrocarbon(best match	
1-Methyl-3-[(1-methylethyl)	
cyclopentane]	5.6
Hydrocarbon(best match	
3,7-Dimethylnonane)	31
C12,H26,o isomer (best match	
2-Ethyl-1-decanol)	11
Hydrocarbon(best match	
2,2,4,4,7,7-Hexamethyl	
octahydro-1H-indene	8.3

Sample No.: 831222-15
(continued)

Sample Date: 12/6/1983

Tentative ID	Est. Conc.
Hydrocarbon(best match	
2,8-Dimethylundecane	32
Hydrocarbon(best match	
Undecane)	6.5
Hydrocarbon(best match	
2,4,6-Trimethyloctane)	5.2

Sample No.: 831222-15

Sample Date: 12/6/1983

Tentative ID	Est. Conc.
Hydrocarbon(best match	
2,6,11-Trimethyldodecane	22
1-(Ethenyloxy) octadecane	trace
Hydrocarbon(best match	
2,7,10-Trimethyldodecane	31
Hydrocarbon(best match	
2,4-Dimethyldecane)	trace
2-Ethyl-1-decanol or 1-Tridec	5
Hydrocarbon(best match	
2,7,10-Trimethyldodecane	15
3H-Benz[E]indole-2-carboxylic acid	23
Hydrocarbon(best match	
Undecane)	4.1

As discussed in Section 1.2.1.1, information regarding sampling depth, methodology of composite sample collection and QA/QC criteria or standards followed during the 1983 and 1984 soil sampling events was not documented and/or available.

4.1.2 BCM Source Characterization

As part of the RI, BCM collected onsite soil samples in March and June 1990 to delineate the horizontal and vertical extent of any soil contamination. The soils/source investigation is described in detail in Section 2.4. Soil samples were collected from eight locations within the the former drum and storage tank area, four other onsite areas and one additional soil sample location adjacent to the east side of the concrete pad. In boring S-07, no sample was collected because no sample interval of unsaturated soil was present between the clay cap and the top of the water table.

Figure 2-3 shows the location of the soil borings installed during the RI. Table 2-2 presents the sample depths for each soil boring.

A total of 24 soil samples were submitted for laboratory analyses, including three field duplicate samples. Section 2.4.4 describes the analytical parameters for which tests were performed.

Table 4-2 presents a summary of the results of the RI soil sampling program. The distribution of compounds detected onsite is presented in Figure 4-1. Table 4-3 presents a statistical summary and frequency of detection for the RI soils analytical data. All analytical data and accompanying documentation is contained in Appendix VII. The data validation report for these samples is provided in Appendix VIII.

Split samples from three locations were retained for chemical analyses by EPA's oversight contractor. Table 4-4 is a summary of EPA's data and the EPA validation reports which contain the analytical data and documentation are contained in Appendix IX.

The following sections contain a discussion of these results by compound group. For purposes of this RI, soil sample results are presented as micrograms per kilogram (ug/kg) which is equivalent to parts per billion or as milligrams per kilogram (mg/kg), which is equivalent to parts per million.

4.1.2.1 Volatile Organic Compounds

Twenty-three soil samples were submitted to CompuChem for analysis of volatile organics. Pursuant to EPA's approval, surface soil sample S-14-(0-1)-S was not analyzed for volatile organics. VOCs were found in onsite soil samples in concentrations ranging from non-detect to 220 ug/kg. Methylene chloride was found in all 23 soil samples (5-220

TABLE 4-2 *

SUMMARY OF RI ANALYTICAL RESULTS IN SOIL (1990)
SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE
SEPTEMBER 1990

Sample Name:	S01(0-2)-S	S01(2-4)-S	S02(0-2)-S	S02(2-4)-S	S03-(2-3)-S	S03(3.5-5.5)-S	S04(2.6-4.6)-S	S04(4.6-6.0)-S
Sample Depth (feet):	0-2	2-4	0-2	2-4	2.0-3.0	3.5-5.5	2.6-4.6	4.6-6.0
BCM Lab ID:	008791	008792	008793	008790 008794	008797	008798	008799	008800
COMPUCHEM ID:	327244 327245 327246	327247 327248 327249 332651	327252 327266 327268	327269 327270 327271	327809 327811 327813	327815 327816 327819	327821 327822 327823	327826 327831 327833
Date Sampled:	3/20/90	3/20/90	3/20/90	3/20/90	3/21/90	3/21/90	3/21/90	3/21/90
Parameters, units								
Metals, mg/kg								
Aluminum	10,200	10,700	15,600	14,300	8,890	9,120	13,100	12,900
Antimony	5.3 UL	4.6 U	4.8 U	4.8 U	4.6 UL	4.4 UL	4.3 UL	4.7 UL
Arsenic	5.7 L	1.2 BL	1.6 B	2.7	7.8 L	5.2 L	2.3 BL	2.6 L
Barium	120	44.3	37.0 B	28.0 B	96.2	37.0 B	77.3	40.6 B
Beryllium	0.73 B	0.57 B	0.52 B	0.39 B	0.22 U	0.35 B	0.21 U	0.36 B
Calcium	3,240	175 B	443 B	202 B	5,010	446 B	12,300	576 B
Chromium	25	11.6	13.6	9.6	39.7	10.9	23.7	11.8
Cobalt	6.8 BL	6.8 BL	5.1 B	11.0 B	10.2 BL	6.1 BL	12.9	6.6 BL
Copper	39.8	6.0	4.9 B	2.3 B	44	9.4	51.5	6.2
Iron	23,800	12,000	16,100	10,700	18,200	12,300	17,500	13,900
Lead	85.3 J	7.5	7.4	20.6	100 J	13.6	33.1 J	9.9
Magnesium	3,690	733 B	813 B	365 B	5,100	533 B	8,040	663 B
Manganese	198	199	68	139	165	62	573	101
Mercury	0.13 U	0.11 U	0.1 U	0.11 U	0.19	0.14	0.12	0.13
Nickel	22.8	6.4 U	7.9 B	6.60 U	122	6.1 U	11.5	7.5 B
Potassium	2,310 Q	667 BQ	1,230	288 U	1,800 Q	508 BQ	1,740 Q	577 BQ
Sodium	386 BK	407 BK	599 B	340 U	382 BK	315 U	781 BK	366 U
Vanadium	43.7	20.8	24.3	16.9	26.8	16.9	40.4	20.4
Zinc	78.9	23.1	24.6	17.0	97.2	20.2	58.9	20.6
Cyanide	0.66 U	0.56 U	0.57 U	0.58 U	0.56 U	0.55 U	0.53 U	0.56 U
Volatile Organic Compounds, ug/kg								
Methylene Chloride	54 BQ	14 BQ	9 BQ	11 BQ	12 BQ	16 BQ	23 BQ	85 BQ
Acetone	8 BJQ	9 BJQ	14 BQ	14 BQ	34 J	11 U	11 U	220 BQ
Benzene	7 U	6 U	6 U	6 U	4 J	6 U	5 U	28 U
2-Hexanone	13 U	12 U	11 U	12 U	11 U	11 U	11 U	56 U
Toluene	7 U	6 U	6 U	6 U	34 J	6 U	5 U	28 U

* See Table 4-2 p. 15 for legend.

Sample Name: Date Sampled:	S01(0-2)-S 3/20/90	S01(2-4)-S 3/20/90	S02(0-2)-S 3/20/90	S02(2-4)-S 3/20/90	S03-(2-3)-S 3/21/90	S03(3.5-5.5)-S 3/21/90	S04(2.6-4.6)-S 3/21/90	S04(4.6-6.0)-S 3/21/90
Parameters, units								
Volatile Organic Compounds, ug/kg								
Ethylbenzene	7 U	6 U	6 U	6 U	92 J	6 U	5 U	28 U
Total Xylenes	7 U	6 U	6 U	6 U	190 J	1 J	5 U	28 U
Carbon Disulfide	7 U	6 U	6 U	6 U	6 U	6 U	5 U	28 U
Chloroform	7 U	6 U	6 U	6 U	6 U	6 U	5 U	28 U
Semivolatile Organics, ug/kg								
Phenol	430 U	380 U	370 U	410 U	2,200 U	370 U	350 U	370 U
4-Methylphenol	430 U	380 U	370 U	410 U	610 J	370 U	350 U	370 U
2,4-Dimethylphenol	430 U	380 U	370 U	410 U	2,200 U	370 U	380	460
Benzoic Acid	45 J	1,900 U	1,800 U	2,000 U	1,500 J	1,800 U	1,700 U	1,800 U
Naphthalene	170 J	380 U	370 U	410 U	20,000	370 U	520	470
2-Methylnaphthalene	250 J	380 U	370 U	410 U	14,000	370 U	1,200	5,800
Acenaphthylene	130 J	380 U	370 U	410 U	7,800	370 U	350 U	370 U
Acenaphthene	44 J	380 U	370 U	410 U	1,900 J	370 U	570	850
Dibenzofuran	110 J	380 U	370 U	410 U	1,300 J	370 U	630	860
Fluorene	430 U	380 U	370 U	410 U	7,400	370 U	620	1,200
Phenanthrene	620	46 J	370 U	410 U	22,000	370 U	1,200	2,000
Anthracene	160 J	380 U	370 U	410 U	5,700	370 U	300 J	130 J
Fluoranthene	1,300	46 J	370 U	410 U	11,000	370 U	320 J	180 J
Pyrene	1,200	57 J	370 U	410 U	22,000	370 U	280 J	230 J
Benzo(a)Anthracene	900	380 U	370 U	410 U	7,200	370 U	170 J	50 J
Chrysene	1,100	380 U	370 U	410 U	7,900	370 U	230 J	93 J
bis(2-Ethylhexyl)Phthalate	430 U	380 U	370 U	410 U	530 J	370 U	350 U	41 J
Benzo(b)Fluoranthene	3,000 XJ	380 U	370 U	410 U	15,000 XJ	370 U	400 X	100 XJ
Benzo(k)Fluoranthene	3,000 X	380 U	370 U	410 U	15,000 X	370 U	400 X	100 XJ
Benzo(a)Pyrene	830	380 U	370 U	410 U	13,000	370 U	170 J	370 U
Ideno(1,2,3,-cd)Pyrene	300 J	380 U	370 U	410 U	3,400	370 U	350 U	370 U
Dibenz(a,h)Anthracene	130 J	380 UJ	370 UJ	410 UJ	1,800 J	370 U	350 U	370 U
Benzo(g,h,i)Perylene	310 J	380 U	370 U	410 U	4,800	370 U	350 U	370 U
Dimethyl Phthalate	430 U	380 U	370 U	410 U	2,200 U	370 U	350 U	370 U
Pesticide Organics, ug/kg								
beta-BHC	9.3 U	9.3 U	9.1 U	10.0 U	8.9 UR	8.9 U	8.6 U	9.0 U
Total Organic Carbon,mg/kg	NT	210.0	NT	NT	NT	NT	NT	NT
Total Petroleum Hydrocarbons, mg/kg	3,000	25 U	25 U	25 U	2,700	25 U	1,600	2,500
Volatile Organics - Tentatively Identified Compounds, ug/kg								
Ethylmethylbenzene	–	–	–	–	18 J	–	–	–
Ethylmethylbenzene	–	–	–	–	400 J	–	–	–
Ethylmethylbenzene	–	–	–	–	36 J	–	–	–
Trimethylbenzene	–	–	–	–	110 J	–	–	–
Ethane1,1,2-Trichloro-1,2,2	–	–	–	–	–	–	24 J	–

Sample Name: Date Sampled:	S01(0-2)-S 3/20/90	S01(2-4)-S 3/20/90	S02(0-2)-S 3/20/90	S02(2-4)-S 3/20/90	S03-(2-3)-S 3/21/90	S03(3.5-5.5)-S 3/21/90	S04(2.6-4.6)-S 3/21/90	S04(4.6-6.0)-S 3/21/90
Parameters, units								
Volatile Organics - Tentatively Identified Compounds, ug/kg								
Cyclohexane, Propyl	—	—	—	—	—	—	41 J	—
Decahydronathalene + Unknown	—	—	—	—	—	—	—	1,500 J
Sub-Benzene + Unknown	—	—	—	—	—	—	—	6,200 J
Unknown Cyclic Hydrocarbon	—	—	—	—	—	—	86 J	—
Unknown Alkene	—	—	—	—	—	—	24 J	—
Unknown Hydrocarbon	—	—	—	—	—	—	82 J	4,800 J
Unknown Hydrocarbon	—	—	—	—	—	—	51 J	6,700 J
Unknown Hydrocarbon	—	—	—	—	—	—	—	4,900 J
Unknown	—	—	—	—	—	—	28 J	8,400 J
Unknown	—	—	—	—	—	—	99 J	6,700 J
Unknown	—	—	—	—	—	—	180 J	7,300 J
Unknown	—	—	—	—	—	—	31 J	8,400 J
Unknown	—	—	—	—	—	—	—	7,900 J
Semivolatile Organics - Tentatively Identified Compounds, ug/kg								
Methylnaphthalene	—	—	—	—	5,800 J	—	—	—
Ethenylnaphthalene	—	—	—	—	2,700 J	—	—	—
Ethylnaphthalene	—	—	—	—	3,300 J	—	—	—
Ethyl Dimethyl Benzene	—	—	—	—	—	—	—	7,100 J
Dimethylnaphthalene	—	—	—	—	3,300 J	—	7,200 J	—
Dimethylnaphthalene	—	—	—	—	9,100 J	—	—	—
Trimethylnaphthalene	—	—	—	—	2,900 J	—	9,700 J	8,600 J
Trimethylnaphthalene	—	—	—	—	—	—	7,500 J	6,000 J
Trimethylnaphthalene	—	—	—	—	—	—	8,200 J	9,700 J
Dimethylphenanthrene	—	—	—	—	2,400 J	—	—	—
Unknown	350 J	—	—	—	3,100 J	—	7,500 J	—
Tetradecanoic Acid	—	—	—	—	5,600 J	—	—	—
Aldol	700 AJ	—	—	—	—	220 AJ	—	—
Aldol	740 AJ	—	—	—	—	—	—	—
1-Methylnaphthalene	260 J	—	—	—	—	—	—	7,500 J
Unknown	480 J	—	—	—	2,700 J	—	—	7,500 J
Tetramethylpentadecane	350 J	—	—	—	—	—	—	—
Dimethylheptadecane	350 J	—	—	—	—	—	—	—
Heptadecane + Unknown	260 J	—	—	—	—	—	—	—
Hexadecanoic Acid	—	—	—	—	31,000 J	—	—	—
Methylphenanthrene	440 J	—	—	—	—	—	—	—
Dimethylheptadecane	440 J	—	—	—	—	—	—	—
11H-Benzofluorene + unknown	350 J	—	—	—	—	—	—	—
Benzanthracenone + unknown	260 J	—	—	—	—	—	—	—
Dimethylheptadecane	310 J	—	—	—	—	—	—	—
Benzonaphthothiophene + unknown	390 J	—	—	—	—	—	—	—
Benzanthracenone + unknown	260 J	—	—	—	—	—	—	—
Unknown Hydrocarbon	920 J	—	—	—	4,400 J	—	12,000 J	7,900 J

Sample Name: Date Sampled:	S01(0-2)-S 3/20/90	S01(2-4)-S 3/20/90	S02(0-2)-S 3/20/90	S02(2-4)-S 3/20/90	S03-(2-3)-S 3/21/90	S03(3.5-5.5)-S 3/21/90	S04(2.6-4.6)-S 3/21/90	S04(4.6-6.0)-S 3/21/90
Parameters, units								
Semivolatile Organics - Tentatively Identified Compounds, ug/kg								
Unknown Hydrocarbon	—	—	—	—	—	—	—	3700 J
Benzopyrene	610 J	—	—	—	—	—	—	—
Benzofluoranthene	740 J	—	—	—	8200 J	—	—	—
Benzofluorene	—	—	—	—	2900 J	—	—	—
Methylpyrene	—	—	—	—	2900 J	—	—	—
Methylpyrene+unknown	—	—	—	—	5300 J	—	—	—
Undecane, 2,6-Dimethyl-	—	—	—	—	—	—	14000 J	—
Undecane, 2,6-Dimethyl-	—	—	—	—	—	—	13000 J	—
Tridecane, 7-Methyl-	—	—	—	—	—	—	13000 J	—
Heptadecane,2,6-Dimethyl-	—	—	—	—	—	—	28000 J	13000 J
Pentadecane,2,6,10,14-Tetra	—	—	—	—	—	—	23000 J	12000 J
Dimethyl-11'-Biphenyl	—	—	—	—	—	—	3600 J	—
Heptadecane,2,6-Dimethyl-	—	—	—	—	—	—	8600 J	24000 J
Heptadecane,2,6-Dimethyl-	—	—	—	—	—	—	—	22000 J
Heptadecane,2,6-Dimethyl-	—	—	—	—	—	—	—	10000 J
Unknown PAH	—	—	—	—	7300 J	—	—	—
Unknown Aromatic Hydrocarbon	—	—	—	—	—	—	—	7900 J
Unknown	660 J	—	—	—	2900 J	—	7900 J	5600 J
Unknown	1100 J	—	—	—	21000 J	—	6400 J	18000 J
Unknown	440 J	—	—	—	78000 J	—	5000 J	5200 J
Unknown	610 J	—	—	—	—	—	8200 J	6700 J
Unknown	—	—	—	—	—	—	7200 J	7100 J
Unknown	—	—	—	—	—	—	11000 J	11000 J
Unknown	—	—	—	—	—	—	7500 J	15000 J
Blank Contaminant	—	—	—	—	—	180 BJ	—	

Sample Name:	S05(3.4-5.2)-S	S05(3.4-4.2)-S Duplicate	S06(3-4)-S	S08(3.7-4)-S	S09(0-1.6)-S	S99(0-1.6)-S Duplicate
Sample Depth (feet):	3.4-5.2	3.4-5.2	3.0-4.0	3.7-4.0	0.0-1.6	0.0-1.6
BCM Lab ID:	008801		008802	008803	008777	008779
COMPUCHEM ID:	327838 327845 327849	327879 327881 327883	327852 327855 327856	327869 327873 327874	328242 328243 328244	328294 328296 328298
Date Sampled:	3/21/90	3/21/90	3/21/90	3/21/90	3/22/90	3/22/90
Parameters, units						
Metals, mg/kg						
Aluminum	7,910	9,350	8,460	9,710	11,100	7,190
Antimony	12.1 BQ	14.3 Q	4.5 U	4.9 U	4.4 U	6.0 B
Arsenic	7.4 L	6.7 L	2.2 B	1.7 B	1.0 B	1.1 B
Barium	46.9	55.6	19.6 B	31.9 B	161.0	114.0
Beryllium	0.25 BJ	0.49 BJ	0.22 B	0.39 B	0.25 B	0.21 U
Calcium	30,100	22,900	844 B	532 B	4,260	3,920
Chromium	13.2	16.3	34.4	13.8	33.1	20.0
Cobalt	9.9 BL	9.7 BL	4.1 B	9.0 B	13.7	8.9 B
Copper	36.7	39.7	12.6	6.8	34.1	30.8
Iron	19,100	21,700	11,200	13,000	20,200	14,200
Lead	45.2 J	51.8 J	21.5	6.6	26.0	25.1
Magnesium	15,800	12,300	823 B	515 B	6,500	4,870
Manganese	248	272	61	247	191	116
Mercury	0.18	0.16	0.18	0.13	0.15	0.11 U
Nickel	392	339	18	11.2	38.8	19.8
Potassium	813 BQ	719 BQ	314 B	296 U	4,040	3,400
Sodium	423 BK	423 BK	317 U	350 U	315 U	317 U
Vanadium	26.6	26.9	16.5	18.2	49.7	44.4
Zinc	55.8	64.2	35.8	34.8	79.7	63.1
Cyanide	0.56 U	0.56 U	0.54 U	0.59 U	0.53 U	0.53 U
Volatile Organic Compounds, ug/kg						
Methylene Chloride	58 BQ	25 BQ	23 BQ	38 BQ	14 BQ	26 BQ
Acetone	29 J	7 BJQ	7 BJQ	53 J	5 J	71 B
Benzene	6 U	6 U	5 U	6 U	5 U	5 U
2-Hexanone	11 UJ	11 U	11 UJ	12 U	11 U	11 U
Toluene	6 U	6 U	5 U	6 U	5 U	5 U
Ethylbenzene	6 U	6 U	5 U	6 U	5 U	5 U
Total Xylenes	6 U	6 U	5 U	6 U	5 U	5 U
Carbon Disulfide	6 U	2 J	5 UJ	6 U	5 U	5 U
Chloroform	6 U	6 U	1 J	6 U	5 U	5 U

Sample Name: Date Sampled:	S05(3.4-5.2)-S 3/21/90	S05(3.4-4.2)-S 3/21/90	S06(3-4)-S 3/21/90	S08(3.7-4)-S 3/21/90	S09(0-1.6)-S 3/22/90	S99(0-1.6)-S 3/22/90
Parameters, units						
Semivolatile Organic Compounds,ug/kg						
Phenol	40 J	1,500 U	360 U	390 U	350 U	350 U
4-Methylphenol	360 J	210 J	65 J	390 U	350 U	350 U
2,4-Dimethylphenol	370 U	1,500 U	360 U	390 U	350 U	350 U
Benzoic Acid	370 UJ	7,200 UJ	71 J	200 J	160 J	310 J
Naphthalene	2,000	1,900	1,100	810	210 J	180 J
2-Methylnaphthalene	1,300	1,100 J	650	690	170 J	150 J
Acenaphthylene	1,700 J	2,600 J	650	150 J	260 J	230 J
Acenaphthene	340 J	270 J	140 J	390 J	350 U	350 U
Dibenzofuran	380	390 J	66 J	64 J	350 U	50 J
Fluorene	1,300	1,400 J	320 J	510	69 J	110 J
Phenanthrene	6,500 D	7,700	1,100	1,800	290 J	830
Anthracene	1,700	2,100	450	520	82 J	190 J
Fluoranthene	17,000 D	23,000	1,100	650	290 J	1,600
Pyrene	12,000 D	17,000	2,300	1,400	420	920
Benzo(a)Anthracene	8,100 D	12,000	940	390 J	300 J	670
Chrysene	7,700 D	11,000	1,000	350 J	300 J	670
bis(2-Ethylhexyl)Phthalate	370 U	1,500 U	140 J	390 U	37 J	130 J
Benzo(b)Fluoranthene	16,000 DXJ	20,000 XJ	2,200 XJ	430 XJ	700 XJ	720
Benzo(k)Fluoranthene	16,000 DX	20,000 XJ	2,200 X	430 XJ	700 XJ	830
Benzo(a)Pyrene	7,600 D	9,800	2,000	360 J	440	750
Ideno(1,2,3,-cd)Pyrene	2,600 J	5,500 J	490	110 J	230 J	270 J
Dibenz(a,h)Anthracene	1,500 J	2,900 J	230 J	390 U	100 J	110 J
Benzo(g,h,i)Perylene	2,400 J	5,800 J	620	160 J	360	350 J
Dimethyl Phthalate	370 U	1,500 U	360 U	390 U	350 U	350 U
Pesticide Organics, ug/kg						
beta-BHC	9.0 UR	9.0 UR	8.7 U	9.5 U	28	37
Total Organic Carbon,mg/kg	208,000	NT	NT	NT	NT	NT
Total Petroleum Hydrocarbons, mg/kg	72	61	250	43	2,700	2,800
Semivolatile Organics - Tentatively Identified Compounds, ug/kg						
Aldol	750 J	—	650 J	480 J	850 J	850 J
Aldol	—	—	720 J	200 J	920 J	890 J
Dimethylheptadecane	—	—	—	—	250 J	—
Dimethylheptadecane	—	—	—	—	110 J	—
Trimethyldodecane + unknown	—	—	—	—	110 J	—
Methylnaphthalene	750 J	—	—	—	—	—
1,4-Methanonaphthalene,1,4-	—	—	—	400 J	—	—
Ethyl Naphthalene	—	—	—	120 J	—	—
Dimethylnaphthalene	1,200 J	—	430 J	240 J	—	—
Dimethylnaphthalene	—	—	—	440 J	—	—
Naphthalene, 2-Ethyl-	—	—	—	79 J	—	—
Trim[illegible] Naphthalene	—	—	—	24[illegible]	—	—
Ant[illegible], 1-Methyl-	—	—	—	[illegible]	—	—

Sample Name: Date Sampled:	S05(3.4-5.2)-S 3/21/90	S05(3.4-4.2)-S 3/21/90	S06(3-4)-S 3/21/90	S08(3.7-4)-S 3/21/90	S09(0-1.6)-S 3/22/90	S99(0-1.6)-S 3/22/90
Parameters, units						
Semivolatile Organics - Tentatively Identified Compounds, ug/kg						
Methylanthracene	2,100 J	1,800 J	—	120 J	—	280 J
Ethylanthracene	—	—	—	—	—	210 J
Anthracene, 2-Ethyl-	—	—	—	280 J	—	—
Anthracenedione	670 J	—	—	—	—	—
9,10-Anthracenedione	—	600 J	—	—	—	—
Dimethylphenanthrene	1,100 J	—	580 J	—	—	—
Benzofluorene	1,000 J	—	400 J	—	—	—
Benzofluorene	1,900 J	—	—	—	—	—
Benzofluorene	1,300 J	—	—	—	—	—
Benzofluorene	1,200 J	—	—	—	—	—
Benzofluorene + unknown	—	—	—	—	—	180 J
11H-Benzofluorene	—	4,200 J	—	—	110 J	—
11H-Benzofluorene	—	2,800 J	—	—	—	—
11H-Benzo(A)fluorene	—	—	—	240 J	—	—
Methylpyrene	940 J	—	290 J	120 J	—	210 J
Methylpyrene	—	—	800 J	240 J	—	—
Methylpyrene + unknown	—	1,900 J	—	—	—	210 J
Methylpyrene + unknown	—	1,900 J	—	—	—	—
Benzanthracenone	820 J	—	—	—	—	—
Benzonaphthothiophene	1,200 J	—	—	—	—	—
Benzonaphthothiophene + unknown	—	3,300 J	—	—	—	—
Benzofluoranthene	1,000 J	2,100 J	—	—	500 J	570 J
Benzofluoranthene	—	3,600 J	—	—	—	—
Benzofluoranthene + unknown	—	2,700 J	—	—	280 J	—
Benzanthracenone + unknown	1,100 J	—	—	—	—	—
Benzanthracenone	—	2,100 J	—	—	—	—
Benzanthracenone + unknown	—	3,000 J	—	—	—	—
Benzofluoranthene	1,100 J	—	1,300 J	—	—	—
Dimethylpyrene	—	1,300 J	360 J	—	—	—
Methyltriphenylene	—	2,100 J	—	—	—	—
Sulfur	12,000 J	—	—	—	—	—
Sulfur,(MOL.S8)	—	28,000 J	—	—	—	—
Hexadeconic Acid	—	—	1,800 J	—	—	—
Methylchrysene	—	—	290 J	—	—	—
Unknown Hydrocarbon	—	—	690 J	—	—	210 J
Unknown Carboxylic Acid	—	—	470 J	—	—	—
Unknown Hydrocarbon	—	—	250 J	—	—	—
Unknown PAH	3,400 J	—	690 J	2,300 J	—	—
Unknown PAH	820 J	—	—	200 J	—	—
Unknown PAH	—	—	—	120 J	—	—
Unknown PNA	750 J	—	—	—	—	—
Unknown	1,300 J	3,000 J	290 J	160 J	180 J	430 J
Unknown	—	1,300 J	290 J	17,000 J	210 J	210 J
Unknown	—	1,800 J	250 J	520 J	140 J	430 J

Sample Name: Date Sampled:	S05(3.4-5.2)-S 3/21/90	S05(3.4-4.2)-S 3/21/90	S06(3-4)-S 3/21/90	S08(3.7-4)-S 3/21/90	S09(0-1.6)-S 3/22/90	S99(0-1.6)-S 3/22/90
Parameters, units						
Semivolatile Organics - Tentatively Identified Compounds, ug/kg						
Unknown	–	1,500 J	430 J	3,400 J	600 J	320 J
Unknown	–	2,400 J	5,400 J	–	1,100 J	250 J
Unknown	–	–	3,100 J	–	390 J	280 J
Unknown	–	–	20,000 J	–	250 J	280 J
Unknown	–	–	–	–	250 J	460 J
Unknown	–	–	–	–	780 J	210 J
Unknown	–	–	–	–	180 J	570 J
Unknown	–	–	–	–	280 J	350 J
Unknown	–	–	–	–	–	280 J
Unknown	–	–	–	–	–	280 J
Volatile Organics-Tentatively Identified Compounds						
Ethane,1,1,2-Trichloro-1,2,2	29 J	–	–	9.5 J	–	–

Sample Name:	S09(2.5-4.2)-S	S10(2.5-4.5)-S	S100(2.5-4.5)-S Duplicate	S11(1-2)-S	S11(2-4)-S	S12(0-2)-S	S12(2-4)-S
Sample Depth (feet):	2.5-4.2	2.5-4.5	2.5-4.5	1.0-2.0	2.0-4.0	0.0-2.0	2.0-4.0
BCM Lab ID:	008778	008780	008787	008786	008781	008782	008783
COMPUCHEM ID:	328245 328246 328247	328248 328249 328251	328303 328305 328307	328252 328254 328256	328260 328261 328262	328263 328265 328266	328268 328270 328271
Date Sampled:	3/22/90	3/22/90	3/22/90	3/22/90	3/22/90	3/22/90	3/22/90
Parameters, units							
Metals, mg/kg							
Aluminum	12,300	6,440	4,990	10,200	10,800	12,000	13,700
Antimony	4.7 B	5.0 U	5.0 U	4.3 U	4.6 U	7.9 B	4.8 U
Arsenic	4.8	8.7	9.0	0.9 B	1.4 B	2.1 B	0.7 U
Barium	103.0	87.7	86.5	157.0	174.0	217.0	101.0
Beryllium	0.48 B	0.24 U	0.24 U	0.25 B	0.28 B	0.22 U	0.42 B
Calcium	10,800	4,880	3,790	9,030	5,070	7,210	4,160
Chromium	16.9	16.4	12.7	22.7	22.5	58.4	20.0
Cobalt	8.5 B	7.2 B	5.8 B	12.7	12.0	21.0	9.8 B
Copper	17.7	22.8	27.9	29.4	34.0	54.3	23.2
Iron	17,400	19,000	17,700	18,600	19,000	28,800	17,500
Lead	29.1	91.7	45.8	16.0	8.9	19.7	6.1
Magnesium	5,190	2,810	2,060	5,890	5,380	8,470	2,570
Manganese	198	145	113	223	196	283	127
Mercury	0.14	0.18	3.9	0.19	0.14	0.13	0.12
Nickel	20.9	15.4	7.5 B	57.8	98.1	33.3	28.6
Potassium	966 B	300 U	752 B	3,350	2,600	4,400	518 B
Sodium	328 U	355 U	351 U	387 B	325 U	330 U	339 U
Vanadium	22.0	20.4	29.4	37.7	38.5	48.0	32.2
Zinc	34.5	95.0	190.0	52.2	59.8	170.0	74.4
Cyanide	0.55 U	0.60 U	0.59 U	0.52 U	0.54 U	0.56 U	0.60 U
Volatile Organic Compounds, ug/kg							
Methylene Chloride	48 BQ	37 BQ	18 BQ	23 BQ	38 BQ	37 BQ	14 BQ
Acetone	11 UJ	15	58 B	8 BJQ	9 BJQ	9 BJQ	6 J
Benzene	5 U	6 U	6 U	5 U	5 U	6 U	6 U
2-Hexanone	11 UJ	12 U	110	11 U	11 U	11 U	12 UJ
Toluene	5 U	6 U	6 U	5 U	5 U	6 U	6 U
Ethylbenzene	5 U	6 U	6 U	5 U	5 U	6 U	6 U
Total Xylenes	5 U	6 U	6 U	5 U	5 U	6 U	6 U
Carbon Disulfide	5 UJ	6 U	6 U	5 U	5 U	6 U	6 U
Chloroform	5 U	6 U	6 U	5 U	5 U	6 U	6 U

Sample Name: Date Sampled:	S09(2.5-4.2)-S 3/22/90	S10(2.5-4.5)-S 3/22/90	S100(25-45)-S 3/22/90	S11(1-2)-S 3/22/90	S11(2-4)-S 3/22/90	S12(0-2)-S 3/22/90	S12(2-4)-S 3/22/90
Parameters, units							
Semivolatile Organics, ug/kg							
Phenol	360 U	400 U	390 U	350 U	360 U	370 U	390 U
4-Methylphenol	360 U	400 U	390 U	350 U	360 U	370 U	390 U
2,4-Dimethylphenol	360 U	670	390 U	350 U	360 U	370 U	390 U
Benzoic Acid	44 J	1,900 UJ	1,900 U	36 J	1,700 UJ	160 J	1,900 UJ
Naphthalene	37 J	1,900	1,500	36 J	360 U	55 J	390 U
2-Methylnaphthalene	48 J	7,700 D	10,000 D	36 J	42 J	82 J	390 U
Acenaphthylene	360 U	400 U	390 U	73 J	360 U	370 U	390 U
Acenaphthene	360 U	580	390 U	350 U	360 U	370 U	390 U
Dibenzofuran	360 U	830	390 U	350 U	360 U	370 U	390 U
Fluorene	360 U	1,000	1,000	350 U	360 U	370 U	390 U
Phenanthrene	210 J	1,400	1,300	55 J	260 J	92 J	390 U
Anthracene	360 U	120 J	390 U	350 U	58 J	370 U	390 U
Fluoranthene	250 J	710	800	69 J	350 J	89 J	390 U
Pyrene	270 J	420	560	94 J	350 J	99 J	47 J
Benzo(a)Anthracene	200 J	430	490	80 J	250 J	65 J	40 J
Chrysene	310 J	630	740	88 J	320 J	130 J	54 J
bis(2-Ethylhexyl)Phthalate	360 U	400 U	390 U	36 J	74 J	370 U	390 U
Benzo(b)Fluoranthene	380 XJ	1,000 XJ	450	210 XJ	500 XJ	260 XJ	70 XJ
Benzo(k)Fluoranthene	380 XJ	1,000 XJ	610	210 XJ	500 XJ	260 XJ	70 XJ
Benzo(a)Pyrene	180 J	400	450	120 J	250 J	86 J	390 U
Ideno(1,2,3,-cd)Pyrene	59 J	180 J	210 J	44 J	76 J	55 J	390 U
Dibenz(a,h)Anthracene	360 U	110 J	77 J	350 U	360 U	370 U	390 U
Benzo(g,h,i)Perylene	72 J	190 J	230 J	66 J	89 J	65 J	390 U
Dimethyl Phthalate	360 U	400 U	390 U	350 U	360 U	370 U	390 U
Pesticide Organics, ug/kg							
beta-BHC	20	24	17	8.4 U	8.7 U	9.0 U	9.5 U
Total Organic Carbon,mg/kg	NT	NT	NT	NT	NT	NT	NT
Total Petroleum Hydrocarbons, mg/kg	25 U	2,400	2,800	240	26	140	25 U
Semivolatile Organics - Tentatively Identified Compounds, ug/kg							
Aldol	480 J	—	—	1,700 J	400 J	600 J	480 J
Aldol	—	—	—	770 J	510 J	1,200 J	480 J
Sulfur, mol.(S8)	2,300 J	—	—	—	4,700 J	—	—
Dimethylheptadecane	150 J	—	—	—	—	190 J	—
Dimethylheptadecane	—	—	—	—	—	410 J	—
Dimethylheptadecane	—	—	—	—	—	190 J	—
Dimethylundecane + unknown	—	8,800 J	—	—	—	—	—
Dimethylundecane	—	—	—	—	—	—	—
Tridecene	—	4,400 J	—	—	—	—	—
Methyltridecane	—	15,000 J	—	—	—	—	—
Tetradecane + unknown	—	4,800 J	—	—	—	—	—
Te[illegible]e	—	—	—	[illegible]	—	—	—
Tri[illegible]decane	—	14,000 J	—	[illegible]	—	—	—

Sample Name:	S09(2.5-4.2)-S	S10(2.5-4.5)-S	S100(2.5-4.5)-S	S11(1-2)-S	S11(2-4)-S	S12(0-2)-S	S12(2-4)-S
Date Sampled:	3/22/90	3/22/90	3/22/90	3/22/90	3/22/90	3/22/90	3/22/90
Parameters, units							
Semivolatile Organics - Tentatively Identified Compounds, ug/kg							
Trimethyldodecane + unknown	—	—	—	—	—	190 J	—
Dimethyltridecane + unknown	—	8,400 J	—	—	—	—	—
Dimethylnaphthalene	—	8,000 J	— J	—	—	—	—
Dimethylheptadecane	—	12,000 J	— J	—	—	—	—
Dimethylheptadecane	—	—	— J	—	—	—	—
Trimethylnaphthalene	—	6,000 J	—	—	—	—	—
Trimethylnaphthalene	—	4,800 J	—	—	—	—	—
Trimethylnaphthalene + unknown	—	—	10,000 J	—	—	—	—
Heptadecane	—	8,400 J	—	—	—	—	—
Tetramethylpentadecane	—	12,000 J	—	—	—	—	—
Benzofluoranthene	—	—	—	180 J	140 J	—	—
Benzofluoranthene + unknown	—	—	—	—	—	150 J	—
Anthracenedione	—	—	—	—	1,800 J	—	—
Cyclichydrocarbon	—	—	7,400 J	—	—	—	—
Sub Cyclohexane	—	—	800 J	—	—	—	—
Unknown Hydrocarbon	—	7,600 J	11,000 J	—	—	—	—
Unknown Hydrocarbon	—	—	14,000 J	—	—	—	—
Unknown Hydrocarbon	—	—	7,800 J	—	—	—	—
Unknown Hydrocarbon	—	—	22,000 J	—	—	—	—
Unknown Hydrocarbon	—	—	6,700 J	—	—	—	—
Unknown Hydrocarbon	—	—	15,000 J	—	—	—	—
Unknown Hydrocarbon	—	—	16,000 J	—	—	—	—
Unknown Hydrocarbon	—	—	25,000 J	—	—	—	—
Unknown Hydrocarbon	—	—	12,000 J	—	—	—	—
Unknown Hydrocarbon	—	—	20,000 J	—	—	—	—
Unknown Hydrocarbon	—	—	14,000 J	—	—	—	—
Unknown Substitute Benzene	—	—	—	—	—	340 J	—
Unknown	700 J	4,800 J	8,600 J	—	940 J	520 J	—
Unknown	290 J	7,200 J	14,000 J	—	—	260 J	—
Unknown	—	6,000 J	11,000 J	—	—	150 J	—
Unknown	—	6,800 J	15,000 J	—	—	220 J	—
Unknown	—	12,000 J	13,000 J	—	—	790 J	—
Unknown	—	5,600 J	7,800 J	—	—	300 J	—
Unknown	—	5,200 J	—	—	—	490 J	—
Unknown	—	—	6,800 J	—	—	190 J	—
Unknown	—	—	17,000 J	—	—	520 J	—
Unknown	—	—	7,700 J	—	—	670 J	—
Unknown	—	—	—	—	—	450 J	—
Volatile Organics Tentatively Identified Compounds,ug/kg							
Cyclohexane, Propyl-	—	19 J	—	—	—	—	—
Octane,2,6-Dimethyl-	—	27 J	—	—	—	—	—
Ethyl Cyclohexane + unknown	—	77 J	—	—	—	—	—
Ethylmethylcyclohexane	—	—	340 J	—	—	—	—

Sample Name: Date Sampled:	S09(2.5-4.2)-S 3/22/90	S10(2.5-4.5)-S 3/22/90	S100(2.5-4.5)-S 3/22/90	S11(1-2)-S 3/22/90	S11(2-4)-S 3/22/90	S12(0-2)-S 3/22/90	S12(2-4)-S 3/22/90
Parameters, units							
Volatile Organics Tentatively Identified Compounds,ug/l							
Dimethyloctane	–	–	1,000 J	–	–	–	–
Methylpropylbenzene + unknown	–	71 J	–	–	–	–	–
Butyl Cyclohexane	–	78 J	–	–	–	–	–
Dimethyl Nonane	–	43 J	–	–	–	–	–
Hexane	–	–	–	–	6.5 J	–	–
Unknown Hydrocarbon	–	40 J	–	–	–	–	–
Unknown Hydrocarbon	–	49 J	–	–	–	–	–
Unknown Hydrocarbon	–	34 J	–	–	–	–	–
Unknown	–	22 J	290 J	–	–	–	–
Unknown	–	–	250 J	–	–	–	–
Unknown	–	–	400 J	–	–	–	–
Unknown	–	–	360 J	–	–	–	–
Unknown	–	–	1,300 J	–	–	–	–
Unknown	–	–	980 J	–	–	–	–
Unknown	–	–	1,900 J	–	–	–	–
Unknown	–	–	450 J	–	–	–	–

Sample Name:	S13(0-2)-S	S13(2-4)-S	S14(0-1)S	Field Blank	Trip Blank	FB032290	TB032290	FB-032390	TB032390
Sample Depth (feet):	0.0-2.0	2.0-4.0	0.0-1.0						
BCM Lab ID:	008784	008785		008796	008795	008805	008804	008789	008788
COMPUCHEM ID:	328273 328276 328278	328283 328284 328286	349918	327220 327222 327232	327239	327729 327738 327749	327753 327260	328234 328235 328236	328240 328241
Date Sampled:	3/22/90	3/22/90	6/22/90	3/20/90 (ug/l)	3/20/90 (ug/l)	3/21/90 (ug/l)	3/21/90 (ug/l)	3/22/90 (ug/l)	3/22/90 (ug/l)
Parameters, units									
Metals mg/kg									
Aluminum	8,010	10,600	5,200	32.6 B	16.0 U	22.6 B	30.5 B	42.0 B	20.4 B
Antimony	4.7 U	5.6 B	7.8 U	21.0 U	21.0 U	21.0 U	21.0 U	21.0 U	21.0 U
Arsenic	2.2 B	2.1 B	1.6 BJ	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
Barium	92.6	65.7	51	3.8 B	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Beryllium	0.22 U	0.39 B	3.3 J	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Calcium	7,550	792 B	19,200 J	200.0 B	50.9 B	80.0 B	103.0 B	98.6 B	48.6 B
Chromium	18.2	12.4	14.6	7.9 B	5.0 U	5.0 U	5.0 U	9.5 B	5.0 U
Cobalt	10.6 B	5.3 B	4.6 B	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
Copper	37.7	10.0	37.1 J	6.4 B	4.0 U	4.0 U	4.4 B	6.4 B	7.4 B
Iron	19,600	8,820	10,600	449.0	21.0 B	41.5 B	36.7 B	117.0 U	11.6 B
Lead	56.5	9.8	40	2.4 B	2.0 U	2.0 U	2.0 U	2.0 U	2.3 B
Magnesium	5,610	932 B	4,860	56.0 U	56.0 U	56.0 U	56.0 U	56.0 U	56.0 U
Manganese	277	298	134	7.1 B	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Mercury	0.12	0.11 U	0.11 R	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nickel	19.9	7.8 B	33.5	29.0 U	29.0 U	29.0 U	29.0 U	29.0 U	29.0 U
Potassium	1,660	544 B	1,130	1,260.0 U	1,260.0 U	1,260.0 U	1,260.0 U	1,260.0 U	1,260.0 U
Sodium	331 U	338 U	192 BQ	1,490.0 U	1,490.0 U	1,490.0 U	1,490.0 U	1,490.0 U	1,490.0 U
Vanadium	33.4	26.1	17.9	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Zinc	90.8	24.9	329 J	9.3 B	1.0 U	6.3 B	1.0 U	3.0 B	2.5 B
Cyanide	0.59	0.56 U	0.56	10.00 U	10.00 U	10.00 U	10.00 U	10.00 U	10.00 U
Volatile Organic Compounds.ug/kg									
Methylene Chloride	27 BQ	32 BQ	NT	2 BJ	5 U	5 U	5 U	5 U	5 U
Acetone	15 BQ	43 B	NT	10 U	10 U	10 U	10 U	10 U	10 U
Benzene	6 U	6 U	NT	5 U	5 U	5 U	5 U	5 U	5 U
2-Hexanone	11 U	11 U	NT	10 U	10 U	10 U	10 U	10 U	10 U
Toluene	6 U	6 U	NT	5 U	5 U	5 U	5 U	5 U	5 U
Ethylbenzene	6 U	6 U	NT	5 U	5 U	5 U	5 U	5 U	5 U
Total Xylenes	6 U	6 U	NT	5 U	5 U	5 U	5 U	5 U	5 U
Carbon Disulfide	6 U	6 U	NT	5 U	5 U	5 U	5 U	5 U	5 U
Chloroform	6 U	6 U	NT	5 U	5 U	5 U	5 U	5 U	5 U

Sample Name: Date Sampled:	S13(0-2)-S 3/22/90	S13(2-4)-S 3/22/90	S14(0-1)S 6/22/90	Field Blank 3/20/90 (ug/l)	Trip Blank 3/20/90 (ug/l)	FB032290 3/21/90 (ug/l)	TB032290 3/21/90 (ug/l)	FB-032390 3/22/90 (ug/l)	TB032390 3/22/90 (ug/l)
Parameters, units									
Semivolatile Organic Compounds,ug/kg									
Phenol	370 U	370 U	350 U	10 U	NT	10 U	NT	10 U	NT
4-Methylphenol	370 U	370 U	350 U	10 U	NT	10 U	NT	10 U	NT
2,4-Dimethylphenol	370 U	370 U	350 U	10 U	NT	10 U	NT	10 U	NT
Benzoic Acid	110 J	120 J	1,700 U	50 U	NT	50 U	NT	50 U	NT
Naphthalene	370 U	370 U	350 U	10 U	NT	10 U	NT	10 U	NT
2-Methylnaphthalene	56 J	370 U	39 J	10 U	NT	10 U	NT	10 U	NT
Acenaphthylene	370 U	370 U	350 U	10 U	NT	10 U	NT	10 U	NT
Acenaphthene	370 U	370 U	350 U	10 U	NT	10 U	NT	10 U	NT
Dibenzofuran	370 U	370 U	350 U	10 U	NT	10 U	NT	10 U	NT
Fluorene	370 U	370 U	350 U	10 U	NT	10 U	NT	10 U	NT
Phenanthrene	120 J	370 U	51 J	10 U	NT	10 U	NT	10 U	NT
Anthracene	370 U	370 U	350 U	10 U	NT	10 U	NT	10 U	NT
Fluoranthene	210 J	370 U	60 J	10 U	NT	10 U	NT	10 U	NT
Pyrene	160 J	370 U	58 J	10 U	NT	10 U	NT	10 U	NT
Benzo(a)Anthracene	160 J	370 U	54 J	10 U	NT	10 U	NT	10 U	NT
Chrysene	210 J	370 U	110 J	10 U	NT	10 U	NT	10 U	NT
bis(2-Ethylhexyl)Phthalate	370 U	370 U	350 U	10 U	NT	10 U	NT	10 U	NT
Benzo(b)Fluoranthene	370 JX	370 U	130 J	10 U	NT	10 U	NT	10 U	NT
Benzo(k)Fluoranthene	370 JX	370 U	120 J	10 U	NT	10 U	NT	10 U	NT
Benzo(a)Pyrene	160 J	370 U	69 J	10 U	NT	10 U	NT	10 U	NT
Ideno(1,2,3,-cd)Pyrene	78 J	370 U	38 J	10 U	NT	10 U	NT	10 U	NT
Dibenz(a,h)Anthracene	370 UJ	370 U	350 U	10 U	NT	10 U	NT	10 U	NT
Benzo(g,h,i)Perylene	80 J	370 U	43 J	10 U	NT	10 U	NT	10 U	NT
Dimethyl Phthalate	370 U	370 U	86 J	10 U	NT	10 U	NT	10 U	NT
Pesticide Organics, ug/kg									
beta-BHC	9.0 U	9.1 U	NT	0.050 U	NT	0.050 U	NT	0.050 U	NT
Total Organic Carbon, mg/kg	NT	NT	NT	NT	NT	NT	NT	NT	NT
Total Petroleum Hydrocarbon, mg/kg	110	25 U	NT	1.0 U	NT	1.0 U	NT	1.0 U	NT
Semivolatile Organic -Tentatively Identified Compounds.ug/kg									
Aldol	600 J	30 J	500 J	–	–	–	–	–	–
Aldol	520 J	–	280 J	–	–	–	–	–	–
Dimethylheptadecane	110 J	–	–	–	–	–	–	–	–
Octacosane + unknown	220 J	–	–	–	–	–	–	–	–
Benzofluoranthene	260 J	–	–	–	–	–	–	–	–
Unknown	520 J	–	350 J	–	–	–	–	–	–
Unknown	150 J	–	280 J	–	–	–	–	–	–
Unknown	300 J	–	250 J	–	–	–	–	–	–
Unknown	300 J	–	390 J	–	–	–	–	–	–
Unknown	–	–	250 J	–	–	–	–	–	–
Unknown	–	–	570 J	–	–	–	–	–	–
Unknown	–	–	460 J	–	–	–	–	–	–
Unk	–	–	530 J		–	–	–	–	–
Un	–	–	1200 J		–	–	–	–	–

-- = Not detected
B = For Organics :Present in an associated blank.
B= For Inorganics: Reported value is less than the contract detection limit but greater than the instrument detection limit
D = Value exceeded the calibration range of the GC/MS. Sample was diluted and re-analyzed.
J = Estimated value below detection limit
X = Coelution of indistiguishable isomers
NT = Not Tested
Q = Value questioned by data validation
L = Reported value is estimated low
K = Reported value is estimated high
U = Compound was not detected. Value listed is the sample quantitation limit.
R = Quality control indicates that the data are unuseable
EPA split samples were not included as part of this summary

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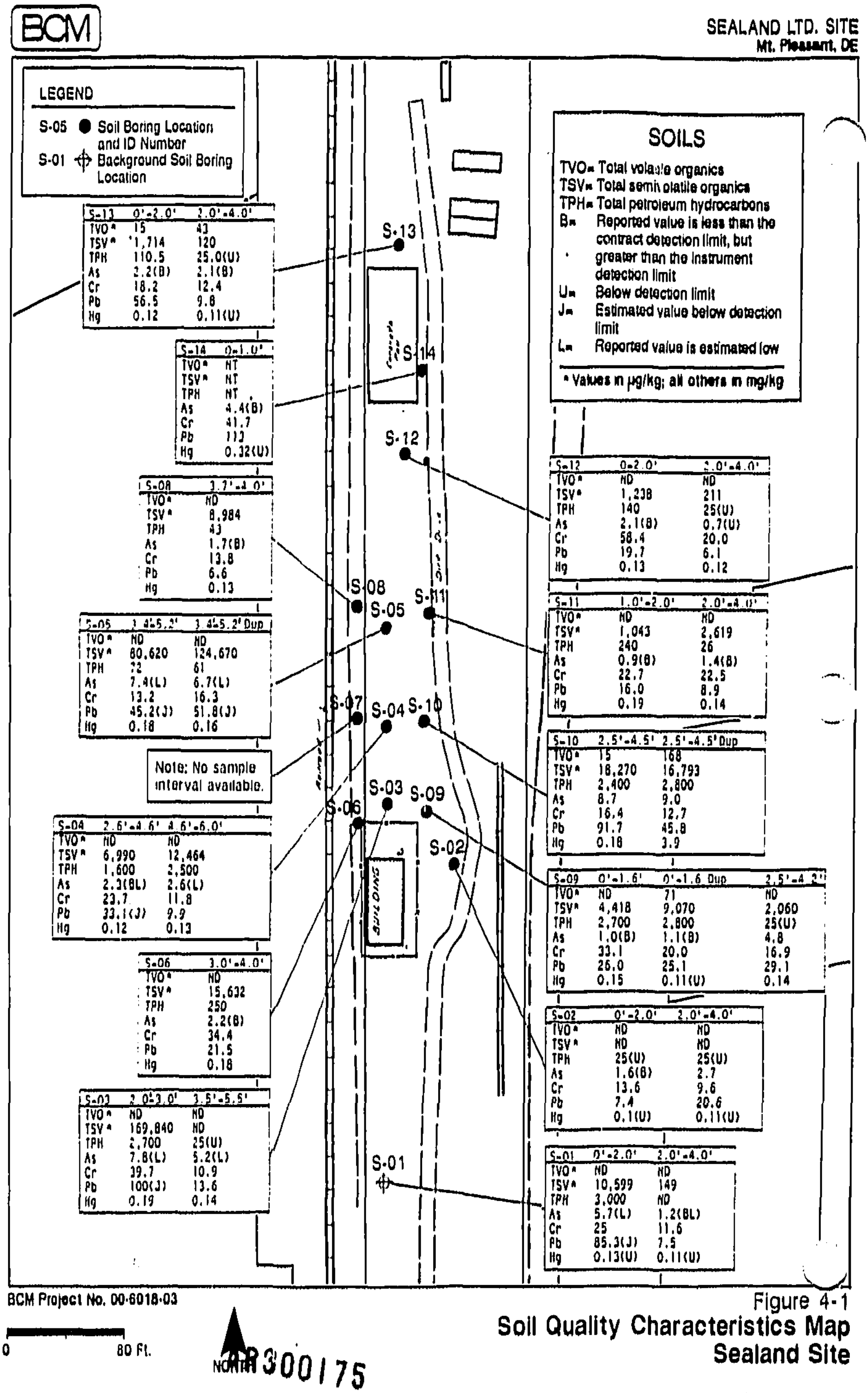

LEGEND

S-05 ● Soil Boring Location and ID Number

S-01 ⌖ Background Soil Boring Location

SOILS

TVO= Total volatile organics

TSV= Total semivolatile organics

TPH= Total petroleum hydrocarbons

B= Reported value is less than the contract detection limit, but greater than the instrument detection limit

U= Below detection limit

J= Estimated value below detection limit

L= Reported value is estimated low

* Values in µg/kg; all others in mg/kg

S-13	0'-2.0'	2.0'-4.0'
TVO*	15	43
TSV*	1,714	120
TPH	110.5	25.0(U)
As	2.2(B)	2.1(B)
Cr	18.2	12.4
Pb	56.5	9.8
Hg	0.12	0.11(U)

S-14	0-1.0'
TVO*	NT
TSV*	NT
TPH	NT
As	4.4(B)
Cr	41.7
Pb	113
Hg	0.32(U)

S-08	3.7'-4.0'
TVO*	ND
TSV*	8,984
TPH	43
As	1.7(B)
Cr	13.8
Pb	6.6
Hg	0.13

S-05	3.4'-5.2'	3.4'-5.2' Dup
TVO*	ND	ND
TSV*	80,620	124,670
TPH	72	61
As	7.4(L)	6.7(L)
Cr	13.2	16.3
Pb	45.2(J)	51.8(J)
Hg	0.18	0.16

Note: No sample interval available.

S-04	2.6'-4.6'	4.6'-6.0'
TVO*	ND	ND
TSV*	6,990	12,464
TPH	1,600	2,500
As	2.3(BL)	2.6(L)
Cr	23.7	11.8
Pb	33.1(J)	9.9
Hg	0.12	0.13

S-06	3.0'-4.0'
TVO*	ND
TSV*	15,632
TPH	250
As	2.2(B)
Cr	34.4
Pb	21.5
Hg	0.18

S-03	2.0'-3.0'	3.5'-5.5'
TVO*	ND	ND
TSV*	169,840	ND
TPH	2,700	25(U)
As	7.8(L)	5.2(L)
Cr	39.7	10.9
Pb	100(J)	13.6
Hg	0.19	0.14

S-12	0-2.0'	2.0'-4.0'
TVO*	ND	ND
TSV*	1,238	211
TPH	140	25(U)
As	2.1(B)	0.7(U)
Cr	58.4	20.0
Pb	19.7	6.1
Hg	0.13	0.12

S-11	1.0'-2.0'	2.0'-4.0'
TVO*	ND	ND
TSV*	1,043	2,619
TPH	240	26
As	0.9(B)	1.4(B)
Cr	22.7	22.5
Pb	16.0	8.9
Hg	0.19	0.14

S-10	2.5'-4.5'	2.5'-4.5' Dup
TVO*	15	168
TSV*	18,270	16,793
TPH	2,400	2,800
As	8.7	9.0
Cr	16.4	12.7
Pb	91.7	45.8
Hg	0.18	3.9

S-09	0'-1.6'	0'-1.6 Dup	2.5'-4.2'
TVO*	ND	71	ND
TSV*	4,418	9,070	2,060
TPH	2,700	2,800	25(U)
As	1.0(B)	1.1(B)	4.8
Cr	33.1	20.0	16.9
Pb	26.0	25.1	29.1
Hg	0.15	0.11(U)	0.14

S-02	0'-2.0'	2.0'-4.0'
TVO*	ND	ND
TSV*	ND	ND
TPH	25(U)	25(U)
As	1.6(B)	2.7
Cr	13.6	9.6
Pb	7.4	20.6
Hg	0.1(U)	0.11(U)

S-01	0'-2.0'	2.0'-4.0'
TVO*	ND	ND
TSV*	10,599	149
TPH	3,000	ND
As	5.7(L)	1.2(BL)
Cr	25	11.6
Pb	85.3(J)	7.5
Hg	0.13(U)	0.11(U)

Figure 4-1
Soil Quality Characteristics Map
Sealand Site

TABLE 4-3

FREQUENCY OF DETECTION FOR SOIL SAMPLES AND COMPARISON TO BACKGROUND CONCENTRATIONS

SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Data Summary	SITE SPECIFIC				
	Frequency of Detection *	Range	Arithmetic Average **	Background	
				0-2 ft	2-4 ft
Volatile Organics, ug/kg					
Acetone	7/18	4 - 71	18.5	4	9
Benzene	1/18	<1 - 4	1.5	<1	<6
2-Hexanone	1/18	<2 - 110	4.9	<2	<12
Toluene	1/18	<5 - 34	3.5	<2	<6
Ethylbenzene	1/18	<5 - 92	5.8	<1	<6
Total Xylenes	2/18	<5 - 190	13.3	<7	<6
Carbon Disulfide	1/18	<5 - 2 #	1.5	<1	<6
Chloroform	1/18	<5 - 1 #	2.6	<3	<6
Semi-Volatile Organics, ug/kg					
Phenol	1/19	<350 - 40 #	322	<430	<380
4-Methylphenol	3/19	<350 - 610	184	<430	<380
2,4-Dimethylphenol	3/19	<350 - 670	312	<430	<380
Benzoic Acid	9/19	<350 - 1600	298	45	<1900
Naphthalene	11/19	<350 - 20000	1484	170	<380
2-Methylnaphthalene	14/19	<350 - 14000	1770	250	<380
Acenaphthylene	6/19	<350 - 7800	695	130	<380
Acenaphthene	7/19	<350 - 1900	343	44	<380
Dibenzofuran	8/19	<350 - 1300	301	110	<380
Fluorene	8/19	<350 - 7400	764	<430	<380
Phenanthrene	14/19	<350 - 22000	2038	620	46
Anthracene	9/19	<350 - 6700	588	160	<380
Fluoranthene	14/19	<350 - 23000	1937	1300	46
Pyrene	15/19	<350 - 22000	2329	1200	57
Benzo(a)anthracene	15/19	<350 - 12000	1119	900	<380
Chrysene	15/19	<350 - 11000	1157	1100	<380
bis(2-Ethylhexyl)phthalate	6/19	<350 - 530	161	<430	<380
Benzo(b)fluoranthene	15/19	<350 - 20000	2112	3000	<380
Benzo(k)fluoranthene	15/19	<350 - 20000	2154	3000	<380
Benzo(a)pyrene	13/19	<350 - 13000	1427	830	<380
Ideno(1,2,3,-cd)pyrene	12/19	<350 - 6500	526	300	<380
Dibenzo(a,h)anthracene	5/19	<350 - 2900	364	130	<380
Benzo(g,h,i)perylene	12/19	<350 - 5800	622	310	<380
Dimethyl phthalate	1/19	<350 - 86 #	268	<430	<380

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* Number of detected values over the total number of samples taken.

** In calculating averages, one-half the detection limit was used for non-detects to represent a conservative estimate of the risk. Duplicate samples were averaged prior to use.

\# Detected concentration was estimated below the quantitation limit

Data questioned by data validation was considered to be below detection.

EPA split samples were not included as part of this summary.

Compiled by: BCM Engineers Inc. (BCM Project No. 00-6018-03)

TABLE 4-3

FREQUENCY OF DETECTION FOR SOIL SAMPLES AND COMPARISON TO BACKGROUND SAMPLES

SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Data Summary	SITE SPECIFIC					REGIONAL				
	Frequency of Detection *	Range	Arithmetic Average **	Background		Northern Delaware a	Delaware b		Southern NJ MD - Delaware a	Eastern U.S. Geometric Mean d
				0-2 ft	2-4 ft		Mean	SD		
Metals, mg/kg										
Aluminum	19/19	4,990 - 15,600	10,441	10,200	10,700	30,000	--	--	700-30,000	--
Antimony	4/19	<4.3 - 7.9	3.3	<4.3	<4.3	<1	--	--	<1	--
Arsenic	18/19	<0.2 - 8.9	3.1	5.7	1.2	<0.1-2.6	--	--	19-41 e	--
Barium	19/19	19.6 - 217	85	120	44.3	500	--	--	10-300	300
Beryllium	14/19	<0.21 - 3.3	0.4	0.73	0.57	<1	--	--	<1	--
Calcium	19/19	175 - 26,500	6,268	3,240	175	130-2,300	--	--	130-5,200	--
Chromium	19/19	9.6 - 58.4	21	25	11.6	50	--	--	1-30	36
Cobalt	19/19	4.1 - 21	9.3	8.8	6.8	3-5	--	--	<3	7
Copper	19/19	2.3 - 54	25	39.8	6.0	<1-10	5	2.2	<1-20	14
Iron	19/19	8,820 - 28,800	16,272	23,800	12,000	<7,000	--	--	100-10,000	15,000
Lead	19/19	6.1 - 100	29	85.3	7.5	20	10	2	<10-20	14
Magnesium	19/19	365 - 14,050	4,101	3,690	733	0-1,500	--	--	50-3,000	--
Manganese	19/19	61.4 - 573	195	198	199	150	--	--	<2-300	285
Mercury	15/18 #	<0.11 - 3.9	0.2	<0.11	<0.11	0.051	--	--	<0.01-0.013	--
Nickel	17/19	<6.1 - 365	47	22.8	<5.8	7-10	6.6	4.4	<5-10	13
Potassium	12/19	<288 - 4,400	1,165	2,310	667	16,000	--	--	2,200-11,000	--
Sodium	6/19	<315 - 781	255	386	407	3,000-5,000	--	--	<500-5,000	--
Vanadium	19/19	16.5 - 48	28	43.7	20.8	30-50	--	--	<7-50	46
Zinc	19/19	17 - 329	75	78.9	23.1	82 c	25	9	<5-198 c	36
Cyanide	2/19	<0.28 - 0.69	0.3	<0.66	<0.56	--	--	--	--	--
Pesticides, ug/kg										
beta-BHC	3/18	<8.4 - 37	8.2	<9.3	<9.3	--	--	--	--	--

---

* Number of detected values over the total number of samples taken

** In calculating averages, one-half the detection limit was used for non-detects to represent a conservative estimate of the risk. Duplicate samples were averaged prior to use.

SD Standard deviation

-- Data not available

Quality control indicates that the mercury data for sample S14(0-1)-S is unuseable.

EPA split samples were not included as part of this summary.

a Shacklette & Boerngen, 1984. Element Concentrations in Soils and other Surficial Materials of the Conterminous United States.

b Logan, T.G. and Ryan, J.A., 1987. Land Application of Sludge. Lewis Publishers, Chelsea, MI.

c Pennsylvania State University, 1985. Criteria and Recommendations for Land Application of Sludges in the Northeast. Bulletin 851, March 1985.

d USEPA, 1985. Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water - Part 1. EPA/600/6-85/002a. September 1985 Revised.

e USEPA, 1984. Health Assessment Document for Inorganic Arsenic. EPA-600/8-83-021F. March 1984.

Compiled by: BCM Engineers Inc. (BCM Project No. 00-6018-03)

TABLE 4-4

SUMMARY OF RI ANALYTICAL RESULTS FOR SPLIT SAMPLES - SOIL
SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Location:	S-04	S-04 (Dup)	S-11	S-12	S-00*
Date Sampled:	3/21-22/90	3/21-22/90	3/21-22/90	3/21-22/90	3/21-22/90
EPA ID:	MCDW19 CDE28 CDE29	MCDW20 CDE30 CDE31	MCDW21 CDE33 CDE34	MCDW22 CDE36 CDE35	CDE32
Parameters, units					
Metals, mg/kg					
Aluminum	10500	10300	9700	9730	NT
Arsenic	2.4	2.6	2.4	24.8	NT
Barium	71.3	40.8 B	138	226	NT
Beryllium	0.59 B	0.5 B	0.56 B	0.54 B	NT
Calcium	*13800*	*650 B*	*6650*	8110	NT
Chromium	18.8	11.8	21	104	NT
Cobalt	8.2 B	5.4 B	10.5 B	25.9	NT
Copper	46.2	8.8 Q	36.5	92.3	NT
Iron	14300	12700	21000	30700	NT
Lead	86.1 J	8.4 J	27.4 J	150 J	NT
Magnesium	7250	593 B	5220	5980	NT
Manganese	674	94.5	461	267	NT
Mercury	0.1 U	0.11 U	0.11	0.1 U	NT
Nickel	14.1	7.8 B	80.7	42	NT
Potassium	1470	203 B	3050	4420	NT
Selenium	UL	UL	UL	2.8 L	NT
Silver	UL	UL	UL	0.63 BL	NT
Sodium	418 B	78.6 B	151 B	156 B	NT
Thallium	0.58 B	0.48 B	0.72 B	1.1 BL	NT
Vanadium	28.8	20.5	36.8	39	NT
Zinc	41.6	18	53	337	NT
Cyanide	10.7	5.9	1.5	5.7	NT
Parameters, units					
Volatiles,ug/kg					
Methylene Chloride	11 Q	120 J	7 Q	27	2 B
Acetone	18 J	320 J	UJ	UJ	20000 J
2-Butanone	R	48 J	R	R	R
Toluene	6 U	22 J	UJ	UJ	UL
Total Xylenes	UJ	5 J	UL	UL	UL
Parameters, units					
Volatile Tentatively Identified Compounds,ug/kg					
Cyclohexane, Cyclopropyl-	63 J	--	--		--
Unknown	28 J	110 J	16 J	130 J	--
Unknown	13 J	200 J	58 J	--	--
Unknown	7.7 J	42 J	27 J	--	--

Location:	S-04	S-04	S-11	S-12	S-00*
Date Sampled:	3/21-22/90	3/21-22/90	3/21-22/90	3/21-22/90	3/21-22/90
Parameters, units					
Volatile Tentatively Identified Compounds,ug/kg					
Unknown	95 J	50 J	--	--	--
Unknown	170 J	560 J	--	--	--
Unknown	--	24 J	--	--	--
Unknown	--	860 J	--	--	--
Unknown	--	600 J	--	--	--
Unknown	--	36 J	--	--	--
Unknown	--	1100 J	--	--	--
Parameters, units					
Semi Volatiles,ug/kg					
Benzoic Acid	UJ	UJ	UJ	1500 L	NT
bis(2-Chloroethoxy)methane	720 U	59 J	730 U	740 U	NT
2,4-Dichlorophenol	720 U	25 J	730 U	740 U	NT
Naphthalene	530 J	740 U	730 U	740 U	NT
2-Methylnaphthalene	1900	7100	730 U	740 U	NT
Dibenzofuran	570 J	740 U	730 U	740 U	NT
Fluorene	650 J	740 U	730 U	740 U	NT
N-Nitrosodiphenylamine	1800	740 U	730 U	740 U	NT
PhenaNthrene	1600	1700	110 J	740 U	NT
Di-n-butylphthalate	170 J	740 U	140 J	740 U	NT
Fluoranthene	290 J	110 J	160 J	740 U	NT
Pyrene	410 J	150 J	210 J	76 J	NT
Benzo(a)anthracene	340 J	740 U	140 J	740 U	NT
Chrysene	380 J	98 J	250 J	110 J	NT
bis(2-Ethylhexyl)phthalate	100 Q	180 Q	730 U	130 JQ	NT
Benzo(b)fluoranthene	280 J	740 U	150 J	740 U	NT
Benzo(k)fluoranthene	290 J	740 U	110 J	740 U	NT
Benzo(a)pyrene	250 J	740 U	150 J	740 U	NT
Indeno(1,2,3-cd)pyrene	180 J	740 U	730 U	740 U	NT
Benzo(g,h,i)perylene	220 J	740 U	730 U	740 U	NT
Parameters, units					
Semivolatile Tentatively Identified Compounds,ug/kg					
1H-Indene,1-Ethylidene-	3400 J	--	--	--	NT
Naphthalene,1,5-Dimethyl-	2800 J	--	--	--	NT
Naphthalene,1,4-Dimethyl-	5900 J	6500 J	--	--	NT
Naphthalene,1,6-Dimethyl-	--	3000 J	--	--	NT
Naphthalene,1,4,6-Trimethyl-	2100 J	--	--	--	NT
Naphthalene,2,3,6-Trimethyl-	2700 J	--	--	--	NT
Unknown	23000 J	3900 J	1800 J	2000 J	NT
Unknown	5300 J	6600 J	29000 J	26000 J	NT
Unknown	4000 J	2700 J	4700 J	4200 J	NT
Unknown	2600 J	5700 J	1300 J	2700 J	NT
Unknown	2600 J	2000 J	--	--	NT
Unknown	2600 J	2500 J	--	--	NT
Unknown	3000 J	3200 J	--	--	NT
Unknown	3000 J	3100 J	--	--	NT
Unknown	6800 J	2200 J	--	--	NT
Unknown	2000 J	1600 J	--	--	NT
Unknown	6000 J	2200 J	--	--	NT
Unknown	2700 J	2300 J	--	--	NT
Unknown	5800 J	3300 J	--	--	NT

Location:	S-04	S-04	S-11	S-12	S-00*
Date Sampled:	3/21-22/90	3/21-22/90	3/21-22/90	3/21-22/90	3/21-22/90
Parameters, units					
Semivolatile Tentatively Identified Compounds,ug/kg					
Unknown	22000 J	5700 J	--	--	NT
Unknown	9700 J	6200 J	--	--	NT
Unknown	--	16000 J	--	--	NT
Unknown	--	4600 J	--	--	NT
Unknown	--	11000 J	--	--	NT

Notes:

B = For organics: present in an associated blank.
B = For inorganics: Reported valuse is less than the contract detection limit but greater than the instrument detection limit
J = Estimated value below detection limit
NT = Not tested.
Q = Value questioned by data validation
R = Quality control indicates that the data are unuseable
U = Compound was not detected. Value listed is the sample quantitation
L = Value estimated low
-- = Not detected.
NA = Not applicable
* = Was unable to determine whether the sample was a field or trip blank.

ug/kg); however, all but one of these values contain data validation qualifiers (see Appendix VIII). Methylene chloride was found to be a laboratory contaminant in all but one of the samples analyzed for VOC. Acetone was found in 20 of 23 soil samples (5-220 ug/kg); however, all but one of these contain data validation qualifiers. Benzene was found in 1 of 23 samples (4 ug/kg in S-03, 2-3 feet). 2-Hexanone was found in 1 of 23 samples (110 ug/kg in S10 Dup., 2.5-4.5 feet but not in the original sample). Only two samples contained volatile organics with results free of data validation qualifiers: Acetone in S-10, 2.5-4.5' and 2-Hexanone in S-100 Dup, 2.5-4.5', in the 23 samples analyzed for VOCs (including three duplicates). Pursuant to EPA's direction, sample S-14-01 was not analyzed for VOCs. Many of the values reported for individual VOCs were estimated values below the detection limit established for the compound in question. These estimated values were considered detected in this discussion of results.

Several soil samples also contained Tentatively Identified Compounds (TICs), including S-03, 2-3 feet (4 TICs), S-04, 2.6-4.6 feet (10 TICs, all below the quantitation limit), S-04, 4.6-6.0 feet (10 TICs, all below the quantitation limit).

VOCs were detected in 4 of the 12 soil borings where VOCs were analyzed. Samples from the borings with the highest volatile organic concentrations were S-09, S-10, and S-13. S-09 and S-10 were collected beneath the clay cap.

4.1.2.2 Semivolatile Organic Compounds

Semivolatile organic compounds were found in onsite soil samples at concentrations ranging from non-detect to 23,000 ug/kg. Of the 24 TCL list semivolatile organic compounds, all 24 were found in at least one sample and 22 were found in at least three samples. The compounds found most frequently and at the highest concentrations include naphthalene (8 of 24 samples, with the highest concentration of 20,000 ug/kg), 2-Methylnapthalene (8 of 24 samples, up to 14,000 ug/kg), phenanthrene (11 of 24 samples, up to 22,000 ug/kg), fluoranthene (9 of 24 samples, up to 23,000 ug/kg), pyrene (10 of 24 samples, up to 22,000 ug/kg), and other isomers of fluoranthene and pyrenes ranging up to 20,000 ug/kg. In terms of total semivolatile organic compounds (excluding TICs), the borings with the highest concentrations of semivolatile organic compounds were installed through the clay cap. Total semivolatile organic compound concentrations of up to 169,840 ug/kg were detected in S-03 at 2-3 feet, between the clay cap and the water table.

TICs were present in most of the soil borings. Only S-01 (2-4'), S-02 (0-2 and 2-4') and S-03 (3.5-5.5') were generally free of TICs.

4.1.2.3 Pesticide Compounds

As outlined in the approved Work Plan, pesticides were not part of the RI sampling program as pesticide materials or compounds were not handled during any of the site operations. Compuchem Laboratories, however, analyzed for pesticides and all results are included in this RI report.

One pesticide compound (beta-BHC) was detected in three samples: S-09 (0-1.6 and 0-1.6 dup), S-09 (2.5-4.2) and S-10 (2.5-4.5 and 2.5-4.5 dup). S-09 and S-10 are located beneath the eastern edge of the capped area.

4.1.2.4 Total Petroleum Hydrocarbons and Total Organic Carbon

Total Petroleum Hydrocarbons (TPH) were present in onsite soil boring samples at concentrations ranging from non-detect (S-02, 0-2' and 2-4', S-03, 3.5-5.5', S-09, 2.5-4.2 and S-12, 2-4') to a maximum of 3,000 mg/kg in S-01 (0-2') which is the background sample. TPH was most prevalent in samples S-01 (0-2'), S-03 (2-3'), S-09 (0-1.6' and Dup.) and S-10 (2.5-4.5 and Dup.). With the exception of S-01, TPH was found at the highest concentrations beneath the southeastern quadrant of the capped area. The distribution of TPH was somewhat sporadic with high and low concentrations found in different samples from the same boring in several instances.

Total Organic Carbon (TOC) was analyzed in two borings: S-01 (2-4') at 210 mg/kg, and S-05 (3.4-5.2) at 208,000 mg/kg.

4.1.2.5 Inorganic Compounds

Inorganic compounds include 19 metals plus cyanide. Of the 19 Target Analyte List metals analyzed, only antimony was absent from any of the samples. Cyanide was detected only in samples S-13 (0-2') and S-14 (0-1') at 0.59 and 1.6 mg/kg respectively. Figure 4-1 shows the distribution of several metals in onsite soil samples. Arsenic is present at concentrations ranging from non-detect to 9.0 mg/kg. Chromium was present in all samples at concentrations ranging from 9.6 to 58.4 mg/kg. The horizontal distribution of chromium appears to be random. The concentrations of chromium appear slightly lower in the deeper samples than in the shallow samples.

Lead was present in onsite soil samples in concentrations ranging from 6.1 to 100 mg/kg. Lead was present in all samples. In a majority of samples the concentration of lead was lower in the deeper samples than in the shallow samples. No horizontal distribution pattern is evident.

Mercury was present in 15 of 18 samples in concentrations ranging from non-detect to 3.9 mg/kg in sample S-10 (2.5-4.5') Dup. Sample S-10 (2.5-4.5') had a concentration of 0.18 mg/kg.

4.2 GROUNDWATER CHARACTERIZATION

4.2.1 EPA/DNREC

Available information indicates that two wells existed onsite prior to the 1983/1984 EPA Emergency Removal Action. Information regarding date of installation and well construction is not available.

Groundwater characterization was initiated in December 1983 with the installation and sampling of six monitoring wells as part of the EPA/DNREC Emergency Removal Action. Over the course of five sampling dates during 1983/1984 selected wells were sampled. The data reported the presence of phenol, chromium, lead, nickel and some base/neutral organic compounds in the groundwater beneath the Site. Toluene and benzene were also reportedly detected at low levels in the Site groundwater on one sampling event. As field and laboratory QA/QC data for these individual sampling events is either incomplete or unavailable, and maps detailing sampling locations do not exist, the results from these events are questionable in regards to their usefulness in any risk analysis calculations.

In March 1986, NUS, under contract to EPA, collected samples from eight onsite and four nearby domestic wells. Results indicated the presence of several PAHs in one onsite well. Potassium and manganese were also reportedly detected in a number of the samples. A second sampling round was conducted in October 1986. Nickel and several PAHs were reported at elevated concentrations in the same onsite well as reported in the earlier 1986 sampling event.

In January 1987, REWAI, under contract to the Sealand PRPs, sampled all existing onsite wells and selected nearby domestic wells for base/neutral organic compounds. A second round of well samples were collected by REWAI in August/September 1987. No base/neutrals, VOCs, or PCBs were detected in any of the samples from the eight onsite wells.

Table 4-5 presents a summary of past sampling results for onsite monitoring wells. Table 4-6 presents results from past sampling associated with offsite private wells. The analytical data from which these summary tables were prepared are contained in files maintained by EPA.

4.2.2 BCM Source Characterization

As part of the RI, BCM collected samples from eight onsite monitoring wells and four nearby offsite domestic wells to characterize groundwater quality. The groundwater investigation is described in detail in Section 2.4. Groundwater samples were collected from onsite monitoring wells and offsite domestic wells on April 25, 26 and 27, 1990.

TABLE 4-5
SUMMARY OF ONSITE GROUNDWATER SAMPLING RESULTS
1983 - 1987 (PRE-RI)
SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Sample No.:	4742	4743	4744	4746	4747	4748	4795	4796
Sample Name:	Blank	MW 1-A	MW 1-B	MW 8-A	MW 8-B	MW 8-C	Blank	Onsite Well
Sampler:	DNREC	DNREC	DNREC	DNREC	DNREC	DNREC	DNREC	DNREC
Date Sampled:	12/9/83	12/9/83	12/9/83	12/9/83	12/9/83	12/9/83	12/12/83	12/12/83
Parameters, units								
Metals, ug/l								
Aluminum								
Antimony								
Arsenic								
Barium								
Beryllium								
Calcium								
Chromium	< 100	17.2	8.8	15.5	12.3	< 100	< 100	
Cobalt								
Copper								
Iron								
Lead	< 100	33	15	42	73	< 100	< 100	
Magnesium								
Manganese								
Mercury								
Nickel	< 100	17	10	37	14	< 100	< 100	
Potassium								
Sodium								
Vanadium								
Zinc								
Cyanide								
Volatile Organic Compounds, ug/l								
Methylene Chloride								
Acetone								
Benzene								
2-Hexanone								
Toluene								

Sample No.:	4742	4743	4744	4746	4747	4748	4795	4796
Sample Name.:	Blank	MW 1-A	MW 1-B	MW 8-A	MW 8-B	MW 8-C	Blank	Onsite Well
Date Sampled:	12/9/83	12/9/83	12/9/83	12/9/83	12/9/83	12/9/83	12/12/83	12/12/83
Parameters, units								
Volatile Organic Compounds, ug/l								
Ethylbenzene								
Total Xylenes								
o-Xylene								
m-Xylene								
p-Xylene								
Carbon Disulfide								
Chloroform								
Semivolatile Organics, ug/l								
Phenol	< 5	0.09	0.06	0.05	0.05		< 5	< 5
4-Methylphenol								
2,4-Dinitrotoluene								
2,6-Dinitrotoluene								
2,4-Dimethylphenol								
Benzoic Acid								
Naphthalene								
2-Chloronaphthalene								
2-Methylnaphthalene								
Acenaphthylene								
Acenaphthene								
Dibenzofuran								
Fluorene								
Phenanthrene								
Anthracene								
Fluoranthene								
Pyrene								
Benzo(a)Anthracene								
Chrysene								
bis(2-Ethylhexyl)Phthalate								
Benzo(b)Fluoranthene								
Benzo(k)Fluoranthene								
Benzo(a)Pyrene								
Ideno(1,2,3,-cd)Pyrene								
Dibenz(a,h)Anthracene								
Benzo(g,h,i)Perylene								
Dimethyl Phthalate								
Hexachlorocyclopentadiene								

Sample No.:	4841	4842	4843	4844	4845	4846	1444	1445	1446
Sample Name:	MW 1	MW 3	MW 4	MW 7	MW 8	MW 4 Dup	MW 1	MW 3	MW 4
Sampler:	DNREC	DNREC	DNREC	DNREC	DNREC	DNREC	DNREC	DNREC	DNREC
Sample Date:	12/15/83	12/15/83	12/15/83	12/15/83	12/15/83	12/15/83	5/16/84	5/16/84	5/16/84
Parameters, units									
Metals, ug/l									
Aluminum									
Antimony									
Arsenic									
Barium									
Beryllium									
Calcium									
Chromium	790	3930	< 100	380	< 100	< 100	60	40	60
Cobalt									
Copper									
Iron									
Lead	460	1000	< 100	638	< 100	< 100	< 30	< 30	< 30
Magnesium									
Manganese									
Mercury									
Nickel	335	1240	< 100	340	< 100	< 100	< 100	< 100	< 100
Potassium									
Sodium									
Vanadium									
Zinc									
Cyanide									
Volatile Organic Compounds, ug/l									
Methylene Chloride									
Acetone									
Benzene									
2-Hexanone									
Toluene									
Ethylbenzene									
Total Xylenes									
Carbon Disulfide									
Chloroform									

Sample No.:	4841	4842	4843	4844	4845	4846	1444	1445	1446
Sample Name:	MW 1	MW 3	MW 4	MW 7	MW 8	MW 4 Dup	MW 1	MW 3	MW 4
Date Sampled:	12/15/83	12/15/83	12/15/83	12/15/83	12/15/83	12/15/83	5/16/84	5/16/84	5/16/84
Parameters, units									
Semivolatile Organic Compounds,ug/l									
Phenol (ug / l)	50	3	15	7	< 5	16	< 5	< 5	< 5
4-Methylphenol									
2,4-Dimethylphenol									
2,4-Dinitrotoluene									
2,6-Dinitrotoluene									
Benzoic Acid									
Naphthalene									
2-Chloronaphthalene									
2-Methylnaphthalene									
Acenaphthylene									
Acenaphthene									
Dibenzofuran									
Fluorene									
Phenanthrene									
Anthracene									
Fluoranthene									
Pyrene									
Benzo(a)Anthracene									
Chrysene									
bis(2-Ethylhexyl)Phthalate									
Benzo(b)Fluoranthene									
Benzo(k)Fluoranthene									
Benzo(a)Pyrene									
Ideno(1,2,3,-cd)Pyrene									
Dibenz(a,h)Anthracene									
Benzo(g,h,i)Perylene									
Dimethyl Phthalate									

Sample No. Sample Name:	1447 MW 7	1448 Blank	1449 Duplicate	1936 MW 2	1937 Duplicate
Sampler:	DNREC	DNREC	DNREC	DNREC	DNREC
Date Sampled:	5/16/84	5/16/84	5/16/84	6/19/84	6/19/84
Parameters, units					
Metals ug/l					
Aluminum					
Antimony					
Arsenic					
Barium					
Beryllium					
Calcium					
Chromium	70	80		48	71
Cobalt					
Copper					
Iron					
Lead	< 30	< 30	< 30	300	560
Magnesium					
Manganese					
Mercury					
Nickel	< 100	< 100	< 100	2490	3360
Potassium					
Sodium					
Vanadium					
Zinc					
Cyanide					
Volatile Organic Compounds, ug/l					
Methylene Chloride					
Acetone					
Benzene					
2-Hexanone					
Toluene					
Ethylbenzene					
Total Xylenes					
o- Xylene ug / l					
m- Xylene ug / l					
p- Xylene ug / l					
Carbon Disulfide					
Chloroform					

Sample No.	1447	1448	1449	1936	1937
Sample Name:	MW 7	Blank	Duplicate	MW 2	Duplicate
Date Sampled:	5/16/84	5/16/84	5/16/84	6/19/84	6/19/84
Parameters, units					
Semivolatile Organics, ug/l					
Phenol	< 5	< 5	< 5	16	19
4-Methylphenol					
2,4-Dimethylphenol					
Benzoic Acid					
Naphthalene					
2-Methylnaphthalene					
Acenaphthylene					
Acenaphthene					
Dibenzofuran					
Fluorene					
Phenanthrene					
Anthracene					
Fluoranthene					
Pyrene					
Benzo(a)Anthracene					
Chrysene					
bis(2-Ethylhexyl)Phthalate					
Benzo(b)Fluoranthene					
Benzo(k)Fluoranthene					
Benzo(a)Pyrene					
Ideno(1,2,3,-cd)Pyrene					
Dibenz(a,h)Anthracene					
Benzo(g,h,i)Perylene					
Dimethyl Phthalate					

Sample Name:	Blank	MW 1	MW 2	MW 3	MW 4	MW 5	MW 6	MW 7	MW 8	MW 6'
Sample No.:	861015-01	861015-04	861015-06	861015-07	861015-09	861015-10	861015-12	861015-13	861015-11	861015-14
Sampler:	NUS	NUS	NUS	NUS	NUS	NUS	NUS	NUS	NUS	NUS
Date Sampled:	10/14/86	10/14/86	10/14/86	10/14/86	10/14/86	10/14/86	10/14/86	10/14/86	10/14/86	10/14/86
Parameters, units										
Metals, ug/l										
Aluminum										
Antimony										
Arsenic										
Barium										
Beryllium										
Calcium										
Chromium	< 10					< 10 *		< 10 *	< 10 *	< 10
Cobalt										
Copper	< 25					< 25 *		< 25 *	< 25 *	< 25
Iron										
Lead	< 5					< 5 *		< 5	< 5	< 5
Magnesium										
Manganese										
Mercury										
Nickel	< 50					< 50 *		< 50 *	< 50 *	779
Potassium										
Sodium										
Vanadium										
Zinc	< 25					< 125		< 25 *	87 + or - 1	< 25
Cyanide										
Volatile Organic Compounds, ug/l										
Chloride	< 1	13.6	57.3	54	2.2	121	51.8	27.5	27.7	51.8
Methylene Chloride										
Acetone										
Benzene										
Toluene										

Sample Name.: Sample No.: Date Sampled:	Blank 861015-01 10/14/86	MW 1 861015-04 10/14/86	MW 2 861015-06 10/14/86	MW 3 861015-07 10/14/86	MW 4 861015-09 10/14/86	MW 5 861015-10 10/14/86	MW 6 861015-12 10/14/86	MW 7 861015-13 10/14/86	MW 8 861015-11 10/14/86	MW 6A 861015-14 10/14/86
Parameters, units										
Volatile Organic Compounds, ug/l										
Ethylbenzene										
Total Xylenes										
o-Xylene										
m-Xylene										
p-Xylene										
Carbon Disulfide										
Chloroform										
Semivolatile Organics, ug/l										
Phenol	1.6 J									
4-Methylphenol										
2,4-Dinitrotoluene										
Di-n-Butylphthalate	0.1 J	N				N	4.1 J	N	N	5.9 J
2,4-Dimethylphenol										
Benzoic Acid										
Naphthalene						0.9 J	19.6		0.1 J	18.1
2-Chloronaphthalene										
2-Methylnaphthalene						0.7 J	18.4			18.2
Acenaphthylene						0.6 J	9.4 J		0.3 J	9.6 J
Acenaphthene							1.7 J			2.2 J
Dibenzofuran										
Fluorene							7.4 J			8.9 J
Phenanthrene						1.0 J	26.6		0.2 J	30.9
Anthracene						0.5 J	9.1 J		0.4 J	10.1
Fluoranthene						1.1 J	17.5		2.0 J	17.6
Pyrene						1.8 J	26.8		2.3 J	28.9
Benzo(a)Anthracene						0.6 J	11.2		3.0 J	10.7
Chrysene						0.6 J	9.2 J		5.8 J	8.7 J
bis(2-Ethylhexyl)Phthalate							7.4 J			6.5 J
Benzo(b)Fluoranthene						0.3 J	4.7 J		6.7	6.0 J
Benzo(k)Fluoranthene						0.2 J	5.7 J		3.2 J	5.1 J
Benzo(a)Pyrene						0.3 J	11.7		2.0 J	10.3
Ideno(1,2,3,-cd)Pyrene							4.0 J		1.9 J	3.5 J
Dibenz(a,h)Anthracene										
Benzo(g,h,i)Perylene							6.2 J		1.7 J	3.0 J
Diethyl Phthalate										0.3 J

Sample Name:	Blank	MW 1	MW 2	MW 3	MW 4	MW 5	MW 6	MW 7	MW 8	
Sample No:	CE236 / MCC901	CE238 / MCC903	CE239 / MCC904	CE240 / MCC905	CE241 / MCC906	CE242 / MCC907	CE243 / MCC908	CE244 / MCC909	CE245 / MCC910	CE256 / MCC930 MW 2A
Sampler:	NUS	NUS	NUS	NUS	NUS	NUS	NUS	NUS	NUS	NUS
Sample Date:	3/27/86	3/27/86	3/27/86	3/27/86	3/27/86	3/27/86	3/27/86	3/27/86	3/27/86	3/27/86
Parameters, units										
Metals, ug/l										
Aluminum	170 U	260	14000	33700	40200	191000	97200	203000	14400	7460
Antimony	59 U	59 U	59 U	59 U	59 U	59 U	59 U	59 U	59 U	59 U
Arsenic	6.7 U	[9]	6.7 U	6.7 U	6.7 U	50	23	[7]	55	6.7 U
Barium	29 U	203	355	489	542	1720	1210	2270	2440	316
Beryllium	4.0 U	4.0 U	4.0 U	6	7	27	18	28	33	4.0 U
Cadmium	5.0 U	5.0 U	5.0 U	5.0 U	5	12	22	5.0 U	34	5.0 U
Calcium	[2030]	75200	44000	27400	46600	39800	60900	116000	61300	41600
Chromium	9.4 U	9.4 U	318	167	84	333	858	903	1310	130
Cobalt	18 U	18 U	36	[42]	[44]	149	144	139	605	[19]
Copper	21 U	21 U	24	37	151	341	269	68	29	21 U
Iron	88 U	12200	66000	136000	64200	364000	367000	418000	813000	29800
Lead	5.0 U	[4.6]	8.5	45	382	720	833	375	464	6.8
Magnesium	920 U	5050	9210	14100	17400	19400	24900	28100	34100	8190
Manganese	[13]	203	275	1240	1090	4000	3160	7460	18900	239
Mercury	0.20 U	0.20 U	0.20 U	0.20 U	0.9	0.67	1.54	0.58	0.54	0.20 U
Nickel	40 U	40 U	55	40 U	159	392	5700	144	499	40 U
Potassium	2890 U	5040	[4380]	[3730]	8940	17400	20700	18100	14800	[3730]
Selenium	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	25 U	5.0 U	25 U	5.0 U
Silver	9.3 U	9.3 U	57	9.3 U	9.3 U	9.3 U	9.3 U	9.3 U	9.3 U	9.3 U
Sodium	4980 U	4980 U	22000	8340	9180	6140	15300	34200	7810	23100
Thallium	6.5 U	6.5 U	6.5 U	6.5 U	6.5 U	10 U	10 U	6.5 U	6.5 U	10 U
Tin	37 U	37 U	37 U	37 U	37 U	37 U	37 U	37 U	37 U	37 U
Vanadium	23 U	23 U	212	227	148	637	958	1120	1800	131
Zinc	16 U	48	189	195	2050	891	1430	791	1820	146
Cyanide	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Volatile Organic Compounds, ug/l										
Chloromethane		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromomethane		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Vinyl Chloride		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloroethane		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Methylene Chloride		15	5 U	5 U	5 U	15	15	5 U	5 U	5 U
Acetone		10 U	35	10 U	10 U	25	10 U	15	10 U	10 U
Carbon Disulfide		5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1-Dichloroethane		5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1-Dichloroethane		5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U

Sample Name: Sample No.: Date Sampled:	Blank CE236 3/27/86	MW 1 CE238 3/27/86	MW 2 CE239 3/27/86	MW 3 CE240 3/27/86	MW 4 CE241 3/27/86	MW 5 CE242 3/27/86	MW 6 CE243 3/27/86	MW 7 CE244 3/27/86	MW 8 CE245 3/27/86	MW 2A CE256 3/27/86
Parameters, units										
Volatile Organic Compounds, ug/l										
Trans-1,2-Dichloroethane		5 U	5 U	5 U	5 U.	5 U	5 U	5 U	5 U	5 U
Chloroform		5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-Dichloroethane		5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-Butanone		10 U	10 U	2 JB	10 U	10 U	10 U	1 JB	2 JB	10 U
1,1,1-Trichloroethane		5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Carbon Tetrachloride		5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Vinyl Acetate		5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Bromodichloromethane		5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-Dichloropropane		5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Trans-1,3-Dichloropropene		5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Trichloroethene		5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Dibromochloromethane		5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2-Trichloroethane		5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Benzene		1 JB	1 JB	1 JB	1 JB	1 JB	2 JB	1 JB	5 U	5 U
cis-1,3-Dichloropropene		5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-Chloroethylvinylether		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromoform		5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-Methyl-2-Pentanone		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Hexanone		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Tetrachloroethene		5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2,2-Tetrachloroethane		5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Toluene		5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Ethylbenzene		5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Total Xylenes		5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Semivolatile Organic Compounds,ug/l										
Phenol		10 U	5 J	2 JB	2 JB	10 U	10 U	2 JB	10 U	2 JB
bis(2-Chloroethyl)Ether		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Chlorophenol		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,3-Dichlorobenzene		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,4-Dichlorobenzene		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzyl Alcohol		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichlorobenzene		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylphenol		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-Chloroisopropyl)Ether		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Methylphenol		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-Nitroso-Di-n-Propylamine		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

Sample Name: Sample No.: Date Sampled:	Blank CE236 3/27/86	MW 1 CE238 3/27/86	MW 2 CE239 3/27/86	MW 3 CE240 3/27/86	MW 4 CE241 3/27/86	MW 5 CE242 3/27/86	MW 6 CE243 3/27/86	MW 7 CE244 3/27/86	MW 8 CE245 3/27/86	MW 2A CE256 3/27/86
Parameters, units										
Semivolatile Organic Compounds,ug/l										
Hexachloroethane		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Nitrobenzene		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Isophorone		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Nitrophenol		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dimethylphenol		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzoic Acid		50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
bis(2-Chloroethoxy)Methane		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dichlorophenol		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2,4-Trichlorobenzene		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Naphthalene		10 U	10 U	10 U	10 U	10 U	39	10 U	10 U	10 U
4-Chloroaniline		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorobutadiene		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chloro-3-Methylphenol		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylnaphthalene		10 U	10 U	10 U	10 U	10 U	30	10 U	10 U	10 U
Hexachlorocyclopentadiene		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4,6-Trichlorophenol		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4,5-Trichlorophenol		50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
2-Chloronaphthalene		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Nitroaniline		50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Dimethyl Phthalate		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acenaphthylene		10 U	10 U	10 U	10 U	10 U	11	10 U	10 U	10 U
3-Nitroaniline		50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Acenaphthene		10 U	10 U	10 U	10 U	10 U	4 J	10 U	10 U	10 U
2,4-Dinitrophenol		50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
4-Nitrophenol		50 U	50 U	50 U	3 J	50 U	50 U	50 U	50 U	50 U
Dibenzofuran		10 U	10 U	10 U	10 U	10 U	1 J	10 U	10 U	10 U
2,4-Dinitrotoluene		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,6-Dinitrotoluene		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Diethylphthalate		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chlorophenyl-phenylether		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluorene		10 U	10 U	10 U	10 U	10 U	8 J	10 U	10 U	10 U
4-Niroaniline		50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
4,6-Dinitro-2-Methylphenyl		50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
N-Nitrosodiphenylamine (1)		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Bromophenyl-phenyl ether		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorobenzene		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Pentachlorophenol		50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Phenanthrene		10 U	10 U	10 U	10 U	10 U	24	10 U	10 U	10 U
Anthracene		10 U	10 U	10 U	10 U	10 U	6 J	10 U	10 U	10 U
Di-n-Butylphthalate		3 JB	3 JB	6 JB	4 JB	5 JB	3 JB	4 JB	4 JB	4 JB
Fluoranthene		10 U	10 U	10 U	10 U	10 U	4 J	10 U	10 U	10 U
Pyrene		10 U	10 U	10 U	1 J	10 U	7 J	10 U	10 U	10 U

Sample Name:	Blank	MW 1	MW 2	MW 3	MW 4	MW 5	MW 6	MW 7	MW 8	MW 2A
Sample No.:	CE236	CE238	CE239	CE240	CE241	CE242	CE243	CE244	CE245	CE256
Date Sampled:	3/27/86	3/27/86	3/27/86	3/27/86	3/27/86	3/27/86	3/27/86	3/27/86	3/27/86	3/27/86
Parameters, units										
Semivolatile Organic Compounds,ug/l										
Butylbenzylphthalate		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
3,3-Dichlorobenzidine		20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Benzo(a)Anthracene		10 U	10 U	10 U	10 U	10 U	1 J	10 U	10 U	10 U
bis(2-Ethylhexyl)Phthalate		2 J	10 U	10 U	10 U	10 U	3 J	1 J	2 J	10 U
Chrysene		10 U	10 U	10 U	10 U	10 U	1 J	10 U	10 U	10 U
Di-n-Octyl Phthalate		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(b)Fluoranthene		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(k)Fluoranthene		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)Pyrene		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Ideno(1,2,3,-cd)Pyrene		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibenz(a,h)Anthracene		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)Perylene		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Pesticide Organics ug/l										
Alpha-BHC		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.20 U	0.01 U	0.01 U	0.01 U
Beta-BHC		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.20 U	0.01 U	0.01 U	0.01 U
Delta-BHC		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.20 U	0.01 U	0.01 U	0.01 U
Gamma-BHC (Lindane)		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.20 U	0.01 U	0.01 U	0.01 U
Heptachlor		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.20 U	0.01 U	0.01 U	0.01 U
Aldrin		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.20 U	0.01 U	0.01 U	0.01 U
Heptachlor Epoxide		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.20 U	0.01 U	0.01 U	0.01 U
Endosulfan I		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.20 U	0.01 U	0.01 U	0.01 U
Dieldrin		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.20 U	0.01 U	0.01 U	0.01 U
4,4-DDE		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.20 U	0.01 U	0.01 U	0.01 U
Endrin		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.20 U	0.01 U	0.01 U	0.01 U
Endosulfan I I		0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.6 U	0.03 U	0.03 U	0.03 U
4,4-DDD		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.20 U	0.01 U	0.01 U	0.01 U
Endosulfan Sulfate		0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	1.0 U	0.05 U	0.05 U	0.05 U
4,4-DDT		0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.40 U	0.02 U	0.02 U	0.02 U
Methoxychlor		0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	1.0 U	0.05 U	0.05 U	0.05 U
Endrin Ketone		0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	1.0 U	0.05 U	0.05 U	0.05 U
Chlordane		0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	5.0 U	0.25 U	0.25 U	0.25 U
Toxaphene		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	0.5 U
Aroclor-1016		0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	3.0 U	0.15 U	0.15 U	0.15 U
Aroclor-121		0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	5.0 U	0.25 U	0.25 U	0.25 U
Aroclor-1232		0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	5.0 U	0.25 U	0.25 U	0.25 U
Aroclor-1242		0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	3.0 U	0.15 U	0.15 U	0.15 U
Aroclor-1248		0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	3.0 U	0.15 U	0.15 U	0.15 U
Ar[illegible]54		0.25 U	0.25 U	[illegible]	0.25 U	0.25 U	5.0 U	0.25 U	0.25 [illegible]	0.25 U
Ar[illegible]50		0.25 U	0.25 U	[illegible]	0.25 U	0.25 U	5.0 U	0.25 U	0.25 [illegible]	0.25 U

F indicates filtered

Sample Name:	F Blank	F MW 1	F MW 2	F MW 3	F MW 4	F MW 5	F MW 6	F MW7	F MW 8	F MW 2A
Sample No.:	MCC919	MCC911	MCC912	MCC913	MCC914	MCC915	MCC916	MCC917	MCC918	MCC931
Sampler:	NUS	NUS	NUS	NUS	NUS	NUS	NUS	NUS	NUS	NUS
Date Sampled:	3/27/86	3/27/86	3/27/86	3/27/86	3/27/86..	3/27/86	3/27/86	3/27/86	3/27/86	3/27/86
Parameters, units										
Metals, ug/l										
Aluminum	170 U	170 U	[180]	170 U	170 U	[190]	[190]	220	170 U	170 U
Antimony	59 U	59 U	59 U	59 U	59 U	59 U	59 U	59 U	59 U	59 U
Arsenic	10 U	10 U	10 U	10 U	10 U	10 U	10	10 U	6.7 U	10 U
Barium	29 U	[158]	[86]	[102]	[48]	[51]	[102]	[69]	[86]	[77]
Beryllium	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U
Cadmium	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Calcium	1260 U	54800	35500	21100	32200	20100	32000	80000	21600	35300
Chromium	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U	9.4 U
Cobalt	18 U	18 U	18 U	18 U	18 U	[27]	18 U	18 U	18 U	18 U
Copper	21 U	21 U	21 U	[23]	21 U	21 U	21 U	21 U	21 U	21 U
Iron	88 U	3860 U	282	88 U	[89]	4840	8560	[91]	110	88 U
Lead	4.4 U	4.4 U	4.4 U	4.4 U	5.0 U	4.4 U	4.4 U	5.0 U	5.0 U	4.4 U
Magnesium	920 U	[4170]	6610	9900	7850	5580	7650	14300	11200	6960
Manganese	12 U	133	98	16	157	1770	818	100	176	83
Mercury	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Nickel	40 U	40 U	40 U	40 U	40 U	81	1080	40 U	40 U	40 U
Potassium	2890 U	[3730]	2890 U	2980 U	[3080]	7640	7640	5690	[4380]	[3080]
Selenium	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Silver	9.3 U	9.3 U	9.3 U	9.3 U	9.3 U	9.3 U	9.3 U	9.3 U	9.3 U	9.3 U
Sodium	4980 U	4980 U	22400	12000	6340	14400	16800	29600	9420	19200
Thallium	6.5 U	6.5 U	10 U	10 U	6.5 U	6.5 U	6.5 U	6.5 U	6.5 U	6.5 U
Tin	37 U	37 U	37 U	37 U	37 U	37 U	37 U	37 U	37 U	37 U
Vanadium	2.3 U	23 U	23 U	23 U	23 U	23 U	23 U	23 U	23 U	2.3 U
Zinc	28	47	155	90	89	152	42	31	55	234
Cyanide	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

Sample Name: Sample No.:	MW 1	MW 2 W-14500	MW 3	MW 4	MW 5	MW 6 W-14499	MW 7 W-14496	MW 8 W-14497	Field Blank W-14498	Trip Blank W-14502
Sampler:	R.E.Wright	R.E.Wright	R.E.Wright	R.E.Wright	R.E.Wright	R.E.Wright	R.E.Wright	R.E.Wright	R.E.Wright	R.E.Wrigh
Date Sampled:	1/27/87	1/27/87	1/27/87	1/27/87	1/27/87	1/27/87	1/27/87	1/27/87	1/27/87	1/27/87
Parameters, units										
Volatile Organic Compounds ug/l										
2-Chlorophenol		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
2,4-Dichlorophenol		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
2,4-Dimethylphenol		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
4,6-Dinitro-o-cresol		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
2,4-Dinitrophenol		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
2-Nitrophenol		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
p-Chloro-m-cresol		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Pentachlorophenol		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Phenol		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
2,4,6-Trichlorophenol		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Semivolatile Organic Compounds ug/l										
Acenaphthene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Acenaphthylene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Anthracene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Benzidine		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Benzo(a)Anthracene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
3,4-Benzofluoranthene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Benzo(g,h,i)Perylene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Benzo(k)Fluoranthene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Bis(2-chloroethoxy) methane		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Bis(2-chloroethyl) ether		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Bis(2-chloroisopropyl) ether		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Bis(2-Ethylhexyl)Phthalate		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
4-Bromophenyl Phenyl Ether		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Butylbenzyl Phthalate		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
2-Chloronaphthalene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
2-Chlorophenyl Phenyl Ether		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Chrysene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Dibenz(a,h)Anthracene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
1,2-Dichlorobenzene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
1,3-Dichlorobenzene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
1,4-Dichlorobenzene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.

Sample Name:	MW 1	MW 2	MW 3	MW 4	MW 5	MW 6	MW 7	MW 8	Field Blank	Trip Blank
Sample No.:		W-14500				W-14499	W-14496	W-14497	W-14498	W-14502
Date Sampled:	1/27/87	1/27/87	1/27/87	1/27/87	1/27/87	1/27/87	1/27/87	1/27/87	1/27/87	1/27/87
Parameters, units										
Semivolatile Organic Compounds ug/l										
3,3'-Dichlorobenzidine		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Diethyl Phthalate		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Dimethyl Phthalate		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Di-n-butyl Phthalate		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
2,4-Dinitrotoluene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
2,6-Dinitrotoluene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Di-n-octylphthalate		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
1,2-Diphenylhydrazine		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Fluoranthene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Fluorene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Hexachlorobenzene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Hexachlorobutadiene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Hexachlorocyclopentadiene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Hexachloroethane		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Isophorone		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Naphthalene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Nitrobenzene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
N-Nitrosodimethylamine		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
N-Nitrosodi-n-propylamine		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
N-Nitrosodi-n-phenylamine		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Phenanthrene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
Pyrene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.
1,2,4-Trichlorobenzene		N.D.				N.D.	N.D.	N.D.	N.D.	N.D.

* = Analyzed in duplicate, both values below specified detection limit.
J = Estimated quantity, concentration below the level for accurate quantitation
B = Analyte found in both the blank and in the sample
N = Not detected after correction for laboratory blank
[ ] = Value is greater than or equal to the instrument detection limit, but less than thecontract required reporting limit
U = Compound was analyzed for, but not detected. The number is the minimum attainable detection limit for the sample.
N.D. = Compound was analyzed for, but not detected.

Sample Name:	MW 1	MW 2	MW 2	MW 3	MW 4	MW 5
Sample No.:	1479-3	1480-1	1480-1 Field Dup.	1479-1	1481-3	1481-2
Sampler:	R.E.Wright	R.E.Wright	R.E.Wright	R.E.Wright	R.E.Wright	R.E.Wright
Date Sampled:	8/27/87	8/27/87	8/27/87	8/27/87	8/27/87	8/27/87
Parameters, units						
Metals, mg/l						
Antimony	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Arsenic	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Beryllium	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Cadmium	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Chromium	N.D.	N.D.	N.D.	0.15	N.D.	N.D.
Copper	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Lead	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Mercury	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Nickel	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Selenium	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Silver	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Thallium	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Zinc	0.03	0.43	0.26	0.04	0.08	0.23
Volatile Organic Compounds ug/l						
Benzene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Bromoform	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Carbon Tetrachloride	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Chlorobenzene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Chlorodibromomethane	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Chloroethane	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.

Sample Name:	MW 1	MW 2	MW 2	MW 3	MW 4	MW 5
Sample No.:	1479-3	1480-1	1480-1 Field Dup.	1479-1	1481-3	1481-1
Date Sampled:	8/27/87	8/27/87	8/27/87	8/27/87	8/27/87	8/27/87
Parameters, units						
Volatile Organic Compounds ug/l						
2-Chloroethylvinyl Ether	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Chloroform	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Dichlorobromomethane	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
1,1-Dichloroethane	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
1,2-Dichloroethane	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
1,1-Dichloroethylene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
1,2-Dichloropropane	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
1,3-Dichloropropene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Ethylbenzene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Methyl Bromide	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Methyl Chloride	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Methylene Chloride	4.9	8.4	5.7	N.D.	N.D.	N.D.
1,1,2,2-Tetrachloroethane	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Tetrachloroethylene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Toluene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
trans-1,2-Dichloroethylene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
1,1,1-Trichloroethane	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
1,1,2-Trichloroethane	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Trichloroethylene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Vinyl Chloride	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Semivolatile Organic Compounds ug/l						
Acenaphthene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Acenaphthylene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Anthracene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Benzidine	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Benzo(a)Anthracene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Benzo(a)Pyrene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Benzo(g,h,i)Perylene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Benzo(b)Fluoranthene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Benzo(k)Fluoranthene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Bis(2-chloroethoxy) methane	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Bis(2-chloroethyl) ether	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Bis(2-chloroisopropyl) ether	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Bis(2-Ethylhexyl)Phthalate	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
4-Bromophenyl Phenyl Ether	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Butylbenzyl Phthalate	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
2-Chloronaphthalene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
2-Chlorophenyl Phenyl Ether	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.

Sample Name:	MW 1	MW 2	MW 2	MW 3	MW 4	MW 5
Sample No.:	1479-3	1480-1	1480-1 Field Dup.	1479-1	1481-3	1481-1
Date Sampled:	8/27/87	8/27/87	8/27/87	8/27/87	8/27/87	8/27/87
Parameters, units						
Semivolatile Organic Compounds ug/l						
Chrysene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Dibenz(a,h)Anthracene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
1,2-Dichlorobenzene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
1,3-Dichlorobenzene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
1,4-Dichlorobenzene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
3,3'-Dichlorobenzidine	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Diethyl Phthalate	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Dimethyl Phthalate	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Di-n-butyl Phthalate	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
2,4-Dinitrotoluene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
2,6-Dinitrotoluene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Di-n-octylphthalate	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
1,2-Diphenylhydrazine	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Fluoranthene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Fluorene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Hexachlorobenzene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Hexachlorobutadiene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Hexachlorocyclopentadiene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Hexachloroethane	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Indeno(1,2,3-cd)pyrene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Isophorone	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Naphthalene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Nitrobenzene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N-Nitrosodimethylamine	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N-Nitrosodi-n-propylamine	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N-Nitrosodi-n-phenylamine	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Phenanthrene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Pyrene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
1,2,4-Trichlorobenzene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.

Sample Name:	MW 6	MW 6	MW 7	MW 8	Trip Blank	Field Blank
Sample No.:	1482-2	1482-2 Duplicate	1483-1	1484-2	1482-3 & 1484-1	1482-1
Sampler:	R.E.Wright	R.E.Wright	R.E.Wright	R.E.Wright	R.E.Wright	R.E.Wright
Date Sampled:	8/28/87	8/28/87	8/28/87	8/28/87	8/28/87	8/28/87
Parameters, units						
Metals, mg/l						
Antimony	N.D.		N.D.	N.D.	N.D.	N.D.
Arsenic	N.D.		N.D.	N.D.	N.D.	N.D.
Beryllium	N.D.		N.D.	N.D.	N.D.	N.D.
Cadmium	N.D.		N.D.	N.D.	N.D.	N.D.
Chromium	N.D.		N.D.	N.D.	N.D.	N.D.
Copper	N.D.		N.D.	N.D.	N.D.	N.D.
Lead	N.D.		N.D.	N.D.	N.D.	N.D.
Mercury	N.D.		N.D.	N.D.	N.D.	N.D.
Nickel	1.3		N.D.	N.D.	N.D.	N.D.
Selenium	N.D.		N.D.	N.D.	N.D.	N.D.
Silver	N.D.		N.D.	N.D.	N.D.	N.D.
Thallium	N.D.		N.D.	N.D.	N.D.	N.D.
Zinc	0.12		0.05	0.09	0.02	0.02
Volatile Organic Compounds ug/l						
Benzene	N.D.		N.D.	N.D.	N.D.	N.D.
Bromoform	N.D.		N.D.	N.D.	N.D.	N.D.
Carbon Tetrachloride	N.D.		N.D.	N.D.	N.D.	N.D.
Chlorobenzene	N.D.		N.D.	N.D.	N.D.	N.D.
Chlorodibromomethane	N.D.		N.D.	N.D.	N.D.	N.D.
Chloroethane	N.D.		N.D.	N.D.	N.D.	N.D.
2-Chloroethylvinyl Ether	N.D.		N.D.	N.D.	N.D.	N.D.
Chloroform	N.D.		N.D.	N.D.	N.D.	N.D.
Dichlorobromomethane	N.D.		N.D.	N.D.	N.D.	N.D.
1,1-Dichloroethane	N.D.		N.D.	N.D.	N.D.	N.D.
1,2-Dichloroethane	N.D.		N.D.	N.D.	N.D.	N.D.
1,1-Dichloroethylene	N.D.		N.D.	N.D.	N.D.	N.D.
1,2-Dichloropropane	N.D.		N.D.	N.D.	N.D.	N.D.
1,3-Dichloropropene	N.D.		N.D.	N.D.	N.D.	N.D.
Ethylbenzene	N.D.		N.D.	N.D.	N.D.	N.D.
Methyl Bromide	N.D.		N.D.	N.D.	N.D.	N.D.
Methyl Chloride	N.D.		N.D.	N.D.	N.D.	N.D.
Methylene Chloride	N.D.		N.D.	N.D.	N.D.	N.D.

Sample Name: Sample No.: Date Sampled:	MW 6 1482-2 8/28/87	MW 6 1482-2 Duplicate 8/28/87	MW 7 1483-1 8/28/87	MW 8 1484-2 8/28/87	Trip Blank 1482-3 & 1484-1 8/28/87	Field Blank 1482-1 8/28/87
Parameters, units						
Volatile Organic Compounds ug/l						
1,1,2,2-Tetrachloroethane	N.D.		N.D.	N.D.	N.D.	N.D.
Tetrachloroethylene	N.D.		N.D.	N.D.	N.D.	N.D.
Toluene	N.D.		N.D.	N.D.	N.D.	N.D.
trans-1,2-Dichloroethylene	N.D.		N.D.	N.D.	N.D.	N.D.
1,1,1-Trichloroethane	N.D.		N.D.	N.D.	N.D.	N.D.
1,1,2-Trichloroethane	N.D.		N.D.	N.D.	N.D.	N.D.
Trichloroethylene	N.D.		N.D.	N.D.	N.D.	N.D.
Vinyl Chloride	N.D.		N.D.	N.D.	N.D.	N.D.
Semivolatile Organic Compounds ug/l						
Acenaphthene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Acenaphthylene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Anthracene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Benzidine	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Benzo(a)Anthracene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Benzo(a)Pyrene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Benzo(g,h,i)Perylene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Benzo(b)Fluoranthene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Benzo(k)Fluoranthene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Bis(2-chloroethoxy) methane	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Bis(2-chloroethyl) ether	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Bis(2-chloroisopropyl) ether	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Bis(2-Ethylhexyl)Phthalate	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
4-Bromophenyl Phenyl Ether	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Butylbenzyl Phthalate	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
2-Chloronaphthalene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
2-Chlorophenyl Phenyl Ether	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Chrysene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Dibenz(a,h)Anthracene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
1,2-Dichlorobenzene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
1,3-Dichlorobenzene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
1,4-Dichlorobenzene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
3,3'-Dichlorobenzidine	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Diethyl Phthalate	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Dimethyl Phthalate	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Di-n-butyl Phthalate	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
2,4-Dinitrotoluene	N.D.	N	N.D.	N.D.	N.D.	N.D.
2,6-Dinitrotoluene	N.D.	N.	N.D.	N.D.	N.D.	N.D.

Sample Name:	MW 6	MW 6	MW 7	MW 8	Trip Blank	Field Blank
Sample No.:	1482-2	1482-2 Duplicate	1483-1	1484-2	1482-3 & 1484-1	1482-1
Date Sampled:	8/28/87	8/28/87	8/28/87	8/28/87	8/28/87	8/28/87
Parameters, units						
Semivolatile Organic Compounds ug/l						
Di-n-octylphthalate	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
1,2-Diphenylhydrazine	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Fluoranthene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Fluorene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Hexachlorobenzene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Hexachlorobutadiene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Hexachlorocyclopentadiene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Hexachloroethane	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Indeno(1,2,3-cd)pyrene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Isophorone	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Naphthalene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Nitrobenzene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N-Nitrosodimethylamine	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N-Nitrosodi-n-propylamine	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N-Nitrosodi-n-phenylamine	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Phenanthrene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Pyrene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
1,2,4-Trichlorobenzene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.

N.D. = Compound was analyzed for, but not detected.

TABLE 4-5 (CONTINUED)
SUMMARY OF ONSITE GROUNDWATER SAMPLING RESULTS
1983 - 1987 (PRE-RI)
TENTATIVELY IDENTIFIED COMPOUNDS
SEALAND LIMITED SITE

Sample Name: MW 5
Sample No.: 86105-10
Sample Date: 10/14/86

Tentative ID	Est. Conc.
D4-1,4-Dichlorobenzene	40
D8-Naphthalene	40
Hexahydro-2h-Azep in-2-one	370
D10-Acenaphthene	40
3-Ethyl-2,7-Dimethyl-Octane	0.5
D10-Phenanthrene	40
D12-Chrysene	40
Unknown	16
D10-Perylene	40

Sample Name: MW 8
Sample No.: 86105-11
Sample Date: 10/14/86

Tentative ID	Est. Conc.
D4-1,4-Dichlorobenzene	40
D8-Naphthalene	40
Hexahydro-2h-Azep in-2-one	230
D10-Acenaphthene	40
2,4,6-Trimethyl-octane	0.8
D10-Phenanthrene	40
Nonadecanol	0.9
2-Methylpyrene	0.5
D12-Chrysene	40
Benzo[j] Fluoranthene	4.1
D10-Perylene	40

Sample Name: MW 6
Sample No.: 86105-12
Sample Date: 10/14/86

Tentative ID	Est. Conc.
1,3,5-Cyclohepatriene	1.1
Hexanal	1.3
Ethylbenzene	0.8
1,3,5,7-Cyclooctatetraene	3.4
Dihydro-2(3H)-Furanone	1.7
D4-1,4-Dichlorobenzene	40
1H-Indene	3.4
Octanoic acid	2.4
2-Oxatricyclo[5.5,0.04,10] Dodeca-5,8,11-Trien-3-one	0.9
D8-Naphthalene	40
Decanal	0.3
Octylcyclohexane	0.6
Hexahydro-2h-Azep in-2-one	4.3
2,3,7-Trimethyloctane	1
2,4,6-Trimethyloctane	1.1
1-Ethylidene-1H-indene	8.3
2,7,10-Trimethyldodecane	4
0-Decylhydroxylamine	1.8
1,1-'Biphenyl	3.5
1-Ethylnaphthalene	2.4
1,5-Dimethylnaphthalene	7.8
Unknown	0.4
1,2-Dimethylnaphthalene	11
2-Ethenylnaphthalene	3.1
4,6-Dimethylundecane	3.6
1,2-Dimethylnaphthalene	2
4,7-Dimethylundecane	3

Sample Name: MW 6
Sample No.: 86105-12
(continued)
Sample Date: 10/14/86

Tentative ID	Est. Conc.
3-Methyl-1,1-Biphenyl	1.4
D10-Acenaphthene	40
2-(1-Methylethyl)-Naphthale	1.3
1,4,5-TrimethylNaphthalene	2.4
3-Methyl-1,1-Biphenyl	1.3
1H-Phenalene	1.7
1H-Phenalene	7.7
3,6-Dimethylundecane	4.5
4-Methyldibenzofuran	0.9
1H-Phenalene	1.1
9H-Xanthene	0.2
4,7-Dimethylundecane	3.1
2,7,10-Trimethyldodecane	7.9
7-Ethyl-1,4-Dimethylazulene	1.3
2-Methyl-9H-Fluorene	2.9
1-Methyl-9H-Fluorene	1
D10-Phenanthrene	40
1-Phenylnaphthalene	1.7
4-Methyldibenzothiophene	1.1
2-Methylanthracene	7.1
2-Methylanthracene	6.9
2-Methylanthracene	2.6
6-Ethyl-2-Methyldecane	1.7
2-Phenylnaphthalene	4.5

Sample Name: MW 6
Sample No.: 86105-12
(continued)
Sample Date: 10/14/86

Tentative ID	Est. Conc.
Unknown	3.9
2,3,5-Trimethylphenanthrene	1.4
11H-Benzo[A]Fluorene	3.4
11H-Benzo[A]Fluorene	10
2-Methylpyrene	4.8
4-Methylpyrene	7
2-Methylpyrene	5.1
D12-Chrysene	40
Unknown	19
Benzo[J] Fluoranthene	3.1
D10-Perylene	40

Sample Name: MW 7
Sample No.: 86105-13
Sample Date: 10/14/86

Tentative ID	Est. Conc.
Dihydro-2(3H)-Furanone	1.7
2,3-Dimethyl-2-Butanol	1
D4-1,4-Dichlorobenzene	40
D8-Naphthalene	40
D10-Acenaphthene	40
3-Ethyl-2,7-Dimethyloctane	0.6
D10-Phenanthrene	40
D12-Chrysene	40
D10-Perylene	40

Sample Name: MW 6A
Sample No.: 86105-14
Sample Date: 10/14/86

Tentative ID	Est. Conc.
1,3,5-Cyclohepatriene	1.3
Ethylbenzene	trace
1,3,5,7-Cyclooctatetraene	3.4
2-(formyloxy)-1-Phenylethan	trace
D4-1,4-Dichlorobenzene	40
1H-Indene	3.1
(1-Methyl-1-Propenyl)-Benze	trace
Nonanol	trace
Octanoic acid	4.7
(1-methyl-1-cyclopropen-1-yl)	trace
Benzene	0.8
D8-Naphthalene	40
2,3,7-Trimethyloctane	1.6
Undecane	1.4
1-Ethylidene-1H-indene	9.2
3,7-Dimethylnonane	2.2
1,1-'Biphenyl	3.6
1-Ethylnaphthalene	3
1,5-Dimethylnaphthalene	9.1
Unknown	0.4
2,3-Dimethylnaphthalene	14
4,7-Dimethylundecane	3.5
1,2-Dimethylnaphthalene	3.8
4,7-Dimethylundecane	2.4
3-Methyl-1,1-Biphenyl	1.7
D10-Acenaphthene	40
2,3,6-Trimethylnaphthalene	3.2
1-(2-Propenyl)-Naphthalene	1.4

Sample Name: MW 6A
Sample No.: 86105-14
(continued)
Sample Date: 10/14/86

Tentative ID	Est. Conc.
1H-Phenalene	1.9
2,6-Dimethylunddecane	4.3
4-Methyldibenzofuran	0.9
1H-Phenalene	1.3
4,7-Dimethylundecane	2.6
2,6,10,14-Tetramethyl Pentadecane	7.3
2-Methyl-9H-Fluorene	3.5
2-Methyl-9H-Fluorene	1.2
2-Methyl-9H-Fluorene	1.1
D10-Phenanthrene	40
1-(Phenylmethylene)-1H-ind	1.6
4-Methyldibenzothiophene	1.4
2-Methylanthracene	8.3
3-Methylphenanthrene	7.3
9-Methylphenanthrene	2.4
4-Methylphenanthrene	16
2-Phenylnaphthalene	48
2,5-Dimethylphenanthrene	3.7
2,5-Dimethylphenanthrene	6.1
3,6-Dimethylphenanthrene	5.8
Unknown	3.8
2,3,5-Trimethylphenanthrene	1.6
11H-Benzo[A] Fluorene	4.5

Sample Name: MW 6A Sample No.: 86105-14 (continued) Sample Date: 10/14/86		Sample Name: MW 1 Sample No.: CE238 Sample Date: 3/27/86		Sample Name: MW 2 Sample No.: CE239 Sample Date: 3/27/86		Sample Name: MW 2A Sample No.: CE256 Sample Date: 3/27/86	
Tentative ID	Est. Conc.	Tentative ID	Est. Conc.	Tentative ID	Est. Conc.	Tentative ID	Est. Conc.
11H-Benzo[A] Fluorene	11	2-Ethylhexanoic acid	4	2,5-Diethyltetrahydrofuron	8	3,3,3-Trichloroprpene	1
2-Methylpyrene	5	Octanoic acid	15	Nonanoic acid	10	2,5-Dimethyltetrahydrofuran	6
4-Methylpyrene	5.1	2,5-Diethyltetrahydrofuron	35	Unknown Alcohol	6	Methylether-1-methyl-L-proli	1
D12-Chrysene	40	Hexahydro-2H-azepin-2-one	34	Unknown	12	Unsaturated Hydrocarbon	7
Unknown	33	Unknown	2				
Unknown	2	Decanoic acid	8				
Benzo[E] Acephenanthylene	5.6	Unknown	1				
D10-Perylene	40	Nonanoic acid	31				
		Decanoic acid	6				
		Nonanoic acid	4				
		Unsaturated Hydrocarbon	16				
		Unsaturated Hydrocarbon	81				
		Unknown	4				

Sample Name: MW 3 Sample No.: CE240 Sample Date: 3/27/86		Sample Name: MW 4 Sample No.: CE241 Sample Date: 3/27/86		Sample Name: MW 5 Sample No.: CE242 Sample Date: 3/27/86		Sample Name: MW 6 Sample No.: CE243 Sample Date: 3/27/86	
Tentative ID	Est. Conc.	Tentative ID	Est. Conc.	Tentative ID	Est. Conc.	Tentative ID	Est. Conc.
Unknown	3	Hexanoic acid	24	2,5-Diethyltetrahydrofuran	4	Pentanoic acid	14
Unknown	2	Unknown	2	Unknown unsaturate	14	Unknown	1
Unknown	1	4,4,5-Trimethyl-2-hexene	1			Unknown	1
Unknown	20	Octanoic acid	2			Unknown	1
		Unknown	2			Nonenoic acid	1
		4-Hydroxybezaldehyde	2			1-Methylnaphthalene	16
		4-Hyroxy-3-methoxybenzalde	1			1,1'-Biphenyl	2
		Unknown	1			1,5-Dimethylnaphthalene	6
						2,3-Dimethylnaphthalene	11
						Unknown(contains nitrogen)	7
						1,1-'Biphenyl	1
						2-Ethylnaphthalene	1
						Unknown	3
						Decanoic acid	4
						Unknown	1
						2-Methylphenanthrene	1
						Unsaturated Hydrocarbon	7
						Unknown	1
						Unknown	4
						Unknown	4

Sample Name: MW 7
Sample No.: CE244

Sample Date: 3/27/86

Tentative ID	Est. Conc.
Unknown	1
2-Ethyl-1-hexanol	1
2,5-Diethyltetrahydrofuron	1
Cupohetan	34
Unknown	1

Sample Name: MW 8
Sample No.: CE245

Sample Date: 3/27/86

Tentative ID	Est. Conc.
Unknown	3
3,3,3-Trichloropropene	3
2-Ethylhexanol	4
2,5-Diethyltetrahydrofuran	3
Unknown	8

Sample Name: HW 1
Sample No.: CE246

Sample Date: 3/27/86

Tentative ID	Est. Conc.
N.D.	
N.D.	

Sample Name: HW 2
Sample No.: CE247

Sample Date: 3/27/86

Tentative ID	Est. Conc.
N.D.	
N.D.	

Sample Name: HW 3
Sample No.: CE248

Sample Date: 3/27/86

Tentative ID	Est. Conc.
N.D.	
N.D.	

Sample Name: HW 4
Sample No.: CE249

Sample Date: 3/27/86

Tentative ID	Est. Conc.
N.D.	
N.D.	

TABLE 4-6
SUMMARY OF OFFSITE GROUNDWATER SAMPLING RESULTS
1983 - 1987 (PRE-RI)
SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Sample Name:	Loving	Stewart	Schafer	Trailer Court	Townsend	4638 Dup.	Blank
Sample No:	4634	4635	4636	4637	4638	4639	4640
Sampler:	DNREC	DNREC	DNREC	DNREC	DNREC	DNREC	DNREC
Date Sampled:	12/2/83	12/2/83	12/2/83	12/2/83	12/2/83	12/2/83	12/2/83
Parameters, units							
Metals, ug/l							
Aluminum							
Antimony							
Arsenic							
Barium							
Beryllium							
Calcium							
Chromium	< 30	< 30	< 30	< 30	< 30	< 30	< 30
Cobalt							
Copper							
Iron							
Lead	< 30	< 30	< 30	< 30	< 30	< 30	< 30
Magnesium							
Manganese							
Mercury							
Nickel	< 100	< 100	< 100	< 100	< 100	< 100	< 100
Potassium							
Sodium							
Vanadium							
Zinc							
Cyanide							
Volatile Organic Compounds, ug/l							
Methylene Chloride							
Acetone							
Benzene							
2-Hexanone							
Toluene							

TABLE 4-6 Page 2

Sample Name:	Loving	Stewart	Schafer	Trailer Court	Townsend	4638 Dup.	Blank
Sample No:	4634	4635	4636	4637	4638	4639	4640
Date Sampled:	12/2/83	12/2/83	12/2/83	12/2/83	12/2/83	12/2/83	12/2/83
Parameters, units							
Volatile Organic Compounds, ug/l							
Ethylbenzene							
Total Xylenes							
o-Xylene							
m-Xylene							
p-Xylene							
Carbon Disulfide							
Chloroform							
Semivolatile Organics, ug/l							
Phenol ug/l	5	5	5	5	5	5	5
4-Methylphenol							
2,4-Dinitrotoluene							
2,6-Dinitrotoluene							
2,4-Dimethylphenol							
Benzoic Acid							
Naphthalene							
2-Chloronaphthalene							
2-Methylnaphthalene							
Acenaphthylene							
Acenaphthene							
Dibenzofuran							
Fluorene							
Phenanthrene							
Anthracene							
Fluoranthene							
Pyrene							
Benzo(a)Anthracene							
Chrysene							
bis(2-Ethylhexyl)Phthalate							
Benzo(b)Fluoranthene							
Benzo(k)Fluoranthene							
Benzo(a)Pyrene							
Ideno(1,2,3,-cd)Pyrene							
Dibenz(a,h)Anthracene							
Benzo(g,h,i)Perylene							
Dimethyl Phthalate							
Hexachlorocyclopentadiene							

Sample Name:	Loving	Stewart	Schafer	Trailer Court	Townsend	4638 Dup.	Blank
Sample No:	4634	4635	4636	4637	4638	4639	4640
Date Sampled:	3/27/86	3/27/86	3/27/86	3/27/86	10/14/86		
Parameters, units							
Metals, ug/l							
Aluminum	170 U	170 U	170 U	170 U			
Antimony	59 U	59 U	59 U	59 U			
Arsenic	6.7 U	6.7 U	6.7 U	6.7 U			
Barium	[55]	29 U	52	[52]			
Beryllium	4.0 U	4.0 U	4.0 U	4.0 U			
Cadmium	5.0 U	5.0 U	5.0 U	5.0 U			
Calcium	33600	44200	14100	33000			
Chromium	9.4 U	9.4 U	9.4 U	9.4 U			
Cobalt	18 U	18 U	18 U	18 U			
Copper	58	21	21 U	43			
Iron	144	227	225	88 U			
Lead	4.4 U	4.4 U	4.4 U	4.4 U			
Magnesium	6270	[2040]	[3210]	6390			
Manganese	37	30	[14]	39			
Mercury	0.02 U	0.02 U	0.02 U	0.02 U			
Nickel	40 U	40 U	40 U	40 U			
Potassium	2890 U	2890 U	2890 U	2890 U			
Selenium	5.0 U	5.0 U	5.0 U	5.0 U			
Silver	9.3 U	9.3 U	9.3 U	9.3 U			
Sodium	25600	4980 U	7360	22200			
Thallium	6.5 U	6.5 U	6.5 U	6.5 U			
Tin	37 U	37 U	37 U	37 U			
Vanadium	23 U	23 U	23 U	23 U			
Zinc	99	[17]	674	72			
Cyanide	10 U	10 U	10 U	10 U			
Volatile Organic Compounds, ug/l							
Chloromethane	10 U	10 U	10 U	10 U			
Bromomethane	10 U	10 U	10 U	10 U			
Vinyl Chloride	10 U	10 U	10 U	10 U			
Chloroethane	10 U	10 U	10 U	10 U			
Methylene Chloride	5 U	5 U	5 U	33			
Acetone	10 U	33	10 U	33			
Carbon Disulfide	5 U	5 U	5 U	5 U			
1,1-Dichloroethane	5 U	5 U	5 U	5 U			
1,1-Dichloroethane	5 U	5 U	5 U	5 U			

Sample Name:	HW 1	HW 2	HW 3	HW 4	HW 1
Sample No:	CE 246/ MCC 920	CE 247/ MCC 921	CE 248/ MCC 922	CE 249/ MCC 923	861015-02
Date Sampled:	3/27/86	3/27/86	3/27/86	3/27/86	10/14/86
Parameters, units					
Volatile Organic Compounds, ug/l					
Trans-1,2-Dichloroethane	5 U	5 U	5 U	5 U	
Chloroform	5 U	5 U	5 U	5 U	
1,2-Dichloroethane	5 U	5 U	5 U	5 U	
2-Butanone	10 U	10 U	10 U	10 U	
1,1,1-Trichloroethane	5 U	5 U	5 U	5 U	
Carbon Tetrachloride	5 U	5 U	5 U	5 U	
Vinyl Acetate	5 U	5 U	5 U	5 U	
Bromodichloromethane	5 U	5 U	5 U	5 U	
1,2-Dichloropropane	5 U	5 U	5 U	5 U	
Trans-1,3-Dichloropropene	5 U	5 U	5 U	5 U	
Trichloroethene	5 U	5 U	5 U	5 U	
Dibromochloromethane	5 U	5 U	5 U	5 U	
1,1,2-Trichloroethane	5 U	5 U	5 U	5 U	
Benzene	5 U	2 JB	5 U	1 JB	
cis-1,3-Dichloropropene	5 U	5 U	5 U	5 U	
2-Chloroethylvinylether	10 U	10 U	10 U	10 U	
Bromoform	5 U	5 U	5 U	5 U	
4-Methyl-2-Pentanone	10 U	10 U	10 U	10 U	
2-Hexanone	10 U	10 U	10 U	10 U	
Tetrachloroethene	5 U	5 U	5 U	5 U	
1,1,2,2-Tetrachloroethane	5 U	5 U	5 U	5 U	
Toluene	5 U	5 U	5 U	5 U	
Ethylbenzene	5 U	5 U	5 U	5 U	
Styrene	5 U	5 U	5 U	5 U	
Total Xylenes	5 U	5 U	5 U	5 U	
Semivolatile Organic Compounds,ug/l					
Phenol	10 U	10 U	10 U	10 U	
bis(2-Chloroethyl)Ether	10 U	10 U	10 U	10 U	
2-Chlorophenol	10 U	10 U	10 U	10 U	
1,3-Dichlorobenzene	10 U	10 U	10 U	10 U	
1,4-Dichlorobenzene	10 U	10 U	10 U	10 U	
Benzyl Alcohol	10 U	10 U	10 U	10 U	
1,2-Dichlorobenzene	10 U	10 U	10 U	10 U	
2-Methylphenol	10 U	10 U	10 U	10 U	
bis(2-Chloroisopropyl)Ether	10 U	10 U	10 U	10 U	
4-Methylphenol	10 U	10 U	10 U	10 U	
N-Nitroso-Di-n-Propylamine	10 U	10 U	[illegible] U	10 U	

Sample Name: Sample No: Date Sampled:	HW 1 CE 246/ MCC 920 3/27/86	HW 2 CE 247/ MCC 921 3/27/86	HW 3 CE 248/ MCC 922 3/27/86	HW 4 CE 249/ MCC 923 3/27/86	HW 1 861015-02 10/14/86
Parameters, units					
Semivolatile Organic Compounds,ug/l					
Hexachloroethane	10 U	10 U	10 U	10 U	
Nitrobenzene	10 U	10 U	10 U	10 U	
Isophorone	10 U	10 U	10 U	10 U	
2-Nitrophenol	10 U	10 U	10 U	10 U	
2,4-Dimethylphenol	10 U	10 U	10 U	10 U	
Benzoic Acid	50 U	50 U	50 U	50 U	
bis(2-Chloroethoxy)Methane	10 U	10 U	10 U	10 U	
2,4-Dichlorophenol	10 U	10 U	10 U	10 U	
1,2,4-Trichlorobenzene	10 U	10 U	10 U	10 U	
Naphthalene	10 U	10 U	10 U	10 U	
4-Chloroaniline	10 U	10 U	10 U	10 U	
Hexachlorobutadiene	10 U	10 U	10 U	10 U	
4-Chloro-3-Methylphenol	10 U	10 U	10 U	10 U	
2-Methylnaphthalene	10 U	10 U	10 U	10 U	
Hexachlorocyclopentadiene	10 U	10 U	10 U	10 U	
2,4,6-Trichlorophenol	10 U	10 U	10 U	10 U	
2,4,5-Trichlorophenol	50 U	50 U	50 U	50 U	
2-Chloronaphthalene	10 U	10 U	10 U	10 U	
2-Nitroaniline	50 U	50 U	50 U	50 U	
Dimethyl Phthalate	10 U	10 U	10 U	10 U	
Acenaphthylene	10 U	10 U	10 U	10 U	
3-Nitroaniline	50 U	50 U	50 U	50 U	
Acenaphthene	10 U	10 U	10 U	10 U	
2,4-Dinitrophenol	50 U	50 U	50 U	50 U	
4-Nitrophenol	50 U	50 U	50 U	50 U	
Dibenzofuran	10 U	10 U	10 U	10 U	
2,4-Dinitrotoluene	10 U	10 U	10 U	10 U	
2,6-Dinitrotoluene	10 U	10 U	10 U	10 U	
Diethylphthalate	10 U	10 U	10 U	10 U	
4-Chlorophenyl-phenylether	10 U	10 U	10 U	10 U	
Fluorene	10 U	10 U	10 U	10 U	
4-Nitroaniline	50 U	50 U	50 U	50 U	
4,6-Dinitro-2-Methylphenyl	50 U	50 U	50 U	50 U	
N-Nitrosodiphenylamine (1)	10 U	10 U	10 U	10 U	
4-Bromophenyl-phenyl ether	10 U	10 U	10 U	10 U	
Hexachlorobenzene	10 U	10 U	10 U	10 U	
Pentachlorophenol	50 U	50 U	50 U	50 U	
Phenanthrene	10 U	10 U	10 U	10 U	
Anthracene	10 U	10 U	10 U	10 U	
Di-n-Butylphthalate	3 JB	10 U	10 U	10 U	
Fluoranthene	10 U	10 U	10 U	10 U	
Pyrene	10 U	10 U	10 U	10 U	

Sample Name:	Blank	MW 1	MW 2	MW 3	MW 4	HW 1	HW 4
Sample No:	CE 236	CE238	CE239	CE240	CE241	W-14501	W-14659
Sampler:	NUS	NUS	NUS	NUS	EPA	R.E.Wright	R.E.Wrigh
Date Sampled:	3/27/86	3/27/86	3/27/86	3/27/86	10/14/86	1/12/87	1/12/87
Parameters, units							
Volatile Organic Compounds ug/l							
2-Chlorophenol						N.D.	
2,4-Dichlorophenol						N.D.	
2,4-Dimethylphenol						N.D.	
4,6-Dinitro-o-cresol						N.D.	
2,4-Dinitrophenol						N.D.	
2-Nitrophenol						N.D.	
4-Nitrophenol						N.D.	
p-Chloro-m-cresol						N.D.	
Pentachlorophenol						N.D.	
Phenol						N.D.	
2,4,6-Trichlorophenol						N.D.	
Semivolatile Organic Compounds ug/l						N.D.	N.D.
Acenaphthene						N.D.	N.D.
Acenaphthylene						N.D.	N.D.
Anthracene						N.D.	N.D.
Benzidine						N.D.	N.D.
Benzo(a)Anthracene						N.D.	N.D.
Benzo(a)Pyrene						N.D.	N.D.
Benzo(g,h,i)Perylene						N.D.	N.D.
Benzo(b)Fluoranthene						N.D.	N.D.
Benzo(k)Fluoranthene						N.D.	N.D.
Bis(2-chloroethoxy) methane						N.D.	N.D.
Bis(2-chloroethyl) ether						N.D.	N.D.
Bis(2-chloroisopropyl) ether						N.D.	N.D.
Bis(2-Ethylhexyl)Phthalate						N.D.	N.D.
4-Bromophenyl Phenyl Ether						N.D.	N.D.
Butylbenzyl Phthalate						N.D.	N.D.
2-Chloronaphthalene						N.D.	N.D.
2-Chlorophenyl Phenyl Ether						N.D.	N.D.
Chrysene						N.D.	N.D.
Dibenz(a,h)Anthracene						N.D.	N.D.
1,2-Dichlorobenzene						N.D.	N.D.

Sample Name:	Blank	MW 1	MW 2	MW 3	MW 4	HW 1	HW 4
Sample No:	CE 236	CE238	CE239	CE240	CE241	W-14501	W-14659
Date Sampled:	3/27/86	3/27/86	3/27/86	3/27/86	10/14/86	1/12/87	1/12/87
Parameters, units							
Semivolatile Organic Compounds ug/l							
1,3-Dichlorobenzene						N.D.	N.D.
1,4-Dichlorobenzene						N.D.	N.D.
3,3'-Dichlorobenzidine						N.D.	N.D.
Diethyl Phthalate						N.D.	N.D.
Dimethyl Phthalate						N.D.	N.D.
Di-n-butyl Phthalate						N.D.	N.D.
2,4-Dinitrotoluene						N.D.	N.D.
2,6-Dinitrotoluene						N.D.	N.D.
Di-n-octylphthalate						N.D.	N.D.
1,2-Diphenylhydrazine						N.D.	N.D.
Fluoranthene						N.D.	N.D.
Fluorene						N.D.	N.D.
Hexachlorobenzene						N.D.	N.D.
Hexachlorobutadiene						N.D.	N.D.
Hexachlorocyclopentadiene						N.D.	N.D.
Hexachloroethane						N.D.	N.D.
Indeno(1,2,3-cd)pyrene						N.D.	N.D.
Isophorone						N.D.	N.D.
Naphthalene						N.D.	N.D.
Nitrobenzene						N.D.	N.D.
N-Nitrosodimethylamine						N.D.	N.D.
N-Nitrosodi-n-propylamine						N.D.	N.D.
N-Nitrosodi-n-phenylamine						N.D.	N.D.
Phenanthrene						N.D.	N.D.
Pyrene						N.D.	N.D.
1,2,4-Trichlorobenzene							

Sample Name: Sample No:	Blank CE 236	MW 1 CE238	MW 2 CE239	MW 3 CE240	MW 4 CE241	HW 1 W-14501	HW 4 W-14659
Date Sampled:	3/27/86	3/27/86	3/27/86	3/27/86	10/14/86	1/12/87	1/12/87
Parameters, units							
Semivolatile Organic Compounds,ug/l							
Butylbenzylphthalate		10 U	10 U	10 U	10 U		
3,3-Dichlorobenzidine		20 U	20 U	20 U	20 U		
Benzo(a)Anthracene		10 U	10 U	10 U	10 U		
bis(2-Ethylhexyl)Phthalate		10 U	10 U	10 U	10 U		
Chrysene		10 U	10 U	10 U	10 U		
Di-n-Octyl Phthalate		10 U	10 U	10 U	10 U		
Benzo(b)Fluoranthene		10 U	10 U	10 U	10 U		
Benzo(k)Fluoranthene		10 U	10 U	10 U	10 U		
Benzo(a)Pyrene		10 U	10 U	10 U	10 U		
Ideno(1,2,3,-cd)Pyrene		10 U	10 U	10 U	10 U		
Dibenz(a,h)Anthracene		10 U	10 U	10 U	10 U		
Benzo(g,h,i)Perylene		10 U	10 U	10 U	10 U		
Pesticide Organics ug/l							
Alpha-BHC		0.01 U	0.01 U	0.01 U	0.01 U		
Beta-BHC		0.01 U	0.01 U	0.01 U	0.01 U		
Delta-BHC		0.01 U	0.01 U	0.01 U	0.01 U		
Gamma-BHC (Lindane)		0.01 U	0.01 U	0.01 U	0.01 U		
Heptachlor		0.01 U	0.01 U	0.01 U	0.01 U		
Aldrin		0.01 U	0.01 U	0.01 U	0.01 U		
Heptachlor Epoxide		0.01 U	0.01 U	0.01 U	0.01 U		
Endosulfan I		0.01 U	0.01 U	0.01 U	0.01 U		
Dieldrin		0.01 U	0.01 U	0.01 U	0.01 U		
4,4-DDE		0.01 U	0.01 U	0.01 U	0.01 U		
Endrin		0.01 U	0.01 U	0.01 U	0.01 U		
Endosulfan I I		0.03 U	0.03 U	0.03 U	0.03 U		
4,4-DDD		0.01 U	0.01 U	0.01 U	0.01 U		
Endosulfan Sulfate		0.05 U	0.05 U	0.05 U	0.05 U		
4,4-DDT		0.02 U	0.02 U	0.02 U	0.02 U		
Methoxychlor		0.05 U	0.05 U	0.05 U	0.05 U		
Endrin Ketone		0.05 U	0.05 U	0.05 U	0.05 U		
Chlordane		0.25 U	0.25 U	0.25 U	0.25 U		
Toxaphene		0.5 U	0.5 U	0.5 U	0.5 U		
Aroclor-1016		0.15 U	0.15 U	0.15 U	0.15 U		
Aroclor-121		0.25 U	0.25 U	0.25 U	0.25 U		
Aroclor-1232		0.25 U	0.25 U	0.25 U	0.25 U		
Aroclor-1242		0.15 U	0.15 U	0.15 U	0.15 U		
Aroclor-1248		0.15 U	[illegible] U	0.15 U	0.15 U		
Aroclor-1254		0.25 U	[illegible] U	0.25 U	0.25 U		
Aroclor-1260		0.25 U	[illegible] U	0.25 U	0.25 U		

* = Analyzed in duplicate, both values below specified detection limit.
J = Estimated quantity, concentration below the level for accurate quantitation
[ ] = Value is greater than or equal to the instrument detection limit, but less than the contract required reporting limit required
U = Compound was analyzed for, but not detected. The number is the minimum attainable detection limit for the sample.

B = Analyte found in both the blank and in the sample
N = Not detected after correction for laboratory blank
N.D. = Compound was analyzed for, but not detected.

Table 4-7 presents a summary of the analytical results for groundwater samples. The distribution of selected compounds detected is presented in Figure 4-2. Table 4-8 presents a statistical summary and frequency detection for groundwater analytical data. All analytical data and accompanying documentation is contained in Appendix X. The data validation report for these samples is provided as Appendix XI.

Three split samples from wells MW-5, MW-6 and MW-7N were retained for EPA by their onsite contractor for chemical analyses. Table 4-9 presents a summary of the split sample results. The analytical data and EPA validation summary reports are contained in Appendix IX.

The following sections contain a discussion of the RI results by compound group and by well location.

Groundwater quality characteristics should be looked at in two ways relative to this RI: onsite versus offsite and upgradient versus downgradient.

Offsite wells were selected according to criteria identified in the approved Work Plan. Four offsite domestic wells were sampled, DW-1, DW-2, DW-3, and DW-4. Eight onsite wells (MW-1, MW-2, MW-5, MW-6, MW-7N, MW-8N, MW-9, and MW-10) were also sampled. Wells MW-1 and MW-2 are hydraulically upgradient of the former site operations. Figure 4-2 shows the distribution of several parameters of interest present in the RI groundwater samples.

For purposes of this RI, groundwater sample results are presented as micrograms per liter (ug/l) which is equivalent to parts per billion or as milligrams per liter (mg/l) which is equivalent to parts per million.

4.2.2.1 Volatile Organic Compounds

Two samples showed the presence of VOCs above the quantitation limit. Methylene chloride was detected in the sample from offsite well S-DW4 at 11.0 ug/l and acetone in the sample from onsite well S-06 at 10.0 ug/l.

Acetone was present in the Trip Blank for April 26 at a concentration of 210 ug/l. Methylene chloride was present in the Trip Blank for April 27 at 1.0 ug/l. No other well water samples showed the presence of VOCs.

No TIC VOCs were present in groundwater samples.

4.2.2.2 Semivolatile Organic Compounds

Few semivolatile organic compounds were detected in groundwater samples. bis(2-Ethylhexyl) phthalate was detected at an estimated concentration of 2.0 ug/l in offsite well sample S-DW4. Napthalene was detected at estimated concentrations of 4.0 ug/l in onsite well samples S-06 and S-07N. No other well samples showed the presence of semivolatile organic compounds.

TABLE 4-7
SUMMARY OF RI ANALYTICAL RESULTS FOR GROUNDWATER (1990)*

SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE
SEPTEMBER 1990

Sample Name:	S-DW1-01	S-DW2-01	S-DW3-01	S-DW-33-01 Duplicate	S-DW4-01	S-01-01	S-02-01	S-22-01 Duplicate	S-05-01	S-06-01	S-07N-01
BCM Lab ID:	012049 012050	012055 012056	012051 012052	012053 012054	012057 012058	012579 012580	012581 012582	012583 012584	012585 012586	012598 012599	012596 012597
COMPUCHEM ID:	335001 335023 335034 335041 335050	335000 335022 335033 335040 335049	335005 335024 335035 335042 335051	335011 335027 335037 335047 335053	334999 335015 335029 335039 335048	335295 335322 335335 335379	335293 335305 335308 335310 335374	335297 335357 335361 335365 335381	335294 335315 335317 335377	335601 335607 335612 335616 335621	335602 335608 335613 335617 335622
Date Sampled:	4/25/90	4/25/90	4/25/90	4/25/90	4/25/90	4/26/90	4/26/90	4/26/90	4/26/90	4/27/90	4/27/90
Parameters, units											
Metals, Filtered, ug/l											
Aluminum	16.0 U	16.0 U	16.0 U	16.0 U	18.2 B	16.0 U	112.0 B	94.5 B	217.0	16.0 U	16.0 U
Antimony	21.0 U	21.0 U	21.0 U	21.0 U	21.0 U	21.0 U	21.0 U	24.0 B	21.0 U	21.0 U	21.0 U
Barium	42.1 B	25.1 B	74.2 B	68.8 B	149.0 B	142.0 B	64.0 B	75.7 B	76.7 B	67.3 B	39.0 B
Beryllium	1.0 U	1.6 Q	1.0 U	1.0 U	1.6 Q	1.0 U	1.0 U	2.0 Q	1.0 U	1.0 U	1.0 U
Calcium	43,300.0	63,400.0	13,600.0	13,600.0	28,300.0	47,500.0	35,300.0	35,100.0	15,700.0	43,500.0	66,100.0
Chromium	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	6.6 B	5.0 U	5.0	5.0 U
Cobalt	3.0 U	3.0 U	3.0 U	3.0 U	17.2 Q	3.0 U	14.2 Q	14.0 Q	19.4 Q	24.4 Q	56.8
Copper	4.0 U	8.4 Q	4.0 U	4.0 U	70.4	4.0 U	4.0 U	4.6 Q	4.0 U	7.7 Q	4.0 U
Iron	68.2 B	724.0	252.0	261.0	4.0 U	553.0	4.0 U	4.0 U	3,140.0	6,120.0	39,400.0
Lead	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 UL	2.0 UL	2.0 U	2.0 UL	2.0 UL
Magnesium	2,310.0 B	8,570.0	3,390.0 B	3,370.0 B	12,800.0	3,450.0 B	8,450.0	8,540.0	5,530.0	13,800.0	21,000.0
Manganese	28.0	25.9	24.7	24.8	31.5	44.4	60.4	62.1	1,870.0	1,750.0	7,440.0
Mercury	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ
Nickel	29.0 U	43.4	29.0 U	29.0 U	29.0 U	29.0 U	33.1 B	32.5 B	57.2	789.0	29.0 U
Potassium	1,600.0 B	3,160.0 B	2,870.0 B	2,180.0 B	2,470.0 B	3,720.0 B	2,880.0 B	2,870.0 B	9,500.0	7,930.0	10,000.0
Selenium	10.0 UJ	10.0 UJ	10.0 UJ	10.0 UJ	2.0 UJ	10.0 UJ	2.0 UJ	2.0 UJ	10.0 UJ	2.0 UJ	2.0 U
Silver	4.0 U	8.2 Q	4.0 U	4.0 U	4.2 Q	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U
Sodium	2,810.0 B	18,800.0	7,830.0	7,910.0	47,600.0	4,640.0 B	26,600.0	26,800.0	20,400.0	21,300.0	25,400.0
Vanadium	2.0 U	2.0 U	2.0 U	2.0 U	5.1 Q	2.0 U	2.0 U	2.0 U	2.4 Q	8.5 Q	29.3 B
Zinc	14.5 Q	581.0	1,390.0	1,400.0	89.4 Q	9.0 Q	44.4	53.4	178.0	42.4 Q	17.2 Q
Cyanide	NT	NT	NT	NT	NT	10.0 U	NT	NT	25.7	NT	NT
Metals,Unfiltered,ug/l											
Aluminum	22.7 B	43.4 B	23.4 B	47.2 B	80.0 B	NT	225.0	206.0	NT	102.0 B	2,190.0
Antimony	21.0 U	21.0 U	21.0 U	21.0 U	21.0 U	NT	21.0 U	21.0 U	NT	21.0 U	21.0 U
Barium	2.5 B	14.8 B	51.6 B	52.0 B	90.2 B	NT	53.2 B	51.6 B	NT	47.0 B	62.6 B
Beryllium	1.0 U	1.0 U	1.0 U	1.0 U	2.1 B	NT	1.0 U	1.0 U	NT	1.0 U	1.3 B
Calcium	35,100.0	49,300.0	11,000.0	10,700.0	21,700.0	NT	28,100.0	27,200.0	NT	31,000.0	56,800.0
Chromium	5.0 U	5.6 B	5.0 U	5.0 U	5.0 U	NT	7.3 B	6.4 B	NT	5.0 U	5.0 U
Cobalt	3.0 U	3.0 U	3.0 U	3.0 U	7.0 Q	NT	11.3 Q	14.1 Q	NT	15.6 Q	51.9 K
Copper	8.9 BK	5.3 BK	4.0 U	12.6 BK	52.4	NT	7.2 Q	7.2 Q	NT	4.0 U	4.0 U
Iron	107.0 K	134.0 K	1,050.0 J	2,450.0 J	4.2 BK	NT	148.0 K	135.0 K	NT	4,540.0 K	45,000.0 K

* See Table 4-7 Page 5 for legend.

Sample Name:	S-DW1-01	S-DW2-01	S-DW3-01	S-DW-33-01	S-DW4-01	S-01-01	S-02-01	S-22-01	S-05-01	S-06-01	S-07N-01
Date Sampled:	4/25/90	4/25/90	4/25/90	4/25/90	4/25/90	4/26/90	4/26/90	4/26/90	4/26/90	4/27/90	4/27/90
Parameters, units											
Metals,Unfiltered,ug/l (continued)											
Lead	2.0 U	2.0 U	2.6 B	5.4	2.0 U	NT	2.0 UL	2.0 UL	NT	2.5 BL	5.9 L
Magnesium	1,710.0 BL	6,810.0	2,580.0 BL	2,470.0 BL	9,670.0	NT	6,590.0	6,410.0	NT	10,000.0	18,000.0
Manganese	23.1	20.4	23.1	23.1	29.0	NT	55.7	49.4	NT	1,250.0	6,630.0
Mercury	0.26 Q	0.20 U	0.20 U	0.20 U	0.46 Q	NT	0.32 Q	0.40 Q	NT	0.20 U	0.20 U
Nickel	29.0 U	37.8 B	29.0 U	29.0 U	29.0 U	NT	29.0 U	29.0 U	NT	572.0	29.0 U
Potassium	1,260.0 UL	3,220.0 B	1,260.0 UL	1,260.0 UL	1,650.0 BL	NT	1,260.0 UL	1,320.0 BL	NT	6,380.0	10,800.0
Selenium	10.0 UJ	9.7 Q	10.0 UJ	11.2 Q	2.3 Q	NT	2.0 UJ	2.0 UJ	NT	2.0 U	10.0 UJ
Silver	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	NT	4.0 U	4.0 U	NT	4.0 U	4.0 U
Sodium	2,330.0 B	15,000.0	6,590.0	6,420.0	38,800.0	NT	22,100.0	21,600.0	NT	18,000.0	23,500.0
Vanadium	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	NT	2.0 U	2.0 U	NT	2.2 B	55.2
Zinc	21.1	47.2	1,190.0	1,350.0	57.3	NT	65.2 Q	38.1 Q	NT	38.1	39.8
Cyanide	10.0 U	12.9	10.0 U	12.9	11.9	NT	14.1	13.3	NT	17.2	11.2
Volatile Organic Compounds, ug/l											
Acetone	10.0 Q	10.0 U	10.0 U	10.0 Q	10.0 Q	NT	10.0 U	10.0 U	NT	10.0	10.0 U
Benzene	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	NT	5.0 U	5.0 U	NT	5.0 U	2.0 J
Methylene Chloride	5.0 U	5.0 U	5.0 U	5.0 U	11.0	NT	5.0 U	5.0 U	NT	5.0 U	5.0 U
Total Xylenes	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	NT	5.0 U	5.0 U	NT	5.0 U	1.0 J
Semivolatile Organics, ug/l											
bis(2-Ethylhexyl) Phthalate	10.0 U	10.0 U	10.0 U	10.0 U	2.0 J	10.0 U	10.0 U	10.0 U	10.0	10.0	10.0 R
Napthalene	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0	4.0 J	4.0 J
Total Organic Carbon, mg/l	3.1	4.8	1.8	1.9	3.0	3.4	2.9	2.5	5.7	4.9	13.0
Total Dissolved Solids, mg/l	120	420	110	110	250	200	310	320	260	350	490
Total Suspended Solids, mg/l	–	–	15	17	–	40	22	31	720	37	810
Semivolatile Organics - Tentatively Identified Compounds, ug/l											
Unknown	–	10.0 J	–	–	–	–	–	–	20 J	22 J	10.0 J
Unknown	–	–	–	–	–	–	–	–	–	–	22.0 J

Sample Name:	S-08N-01	S-09-01	S-10-01	Field Blank	Field Blank	Field Blank	Trip Blank	Trip Blank	Trip Blank
BCM Lab ID:	012594 012595	012592 012593	012587 012588	012060 012061	012590 012591	012601 012602	012059	012589	012600
COMPUCHEM ID:	335603 335609 335618 335623	335600 335606 335611 335615 335620	335292 335299 335303 335373	335009 335026 335036 335043 335052	335296 335341 335348 335351 335384	335599 335605 335610 335614 335619	335012 335038	335298 335369	335598 335604
Date Sampled:	4/27/90	4/27/90	4/26/90	4/25/90	4/26/90	4/27/90	4/25/90	4/26/90	4/27/90
Parameters, units									
Metals, Filtered, ug/l									
Aluminum	16.0 U	16.0 U	16.0 U	16.0 U	16.0 U	16.0 U	NT	NT	NT
Antimony	21.0 U	21.0 U	21.0 U	21.0 U	21.0 U	21.0 U	NT	NT	NT
Barium	50.0 B	44.5 B	131.0 B	3.1 B	1.0 B	7.2 B	NT	NT	NT
Beryllium	1.0 U	1.0 U	2.0 Q	1.0 U	1.0 U	1.0 U	NT	NT	NT
Calcium	23,700.0	67,000.0	57,000.0	38.3 B	33.2 Q	50.3 Q	NT	NT	NT
Chromium	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	NT	NT	NT
Cobalt	7.5 BQ	7.6 Q	7.2 Q	3.0 U	3.6 Q	3.0 U	NT	NT	NT
Copper	4.0 U	4.0 U	7.8 Q	4.0 U	4.0 U	4.0 U	NT	NT	NT
Iron	4.7 BQ	4.0 U	88.2 Q	5.5 B	20.0 B	4.5 B	NT	NT	NT
Lead	2.0 U	2.0 UL	2.0 U	2.0 U	2.0 U	2.0 U	NT	NT	NT
Magnesium	10,700.0	20,600.0	3,230.0 B	84.3 Q	288.0 Q	287.0 Q	NT	NT	NT
Manganese	196.00	52.7	17.8	1.0 U	1.0 U	1.0 U	NT	NT	NT
Mercury	0.23 Q	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	NT	NT	NT
Nickel	29.0 U	29.0 U	29.0 U	29.0 U	29.0 U	29.0 U	NT	NT	NT
Potassium	3,800.0 B	4,460.0 B	3,010.0 B	1,260.0 U	1,260.0 U	1,260.0 U	NT	NT	NT
Selenium	2.0 UJ	10.0 UJ	10.0 UJ	2.0 UJ	2.0 UJ	2.0 UJ	NT	NT	NT
Silver	4.0 U	4.0 U	4.0 U	4.9 Q	4.0 U	49.2	NT	NT	NT
Sodium	8,830.0	32,800.0	4,490.0 B	1,490.0 U	1,490.0 U	1,910.0 B	NT	NT	NT
Vanadium	2.0 U	2.0 U	5.1 Q	2.0 U	3.2 Q	2.0 U	NT	NT	NT
Zinc	35.2	20.7 Q	25.3 Q	23.5	8.5 B	14.3 B	NT	NT	NT
Cyanide	19.5	NT	10.0 U	NT	NT	NT	NT	NT	NT
Metals,Unfiltered,ug/l									
Aluminum	NT	1,090.0	NT	16.0 U	22.1 B	16.0 U	16.0 U	25.8 B	16.0 U
Antimony	NT	21.0 U	NT	21.0 U	21.0 U	21.0 U	21.0 U	21.0 U	21.0 U
Barium	NT	35.6 B	NT	1.9 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Beryllium	NT	1.0 U	NT	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Calcium	NT	50,200.0	NT	17.0 U	33.4 B	17.0 U	17.0 U	20.5 B	17.0 U
Chromium	NT	5.8 B	NT	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Cobalt	NT	8.3 Q	NT	3.0 U	3.3 Q	3.0 U	3.0 U	3.2 B	3.2 BQ
Copper	NT	4.0 U	NT	4.0 U	7.2 BK	4.0 U	4.0 U	7.3 BK	4.0 U
Iron	NT	2,220.0 K	NT	4.0 U	4.0 U	4.1 BK	4.0 U	4.0 U	4.0 U

Sample Name:	S-08N-01	S-09-01	S-10-01	Field Blank	Field Blank	Field Blank	Trip Blank	Trip Blank	Trip Blank
Date Sampled:	4/27/90	4/27/90	4/26/90	4/25/90	4/26/90	4/27/90	4/25/90	4/26/90	4/27/90
Parameters, units									
Metals,Unfiltered,ug/l (continued)									
Lead	NT	3.3 L	NT	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Magnesium	NT	15,200.0	NT	56.0 U	56.0 UL	56.0 UL	94.2 Q	56.0 UL	56.0 UL
Manganese	NT	129.0	NT	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Mercury	NT	0.20 U	NT	0.35 K	0.20 U	0.24 K	0.2 U	0.40 K	0.20 U
Nickel	NT	29.0 U	NT	29.0 U	29.0 U	29.0 U	29.0 U	29.0	29.0 U
Potassium	NT	4,520.0 B	NT	1,260.0 U	1,260.0 UL	1,260.0 U	1,260.0 U	1,260.0 L	1,260.0 UL
Selenium	NT	2.0 UJ	NT	2.0 UJ	2.0 UJ	2.0 UJ	2.0 UJ	2.0 J	2.0 UJ
Silver	NT	4.0 U	NT	4.0 U	4.0 U	4.0 U	4.4 Q	4.0	4.0 U
Sodium	NT	25,900.0	NT	1,490.0 U	1,490.0 U	1,490.0 U	1,490.0 U	1,490.0	1,490.0 U
Vanadium	NT	13.8 B	NT	2.0 U	2.0 U	2.0 U	2.0 U	2.0	2.0 U
Zinc	NT	27.6 K	NT	1.6 BK	17.9 BK	1.0 BK	5.6 Q	21.7 K	1.0 U
Cyanide	NT	10.3	NT	10.0 U	10.0 U	10.0 U	NT	10.0 U	10.0 U
Volatile Organic Compounds, ug/l									
Acetone	NT	10.0	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	21.0	10.0 U
Benzene	NT	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Methylene Chloride	NT	1.0 J	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	1.0 J
Total Xylenes	NT	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Semi Volatile Organic Compounds, ug/l									
bis(2-Ethylhexyl)Phthalate	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	NT	NT	NT
Naphthalene	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	NT	NT	NT
	12.0	6.7	1.7	1.3	–	1.3	NT	NT	NT
Total Organic Carbon,mg/l	400	500	230	–	12	–	NT	NT	NT
Total Dissolved Solids, mg/l	1600	290	5.6	–	–	–	NT	NT	NT
Total Suspended Solids, mg/l									
Semivolatile Organics - Tentatively Identified Compounds, ug/l									
Unknown Hexanedioic Acid	–	–	28 J	–	–	–	–	–	–

Notes:

U = Compound was not detected. Value listed is the sample quantitation limit.
— = Not detected
B = For Organics :Present in an associated blank.
B = For Inorganics:Reported value is less than the contract detection limit but greater than the instrument detection limit
J = Estimated value below detection limit
X = Coelution of indistinguishable isomers
NT = Not Tested
Q = Value questioned by data validation
L = Reported value is estimated low
K = Reported value is estimated high
R = Quality control indicates that the data are unusable.

EPA split samples were not included as part of this summary.

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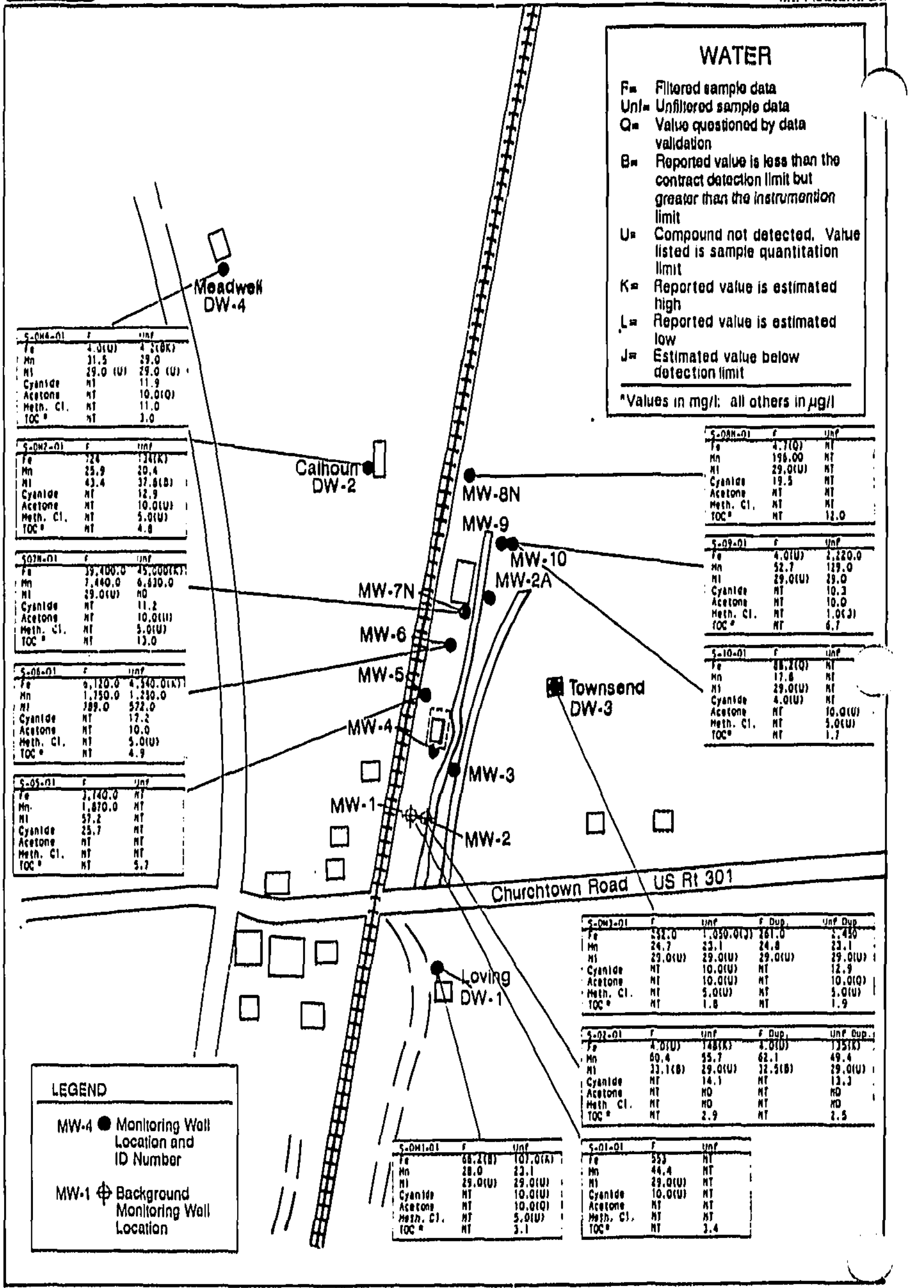
BCM

SEALAND LTD. SITE
Mt. Pleasant, DE



WATER

F= Filtered sample data
Unf= Unfiltered sample data
Q= Value questioned by data validation
B= Reported value is less than the contract detection limit but greater than the instrumention limit
U= Compound not detected. Value listed is sample quantitation limit
K= Reported value is estimated high
L= Reported value is estimated low
J= Estimated value below detection limit

*Values in mg/l; all others in µg/l

S-DW4-01	F	Unf
Fe	4.0(U)	4.2(BK)
Mn	31.5	29.0
Ni	29.0 (U)	29.0 (U)
Cyanide	NT	11.9
Acetone	NT	10.0(Q)
Meth. Cl.	NT	11.0
TOC *	NT	3.0

S-DW2-01	F	Unf
Fe	724	134(K)
Mn	25.9	20.4
Ni	43.4	37.8(B)
Cyanide	NT	12.9
Acetone	NT	10.0(U)
Meth. Cl.	NT	5.0(U)
TOC *	NT	4.8

S07N-01	F	Unf
Fe	39,400.0	45,000(K)
Mn	7,440.0	6,630.0
Ni	29.0(U)	ND
Cyanide	NT	11.2
Acetone	NT	10.0(U)
Meth. Cl.	NT	5.0(U)
TOC *	NT	13.0

S-06-01	F	Unf
Fe	6,120.0	4,540.0(K)
Mn	1,750.0	1,250.0
Ni	389.0	572.0
Cyanide	NT	17.2
Acetone	NT	10.0
Meth. Cl.	NT	5.0(U)
TOC *	NT	4.9

S-05-01	F	Unf
Fe	3,140.0	NT
Mn	1,870.0	NT
Ni	57.2	NT
Cyanide	25.7	NT
Acetone	NT	NT
Meth. Cl.	NT	NT
TOC *	NT	5.7

S-08N-01	F	Unf
Fe	4.7(Q)	NT
Mn	196.00	NT
Ni	29.0(U)	NT
Cyanide	19.5	NT
Acetone	NT	NT
Meth. Cl.	NT	NT
TOC*	NT	12.0

S-09-01	F	Unf
Fe	4.0(U)	2,220.0
Mn	52.7	129.0
Ni	29.0(U)	29.0
Cyanide	NT	10.3
Acetone	NT	10.0
Meth. Cl.	NT	1.0(J)
TOC *	NT	6.7

S-10-01	F	Unf
Fe	88.2(Q)	NT
Mn	17.8	NT
Ni	29.0(U)	NT
Cyanide	4.0(U)	NT
Acetone	NT	10.0(U)
Meth. Cl.	NT	5.0(U)
TOC*	NT	1.7

S-DW3-01	F	Unf	F Dup.	Unf Dup
Fe	232.0	1,050.0(J)	261.0	2,450
Mn	24.7	23.1	24.8	23.1
Ni	29.0(U)	29.0(U)	29.0(U)	29.0(U)
Cyanide	NT	10.0(U)	NT	12.9
Acetone	NT	10.0(U)	NT	10.0(Q)
Meth. Cl.	NT	5.0(U)	NT	5.0(U)
TOC *	NT	1.8	NT	1.9

S-02-01	F	Unf	F Dup.	Unf Dup.
Fe	4.0(U)	148(K)	4.0(U)	135(K)
Mn	60.4	55.7	62.1	49.4
Ni	33.1(B)	29.0(U)	32.5(B)	29.0(U)
Cyanide	NT	14.1	NT	13.3
Acetone	NT	ND	NT	ND
Meth Cl.	NT	ND	NT	ND
TOC *	NT	2.9	NT	2.5

S-DW1-01	F	Unf
Fe	68.2(B)	107.0(K)
Mn	28.0	23.1
Ni	29.0(U)	29.0(U)
Cyanide	NT	10.0(U)
Acetone	NT	10.0(Q)
Meth. Cl.	NT	5.0(U)
TOC *	NT	3.1

S-01-01	F	Unf
Fe	553	NT
Mn	44.4	NT
Ni	29.0(U)	NT
Cyanide	10.0(U)	NT
Acetone	NT	NT
Meth. Cl.	NT	NT
TOC*	NT	3.4

BCM Project No. 00-6018-03

0 300 Ft. NORTH

Figure 4-2
Groundwater Quality Characteristics
Sealand Site

TABLE 4-8

FREQUENCY OF DETECTION FOR GROUNDWATER SAMPLES AND COMPARISON TO BACKGROUND CONCENTRATIONS

SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Data Summary	SITE SPECIFIC				
	Frequency of Detection* [ ]	Range	Arithmetic Average **	Background	
				MW1	MW2***
Metals, Filtered, ug/l					
Aluminum	3/10 [2]	<16 - 217	39.5	<16	103
Antimony	1/10 [1]	<21 - 24	11.2	<21	17.3
Barium	10/10 [3]	50 - 149	84.1	142	69.9
Beryllium	1/10 [1]	<1.0 - 2	0.6	<1.0	<1.0
Calcium	*10/10 [0]*	*13,600 - 67,000*	*39,760*	*47,500*	*35,200*
Chromium	1/10 [1]	<5 - 6.6	2.8	<5	4.6
Cobalt	2/10 [2]	<3 - 56.8	7.6	<3	14.1
Copper	2/10 [2]	<4 - 70.4	9.4	<4	<4
Iron	6/10 [3]	<4 - 39,400	4,957	553	<4
Magnesium	10/10 [2]	3,230 - 21,000	10,299	3,450	8,495
Manganese	10/10 [4]	17.8 - 7,440	1,149	44	61
Nickel	3/10 [1]	<29 - 789	98.1	<29	32.8
Potassiun	10/10 [3]	2,180 - 10,000	5,029	3,720	2,875
Sodium	10/10 [1]	4,490 - 47,600	20,003	4,640	26,700
Vanadium	2/10 [2]	<2 - 29.3	1.0	<2	<2
Zinc	5/10 [1]	<1 - 1440	166.3	9	49
Cyanide	2/4 [-]	<10 - 25.7	13.8	<10	NT
Metals, Unfiltered, ug/l					
Aluminum	6/6	23.5 - 2190	618.8	NT	216
Barium	6/6	35.6 - 90.2	56.6	NT	52.4
Beryllium	2/6	<1.0 - 2.1	0.9	NT	<1
Calcium	6/6	10700 - 56800	33033.3	NT	27650
Chromium	2/6	<5.0 - 7.3	3.8	NT	6.9
Cobalt	1/6	<3.0 - 51.9	9.9	NT	12.7
Copper	2/6	<4.0 - 52.4	11.2	NT	7.2
Iron	6/6	4.2 - 45000	8942.6	NT	142
Lead	4/6	<4.0 - 5.9	3.0	NT	<2
Magnesium	6/6	2470 - 18000	10315.8	NT	6500
Manganese	6/6	23.1 - 6630	1352.3	NT	52.6
Nickel	1/6	<0.2 - 572	107.4	NT	0.36
Potassium	5/6	<1260 - 10800	84	NT	1290
Sodium	6/6	6420 - 38800	22425.8	NT	21850
Vanadium	3/6	<2.0 - 55.2	12.3	NT	<2
Zinc	5/6	27.6 - 1350	239.0	NT	51.6
Cyanide	6/6	10.3 - 17.2	12.2	NT	13.4

TABLE 4-8

FREQUENCY OF DETECTION FOR GROUNDWATER SAMPLES AND COMPARISON TO BACKGROUND CONCENTRATIONS

SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Data Summary	SITE SPECIFIC				
	Frequency of Detection* [ ]	Range	Arithmetic Average **	Background	
				MW1	MW2***
Volatile Organic Compounds, ug/l					
Benzene	1/7	<5 - 2 #	2.4	<5	<5
Methylene Chloride	2/7	<5 - 11	3.5	<5	<5
Total Xylenes	1/7	<5 - 3 #	2.2	<5	<5
Semivolitale Organics, ug/l					
bis(2-Ethylhexyl) Phthalate	1/10	<10 - 2 #	4.7	<10	<10
Napthalene	2/10	<10 - 4 #	4.8	<10	<10

NT Not tested
* Number of detected values over the total number of samples taken.
** In calculating averages, one-half the detection limit was used for non-detects to represent a conservative estimate of the risk. Duplicate samples were averaged prior to use.
*** Value represents an average of duplicate samples.
[ ] The number of detects which are twice the background
Detected value was estimated below the quantitation limit.
Data questioned by data validation was considered to be below detection.

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TABLE 4-9 *

SUMMARY OF RI ANALYTICAL RESULTS FOR SPLIT SAMPLES - GROUNDWATER
SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Location:	MW0501	MW0001 (Dup of MCDW31)	MW0601	MW0701	MW0801	Field Blank	Field Blank	Trip Blank	Trip Blank
EPA ID:	MCDW31 MCDW37 CDE47 CDE47RE	MCDW32 MCDW38 CDE48 CDE48RE	MCDW42 MCDW43 CDE52 CDE52RE	MCDW44 MCDW45 CDE53	MCDW46 MCDW47 CDE54	MCDW33 MCDW39 CDE49	MCDW40 MCDW41 CDE51	CDE55	CDE50
Date Sampled:	4/26-27/90	4/26-27/90	4/26-27/90	4/26-27/90	4/26-27/90	4/26-27/90	4/26-27/90	4/26-27/90	4/26-27/90
Parameters, units									
Metals, mg/l (Unfiltered)									
Aluminum	11800	5220	209	14700	71700	13 U	13 U	NT	NT
Antimony	12 U	12 U	12 U	12 U	18 B	12 U	12 U	NT	NT
Arsenic	4.2 B	3.5 B	4.3 B	10.5	11.3	2 U	2 U	NT	NT
Barium	113 B	105 B	50.6 B	90 B	366	2 U	2 U	NT	NT
Beryllium	2.7 B	2.2 B	1 U	2.2 B	4 B	1 U	1 U	NT	NT
Cadmium	1.2 B	1 U	1 U	1 U	1 U	1 U	1 U	NT	NT
Calcium	15000	14700	35900	59800	34000	25 U	25 U	NT	NT
Chromium	4 U	4 U	4 U	86.7	949	4 U	4 U	NT	NT
Cobolt	21.2 B	19.4 B	14.5 B	46 B	56.3	4 U	4 U	NT	NT
Copper	11.4 B	7.4 B	5 U	5 U	5 U	5 U	5 U	NT	NT
Iron	10900 K	8440 K	3660 K	52900 K	221000 K	6 U	6 U	NT	NT
Lead	16.4	16.7	2 U	5.4	27.4	2 U	2 U	NT	NT
Magnesium	5510	5300	12200	20000	20700	54 U	54 U	NT	NT
Manganese	1790	1820	1280	6840	1550	1.8 U	1.3 BQ	NT	NT
Nickel	77.5	61.9	608	28.2 B	160	5 U	5 U	NT	NT
Potassium	11900	12000	7470	12300	15500	89 U	89 U	NT	NT
Silver	13.1 Q	11.7 Q	11.6 Q	6.7 BQ	3 U	12.5	10.8 B	NT	NT
Sodium	20700	21000	23000	27000	11300	41 U	41 U	NT	NT
Vanadium	17.4 B	12 B	3 U	73.3	719	3 U	3 U	NT	NT
Zinc	191	185	40 Q	61.6	504	5 U	5 U	NT	NT
Parameters, units									
Metals, mg/l (Filtered)									
Aluminum	219	222	13.5 B	13 U	13 U	13 U	13 U	NT	NT
Arsenic	2.4 B	2 U	2.9 B	2 U	2 U	2 U	2 U	NT	NT
Barium	83.6 B	68.5 B	79.5 B	42.1 B	87.6 B	3.7 B	3.7 B	NT	NT
Beryllium	1.4 B	1 U	1 U	1 U	1 U	1 U	1 U	NT	NT
Cadmium	1 U	1 U	1 U	1 U	1.2 B	1 U	1 U	NT	NT
Calcium	14400	14300	39200	60300	29300	28.4 BQ	27.1 BQ	NT	NT
Cobolt	15.5 B	14.9 B	13 B	40.4 B	4.4 B	4 U	4 U	NT	NT
Iron	2940	2950	5640	29600	22 BQ	6 U	19.1 BQ	NT	NT
Magnesium	4960 B	4920 B	12200	19400	13500	54 U	54 U	NT	NT
Manganese	1690	1670	1530	6670	236	1 U	1 U	NT	NT
Nickel	54.4	52.1	700	8.9 B	17.1 B	5 U	5 U	NT	NT
Potassium	11600	11400	8160	10800	3920 B	89 U	89 U	NT	NT
Silver	3.8 BQ	3 U	3 U	3 U	3 U	4.8 B	3 U	NT	NT
Sodium	21100	20500	21100	26300	11100	419 B	408 BQ	NT	NT
Vanadium	3 U	3 U	3 U	3 U	3 U	3 U	3 U	NT	NT
Zinc	158	146	41.4	5 U	57.7	5 U	5 U	NT	NT

* See legend on Table 4-9 Page 2.

Location:	MW0501	MW0001	MW0601	MW0701	MW0801	Field Blank	Field Blank	Trip Blank	Trip Blank
Date Sampled:	4/26-27/90	4/26-27/90	4/26-27/90	4/26-27/90	4/26-27/90	4/26-27/90	4/26-27/90	4/26-27/90	4/26-2
Parameters, units									
Volatiles,ug/l									
Methylene Chloride	1 Q	1 Q	1 Q	1 Q	1 Q	7 Q	6 Q	8 Q	7 Q
Acetone	UJ	UJ	4 Q	2 Q	1 Q	6 Q	5 Q	3 Q	5 Q
Benzene	0.7 J	0.6 J	5 U	1 J	5 U	5 U	5 U	5 U	5 U
Chloroform	5 U	5 U	5 U	5 U	5 U	5	4 J	3 J	5
Toluene	2 Q	2 Q	5 U	0.7 Q	5 U	5 U	0.5 Q	0.7 B	5 U
Total Xylenes	2 J	1 J	5 U	2 J	5 U	5 U	5 U	5 U	5 U
Parameters, units									
Volatile Tentatively Identified Compounds,ug/l									
Alkenylbenzene	--	--	--	--	9 J	--	--	--	--
1H-Indene	--	--	--	--	--	--	--	7.1 J	--
Unknown	--	--	--	--	--	--	5.1 J	--	--
Parameters, units									
Semivolatiles,ug/l									
Acenaphthylene	UJ	UJ	UJ	1 J	10 U	10 U	10 U	--	--
Naphthalene	UJ	UJ	UJ	5 J	10 U	10 U	10 U	--	--
Diethylphthalate	6 Q	12 Q	UJ	3 Q	10 U	4 Q	2 Q	--	--
Di-n-butylphthalate	0.8 Q	1 Q	UJ	0.6 Q	10 U	1 Q	0.5 Q	--	--
Bis(2-Ethylhexyl)phthalate	UJ	UJ	UJ	10 U	1 B	2 J	10 U	--	--
Parameters, units									
Tentatively Identified Semivolatiles,ug/l									
Alkane (MW = 170)	--	--	--	10.0 J	--	--	--	--	
Alkane (MW = 212)	--	--	--	15.0 J	--	--	--	--	
Alkane (MW = 226)	--	--	--	16.0 J	--	--	--	--	--
Alkane (MW = 240)	--	--	--	14.0 J	--	--	--	--	--
Alkane (MW = 198)	--	--	--	12.0 J	--	--	--	--	--
Alkane (MW = 184)	--	--	--	8.6 J	--	--	--	--	--
Unknown (contains Nitrogen	8.0 J	11.0 J	22.0 J	13.0 J	--	--	--	--	--
Unknown (contains Nitrogen	31.0 J	28.0 J	--	--	--	--	--	--	--
Unknown (MW = 346)	--	--	--	--	--	--	--	--	--
Unknown	--	--	--	--	--	--	--	--	--

Notes:

B = For organics: present in an associated blank
B = For inorganics: Reported valuse is lless than the contract detection limit but greater than the instrument detection limit
J = Estimated value below detection limit.
NT = Not tested.
Q = Value questioned by data validation
R = Quality control indicates that the data are unuseable
U = Compound was not detected. Value listed is the sample quantitation
-- = Not detected.

Few TIC semivolatile organic compounds were detected in groundwater samples. Unknown TICs were tentatively identified at estimated concentrations of 10.0 ug/l in offsite well S-DW2, 20 ug/l in S-05, 22.0 ug/l in S-06, 10.0 and 22.0 ug/l in S-07N and an unknown Hexanedioic Acid at 28.0 ug/l in sample S-10. No other semivolatile organic TICs were detected in any of the groundwater samples.

4.2.2.3 Pesticide Organic Compounds

No pesticide organic compounds were detected in any offsite or onsite groundwater samples.

4.2.2.4 Total Petroleum Hydrocarbons and Total Organic Carbon

No Total Petroleum Hydrocarbons were detected in any offsite or onsite groundwater samples.

Total Organic Carbon (TOC) was detected in all onsite groundwater samples at concentrations ranging from 1.7 to 13.0 mg/l. Well MW-7N exhibited the highest onsite concentration. Offsite wells had concentrations ranging from 1.8 to 4.8 mg/l with the highest concentration in the sample from DW-2.

4.2.2.5 Total Dissolved Solids

Total Dissolved Solids (TDS) were present in concentrations ranging from 110 to 500 mg/l in offsite and onsite groundwater samples. Offsite wells ranged from 110 to 420 mg/l. Onsite wells ranged from 200 to 500 mg/l. The highest concentrations were found in onsite well samples S-07N (490 mg/l) and S-09 (500 mg/l).

4.2.2.6 Inorganic Compounds

Twenty metals plus cyanide were analyzed in filtered and unfiltered groundwater samples from offsite and onsite wells. The presence of beryllium, cobalt, copper, silver, vanadium and zinc in some of the filtered and unfiltered samples was questioned during data validation. Of the 20 metals tested, only antimony, barium, beryllium, chromium and mercury were not present above their respective detection limits in any sample. Cyanide was detected in filtered samples S-05-01 (25.7 ug/l) and S-08N-01 (19.5 ug/l) Cyanide was also detected in the following unfiltered samples: S-DW2-01 (12.9 ug/l), S-DW3-01 (12.9 ug/l), S-DW4-01 (11.9 ug/l), S-02-01 (14.1 ug/l), S-02-01 Dup. (13.3 ug/l), S-06-01 (17.2 ug/l), S-07N-01 (11.2 ug/l) and S-09-01 (10.3 ug/l). Figure 4-2 shows the distribution of several metals in both onsite and offsite monitoring wells. Iron is present at concentrations ranging from non-detect to 45,000 ug/l. Manganese was present in all samples at concentration ranging from 17.8 to 6,360 ug/l. The distribution of nickel appears to onsite wells only. The concentrations of nickel ranged from non-detect to 789 ug/l.

5.0 HUMAN HEALTH AND ENVIRONMENTAL RISK ASSESSMENT

5.1 INTRODUCTION

5.1.1 Overview

This human health and environmental risk assessment describes the potential for adverse health effects due to exposure to chemicals found at the Site. Risk assessment combines the concentration of the chemicals with toxicological data to determine a numerical estimate of the magnitude and severity of the potential effects to human health and the environment due to actual or possible future exposure to chemicals.

5.1.2 Site Description

This section presents a brief description of the Site and a summary of the conditions pertinent to the risk assessment. For the risk assessment, the Site description focuses on opportunities for human and environmental exposure, both currently and in the future. The Site description includes surrounding land use, evidence for current exposure, and the Site's proximity to surface waters. A more detailed presentation of the Site description is given in Section 1.1.1 of this report.

The Site is a narrow strip of land (approximately 57 feet by 1,140 feet) which runs parallel to active Conrail railroad tracks. Currently, the Site contains a concrete slab, a one-story building, an abandoned rail spur, and miscellaneous debris. There are no residential units immediately adjacent to the Site. However, there are private residential areas located to the east and south of the Site. There is no evidence of consistent use of the Site such as dirt bike trails to suggest that teenage children from the nearby residences play at the Site on a regular basis. However, children and adults have been observed walking along the gravel bed of the active rail line.

Sealand Ltd. operated a waste oil recycling facility from August 1982 to August 1983. When the Site was abandoned in August 1983, the Site contained 21 steel tanks or hoppers, one 8,000-gallon wooden storage tank and, approximately 300 55-gallon steel drums, a boiler house, and various mixing chambers and pressure vessels. DNREC conducted a Site investigation and concluded that the wooden storage tank and some drums were leaking their contents onto the ground surface.

In December 1983, the DNREC and EPA initiated an Emergency Removal Action under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The action consisted of the removal of drums and storage tanks along with 80 cubic yards of solid waste. In addition, the tank and drum storage area was capped with approximately 1 foot of clay and 6 inches of topsoil. None of the soil suspected of being contaminated within the storage tank area was removed from the Site. Soil from the excavation of a L-shaped trench along the southern and western boundaries of the storage tank area, was also placed within the former tank area before placement of the cap. According to EPA records, the trench was constructed along the railroad side of the Site to aid in minimizing any horizontal movement of contaminants. Six groundwater monitoring wells were also installed during the Emergency Removal Action. Available information indicates that there were two wells existing onsite prior to the Emergency Removal Action which was concluded in June 1984.

The nearest surface water, Joy Run, is located 1,000 to 1,500 feet north of the Site. Soil within the the former tank area is capped so there is no source of surface contamination to the stream. There is no visible evidence of intrusive activities or disturbance to the cap. There are currently other sources of surface runoff contamination from a former asphalt manufacturing facility, including several tar spills and an abandoned tank trailer which are between the Site and Joy Run. A source of contaminated subsurface water include a dump area (which consists mainly of discarded highway materials) on the banks of Joy Run.

5.1.3 Scope of Risk Assessment

The risk assessment is a formal procedure with protocols (EPA, 1989a and 1986a-f). First, the risk assessment evaluates the chemicals found in the soil and groundwater at the Site and determines which Site-related chemicals are a potential concern to human health and the environment. Next, it considers the likelihood that humans or the environment are currently exposed to these chemicals or will be at some time in the future. In the final step, it uses the concentrations of the chemicals at the point of exposure to estimate the potential for an adverse effect on human health or the environment.

All chemicals, even beneficial ones, may produce some health effect if the concentration is sufficiently high. The factor differentiating beneficial from harmful effects is the amount of chemical entering into the body (dose). The risk assessment procedures estimate whether the concentration of a particular chemical is sufficiently high to cause concern for human health and the environment.

Risk assessment protocols are designed to be conservative to account for uncertainties such as the extent of contamination and the presence of highly sensitive individuals in the exposed population. The conservative approach is used to assure that the results of the risk assessment will be protective of human health and the environment.

The risk assessment evaluates a reasonable "worst-case" scenario so that regulators and the general public can compare this Site with other measures of risk. This approach makes risk assessment a useful tool in assuring that all aspects of potential adverse effects have been addressed. The risk assessment , therefore, is structured to predict the reasonable "worst-case" effects that can possibly happen rather than the most likely or probable potential of actual human health and environmental impacts.

5.1.4 Organization of Risk Assessment

The risk assessment process consists of four steps: identification of chemicals of potential concern, exposure assessment, toxicological assessment, and risk characterization. The steps are briefly described below.

- Identification of Chemicals of Potential Concern presents the data and describes the extent of contamination. The chemicals of potential concern are selected based on validity of the data, frequency of detection, range of concentrations, and comparison to background concentrations.

- Exposure Assessment determines the various ways humans are exposed to chemicals from the Site (exposure pathways) and the concentrations actually taken into the body (dose). Exposure pathways are identified based on human and environmental populations in the vicinity of the Site and within the pathways of chemical migration.

- Toxicological Assessment presents the toxicity values derived by EPA toxicologists for known health effects for each chemical. The toxicity values are calculated from studies which relate the level of a chemical taken into the body (dose) to an effect on human health (response).

- Risk Characterization estimates a numerical value for the risk by combining the dose from exposure with the toxicity value. It presents potential carcinogenic and noncarcinogenic health effects. It also presents uncertainty factors or an evaluation of how well the numerical value can be relied upon to give an accurate description of the potential risks.

5.2 IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN

The analytical data for the Site have been compiled and evaluated. Those Site-related chemicals frequently detected at concentrations above background (chemicals of potential concern) have been selected for characterization of the risk.

5.2.1 Data Collection Considerations

It is necessary that data used in the risk assessment be collected, analyzed, reported and evaluated in a manner consistent with current EPA protocols. All available data (historical and RI sampling) were considered for this risk assessment. The historical data (data collected prior to the RI sampling) were not used since there is not sufficient information to determine sampling locations, quality assurance/quality control (QA/QC), and sampling methodology (e.g., composite versus single samples).

Also, the historical data may not be representative of existing contamination. Historical groundwater data was collected from 1983 to 1987, while soil data was only collected during 1983-1984. Table 1-4 presents a summary of past sampling activities for soils and groundwater. All data generated for the RI were used for the risk assessment.

5.2.1.1 Historical Data

Groundwater

The existing historical data for the Site is discussed in detail in the RI/FS Work Plan for the Sealand Site and also in Section 4.1 of this report. In summary, for the 1983/1984 Emergency Removal Action sampling, phenol, chromium, lead, nickel and base neutrals were detected in the groundwater beneath the Site. Toluene and benzene were also detected at low concentrations. As field and laboratory QA/QC data for these sampling events is either incomplete or unavailable, and maps detailing the sampling locations do not exist, the results from these events are questionable in regards to their input to any risk analysis.

In March and October 1986, samples collected by NUS Corporation from eight onsite monitoring wells and four nearby domestic wells contained several polynuclear aromatic hydrocarbons (PAHs) in one well. A second round of sampling indicated that nickel and several PAHs were present at elevated concentrations.

REWAI, collected samples in January 1987 from all existing onsite monitoring wells and nearby homes. No base neutral organic compounds were found. A second round of sampling conducted in August and September of 1987 found no detectable concentrations of volatile organic or base neutral organic compounds.

Soil

The existing historical data for the Site is discussed in detail in the RI/FS Work Plan for the Site and also in Section 4.1 of this report. In summary, soil samples collected for the 1983/1984 Emergency Removal Action contained base neutral organic compounds, phenol, chromium, lead, nickel, benzene, toluene, ethylbenzene, and PCBs. Detailed records on soil sampling location, depth of sample and sampling or compositing methodology were incomplete or not available.

5.2.1.2 Rationale for Collection of Remedial Investigation Data

For the RI, monitoring and domestic wells were sampled to determine whether groundwater contamination exists at the Site from the past operations, and if so, whether the contaminants present in the groundwater have migrated offsite, and if the drinking water supply in the vicinity of the Site had been impacted. Soil samples were also collected at the Site for the purpose of delineating the vertical and horizontal extent and degree of soil contamination remaining after the conclusion of the Emergency Removal Action.

EPA risk assessment protocol recommends that samples from areas not impacted by the Site be collected to provide background information of naturally-occurring chemicals. Chemicals which were found at concentrations similar to background levels were eliminated from further consideration in the risk assessment.

Groundwater

Groundwater samples were collected from 12 monitoring and domestic wells. Two of these wells (S-MW1-01 and S-MW2-01) represent upgradient, background samples. These samples were analyzed for Target Compound List (TCL) organics plus 10 tentatively identified compounds (TICs), TCL semivolatile plus 20 TICs, and TCL metals (including mercury), total dissolved solids (TDS), and total organic carbon (TOC). Filtered and unfiltered samples were analyzed from all wells.

Soil

Nineteen soil samples (excluding field duplicates) were collected from seven onsite borings at depths from the upper 6 inches to 6 feet. Seven samples were collected from the surface soil, defined in this risk assessment as the upper 6 inches to 2 feet. The 12 samples were collected at intervals to 6 feet. These samples were analyzed for TCL organics plus 10 tentatively identified compounds (TICs), TCL semivolatile plus 20 TICs, and TCL metals (including mercury) and PCB/pesticides.

5.2.2 Data Evaluation Considerations

The existing and RI analytical data on inorganic and organic chemicals in soil and groundwater were compiled and evaluated. This evaluation included QA/QC information, location of samples, range of concentrations, comparison to EPA split sample results, and comparison to background.

5.2.2.1 Historical Data

Data collected from previous Site investigations are discussed in Sections 4.1 and 4.2 in this report. The data were not included in the risk assessment because there are insufficient QA/QC samples and documentation and information on sampling location, nomenclature or identification, and sampling methodology is incomplete or not available.

The decision to not include historical data does not indicate that the data is inaccurate, but only that there is insufficient information to support a review in accordance with EPA risk assessment protocols (EPA, 1989). The QA/QC information is used to determine the validity of the data. As discussed in more detail in this section, there is an inherent uncertainty in all analytical results that must be evaluated to determine if the reported concentration is accurate. The information necessary to perform a QA/QC review in accordance with EPA protocols was not available for the historical data.

The data collected during the RI are considered more representative of existing conditions. The soil and well locations sampled were designed to delineate the extent of contamination and the samples were collected in accordance with EPA protocols. The historical data was collected between 1983 and 1987 for groundwater and 1983 and 1984 for soil samples.

5.2.2.2 Quality Assurance/Quality Control Evaluation of Data

The validity of analytical data is evaluated using a QA/QC protocol. QA/QC protocols are used to determine the level of confidence that the chemical concentration reported by the laboratory is the same as the concentration actually present in the sample. QA/QC protocols verify a series of requirements to support the validity of the data such as proper operation of the analytical equipment, consistent standard methods, correctness of calculations, and any uncertainty associated with the concentrations reported by the laboratory.

Prior to selection of chemicals of potential concern, the data was validated to identify cases where the reported concentration may be inaccurate (estimated concentrations) or the chemical may not have been present in the sample when it was collected (questionable data). Appendix VIII contains the data validation results for the RI soil sampling event. Validation results for the groundwater sampling event are contained in Appendix XI.

Data validation identifies chemical compounds and/or concentrations which could not be accurately determined quantitatively or qualitatively. Data is qualified as "estimated" when the concentration of the chemical is below the quantitation limit or when quality control limits are not met. In cases when the result is estimated, the chemical was detected in the sample; however, it is not certain if the actual concentration is greater or less than the reported concentration."

During the collection and handling of samples and/or during laboratory procedures, chemical compounds can be inadvertently introduced. To account for these accidental additions of chemical contaminants, blank samples that are prepared in the field and/or laboratory are also analyzed. Chemicals detected in either the field or laboratory blank may not actually be present in the sample and may therefore be considered questionable.

Questionable data are defined as sample concentrations that are within a factor of 10 of the blank concentration for the common laboratory contaminants: methylene chloride, toluene, acetone, phthalate esters, and methanol. For any other compounds detected in a related blank, a factor of 5 is used to define questionable data.

5.2.2.3 EPA Split Sample Results

Split samples were collected and analyzed for four groundwater samples (MW5, MW6, MW7N, and MW8N) and four soil samples [S04(2.6-4.6)-S, S04(4.6-6.0)-S, S11(2-4)-S, and S12(0-2)-S) (See Appendix IX). Results were reviewed against the BCM contracted-laboratory results. Those compounds which were detected in the EPA split sample but not in the BCM results or detected at a higher concentration in the EPA split sample were further evaluated for use in the risk assessment.

5.2.3 Selection of Chemicals of Potential Concern

The data collected for each medium (soil and groundwater) were assessed to determine the chemicals of potential concern. All data collected during the 1989 RI received equal consideration in the assessment.

A review of the compounds detected indicates that the chemicals of potential concern are the semivolatile organic compounds and two metals, nickel and mercury, in soil (Table 5-1). The remaining compounds in soil and all the compounds in the groundwater were omitted because they were detected at low frequencies and concentrations, at isolated locations or at concentrations within the range of background.

5.2.3.1 Compounds Detected in the Soil

A summary of the parameters detected from the remedial investigation soil sampling program conducted in March 1990 are presented in Table 4-2. Frequency of detection, range of the chemical concentrations and the arithmetic average values were compiled. The two background samples [S1(0-2)-S and S1(2-4)-S] were not included in the frequency of detection or average concentration. Literature values reported for soil from the State of Delaware, surrounding states, and the eastern coastal area were also used to represent regional background concentrations. A summary of these data is presented in Table 4-3.

TABLE 5-1

CHEMICALS OF POTENTIAL CONCERN

SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Chemicals with Toxicity Factors

- Nickel
- Mercury
- Phenol
- 4-Methylphenol
- Anthracene *
- Acenaphthene*
- Benzo(a)pyrene *
- Di-n-butyl phthalate
- Benzoic Acid
- Naphthalene *
- bis(2-Ethylhexyl)phthalate
- Fluoranthene *
- Fluorene *
- Pyrene *
- Nitrosodiphenylamine

Chemicals with Relative Potency Factors

- Benzo(a)anthracene *
- Chrysene *
- Benzo(b)fluoranthene *
- Benzo(k)fluoranthene *
- Ideno(1,2,3-cd)pyrene *
- Dibenzo(a,h)anthracene *

Chemicals without Toxicity Factors

- 2,4-Dimethylphenol
- 2-Methylnaphthalene *
- Acenaphthylene *
- Dibenzofuran
- Phenanthrene *
- Benzo(g,h,i)perylene *
- Dimethyl phthalate

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* Polynuclear aromatic hydrocarbon (PAH)

Compiled by: BCM Engineers Inc. (BCM Project No. 00-6018-03)

All semivolatile organic compounds and two inorganics, mercury and nickel, were considered as chemicals of potential concern. Volatile organic compounds, pesticides and all other inorganic compounds were not selected as chemicals of potential concern in the soil because the concentrations detected were in the range of background concentrations, represented isolated events unrelated to previous Site activities, or were infrequently detected at low concentrations.

A preliminary review of the data was presented to EPA Region III in an interim document, *Report on Scope of the Sealand Risk Assessment*, dated August 1990. EPA Region III agreed with the conclusion that the only chemicals of potential concern in the soil were all the semivolatile organic compounds, nickel and mercury.

Volatile Organic Compounds

The volatile organic compounds are not considered chemicals of potential concern because of the low frequency and levels of detection. Eight volatile organic compounds (acetone, benzene, 2-hexanone, toluene, ethylbenzene, carbon disulfide, chloroform and total xylenes) were detected in the soil samples. Acetone was detected in seven samples with the concentrations ranging from 4 to 71 ug/kg (ug/kg equals ppb).

Benzene, carbon disulfide and chloroform were all detected once at concentrations of 4, 2 and 1 ug/kg, respectively. Toluene and ethylbenzene were also detected in one of 18 samples at concentrations of 34 and 92 ug/kg, respectively. 2-Hexanone was also detected in one sample at 110 ug/kg. However, in a duplicate sample, 2-hexanone was below detection. Total xylenes were detected in two samples at 1 and 190 ug/kg. One soil sample [S03(2-3)-S] contained five of the above compounds (acetone, benzene, toluene, ethylbenzene, and total xylenes).

Semivolatile Organic Compounds

Semivolatile organic compounds were detected in 19 soil samples. A total of twenty-four compounds were detected. Because of the frequency of detection at concentrations above background, all of these compounds are considered chemicals of potential concern. These chemicals were also detected in the background sample. The semivolatiles are largely polynuclear aromatic hydrocarbons (PAHs).

PAHs result from the incomplete combustion of organic material such as petroleum products, and are widely distributed in the environment from sources such as tar and roadway materials. Therefore the concentration of PAHs in the background sample also plays an important role in assessing risks associated with the Site.

Pesticides

The only pesticide detected in the soil samples, beta-hexachlorocyclohexane (beta-BHC), was not included as a chemical of potential concern based on low rate of detection and low concentrations, and its likely source from agricultural use. Beta-BHC was detected in 3 of the 18 soil samples. The maximum concentration detected was 37 ug/kg. Beta-BHC was one chemical component of a mixture once used as an insecticide for vegetable and fruit crops. The presence of beta-BHC at the Site is low in frequency and can most likely be attributed to the farmlands in the area of the Site. Low levels of pesticides are frequently found in non-agricultural soil in rural areas.

Inorganic Compounds

Of the 20 inorganic compounds which were detected in the soil samples, only 9 had concentrations above background concentrations: antimony, beryllium, calcium, copper, magnesium, manganese, mercury, nickel, and zinc.

To determine chemicals of potential concern, the data for onsite samples were compared to the Site-specific background sample results and literature values for local and regional soils. Based on this comparison, mercury and nickel were included as chemicals of potential concern because concentrations above background were reported for several samples.

Nickel was detected in 17 samples, 9 of which were below background concentrations and 3 were within background criteria. The remaining five samples were greater than background concentrations. Nickel was chosen as an inorganic chemical of potential concern.

Mercury was detected in 15 of the 19 samples but not in the background samples. The maximum value was 3.9 ug/kg. A data value of 0.18 ug/kg mercury was reported for a duplicate sample.

Calcium and magnesium were not considered as chemicals of potential concern because of their low toxicity. Antimony was only detected in four samples and two of these values were slightly above the detection limit. Beryllium was detected in 14 samples; only one, however, was above background. Copper, detected in all samples, only had one value above background. Beryllium and copper concentrations above background were considered isolated incidents and are not representative of site contamination.

Zinc was detected in all 19 samples. Fourteen of these values were below the background concentration, and two values were within the background criteria. Three values were above background at concentration of 170, 190 and 939 ug/kg. A duplicate sample for the 190 ug/kg sample had a concentration of 95 ug/kg zinc which is slightly above background (79 ug/kg). The zinc concentration of 939 was detected outside the cap area. It is considered to be an isolated incident and not representative of the entire Site. Based on the above, antimony, manganese, and zinc were not considered as chemicals of potential concern.

5.2.3.2 Compounds Detected in the Groundwater

A summary of the parameters detected from the remedial investigation groundwater sampling program conducted in April 1990 are presented in Table 4-7. Frequency of detection, range of the chemical concentrations and the arithmetic average values were compiled (Table 4-8). Twelve wells were sampled. Two wells (S-MW1-01 and S-MW2-01) are background wells for the Site and were not included in the frequency of detection or average concentration.

Inorganic parameters were analyzed on both filtered and unfiltered samples. The unfiltered data includes inorganics absorbed on particulate soil material as well as inorganics dissolved in the water. The filtered results represent dissolved inorganic constituents only.

The evaluation of inorganic groundwater data was performed on the filtered samples. The data for filtered samples were compared to background. Any parameters found at concentrations greater than 50 percent above a quantified background concentration were considered in more detail. When both the background and downgradient concentrations were estimated, such as those detected below the quantitation limit, the concentrations were not considered different.

None of the compounds in groundwater are chemicals of potential concern based on low frequency of detection, low detection levels, and comparison to background data. Organic compounds were detected at low frequencies and concentrations. Inorganic compounds were also detected; however, the concentrations were similar to background conditions.

A preliminary review of the data was presented to EPA Region III in an interim document, Report on Scope of the Sealand Risk Assessment, dated August 1990. EPA Region III agreed with the conclusion that the chemicals in the ground water were not found at concentrations of potential concern.

Volatile Organic Compounds

Volatile organic compounds detected in the groundwater samples include benzene, methylene chloride, and total xylenes. Benzene and total xylenes were both detected once at 2 and 1 ug/l, respectively. Methylene chloride was detected twice at concentrations of 1 and 11 ug/l. Based on low frequency of detection and low concentrations, these compounds were not considered as chemicals of potential concern.

Semivolatile Organic Compounds

Two semivolatile organic compounds were detected in the groundwater samples. Napthalene was detected in two samples at 4.0 ug/l. Bis(2-ethylhexyl)phthalate was detected once at 2 ug/l. Based on low frequency of detection and low concentrations, these compounds were not considered as chemicals of potential concern.

Pesticides/PCBs

Pesticides and PCBs were not detected in any of the groundwater samples.

Inorganic Compounds

None of the inorganic compounds were selected as chemicals of potential concern in groundwater. Inspection of Table 4-7 shows that there were a limited number of concentrations above background in either filtered or unfiltered samples. The unfiltered data includes compounds absorbed on particulate soil material as well as inorganics dissolved in the water. The filtered results represent dissolved inorganic constituents only.

Nickel was found at concentrations above background in only one well sample. This isolated detected concentration does not constitute evidence of wide spread contamination. There is no evidence of general contamination of the groundwater by inorganics.

5.2.3.3 Tentatively Identified Compounds in Groundwater and Soil

TICs are presented in Tables 4-2 and 4-7. These chemicals were not included as chemicals of potential concern because many of the compounds were unknown or have limited health effects information.

A limited number of TICs were found in four well samples. However, these compounds were listed as unknown.

TICs were more prevalent in the soil samples. Volatile organic TICs were detected in seven soil samples. The majority of these compounds were listed as unknowns. Semivolatile organic TICs were detected in 16 samples and can be classified as hydrocarbons.

Total petroleum hydrocarbon (TPH) was also determined for the soil samples. TPH concentrations ranged from the limit of detection to a maximum of 3,000 mg/kg in the background sample. These findings are consistent with the fact that sample locations for soil were biased towards stained areas.

TPH is a common contaminant in rural and urban areas from motor oil drippings from cars and trucks. TPH analysis is a single quantitative measure of all extractable hydrocarbons including long chain alkanes, semivolatiles, PAHs, TICs, and possibly some volatiles. The data in Table 4-2 shows that the concentration of TPH is is greater than the summation of the semivolatile and TICs concentrations. In some instances, the difference between these values is several orders of magnitude. It is conceivable and expected that TPH data be greater than the summation of the listed semi-volatile compounds. For the semivolatile analyses, a select group of semivolatiles and TICs were specifically analyzed. However, for TPH analysis, all extractable hydrocarbons were included.

TPH is not a specific concern at the Site because the concentration in the background surface soil sample is higher than the onsite concentrations. As noted in Section 1.0, the Site is bordered by a former asphalt facility (Tilcon Minerals, Inc.) and an active Conrail line. The Tilcon property is covered with numerous piles of railbed construction debris including asphalt. In addition, an old tank trailer, most likely used for hauling asphalt, is present onsite with staining below and around it. Both the Tilcon property and the active rail line are sources of TPH. The background soil sample was collected from an undisturbed portion of the Sealand Site at a location upgradient of all known waste hauling activities. The exact reason why the background sample had higher TPH levels than the onsite sample is not known. It may be speculated, however, that the concentration is due to the fact that TPH sources are indigenous to the area or that unauthorized use of the Site (i.e., trespassing) has resulted in a small discrete area of high TPH levels (i.e., changing the oil from a car/truck).

5.2.3.4 EPA Split Samples

EPA split sample results for soil and water were included in the risk assessment data evaluation. Split sample results are contained in Appendix IX.

The evaluation determined that the only chemicals of potential concern were two semivolatiles, di-n-butyl phthalate and nitrosodiphenylamine, which were both detected once in the soil samples. Several other semivolatiles were detected in the EPA samples at a slightly higher concentration. However, incorporation of these concentrations into the reasonable maximum exposure (RME) calculations did not result in a significantly higher RME concentration.

5.2.4 Summary of Chemicals of Potential Concern

The chemicals of potential concern for this risk assessment include all semivolatile organic compounds and two inorganics, nickel and mercury, in the soil. The selection of semivolatile organics is supported by the analytical data collected during previous investigations and the history of Site operations. The metals are included based on their frequency of detection at concentrations above background.

In soil, the eight volatile organic compounds detected have low frequency of detection and distribution. The inorganic parameters, with the exception of nickel and mercury are within the range of background, or isolated events unrelated to the Site. The TICs were not included as chemicals of potential concern since many compounds were unknown and toxicity values have not been established.

No chemicals of potential concern were identified in groundwater samples. The volatile and semivolatile detections were low in frequency and concentration and the inorganic parameters are within Site-related background concentrations. TICs detected in the groundwater were also not included as chemicals of potential concern since the frequency of detection was low and the compounds were listed as unknown.

5.3 EXPOSURE ASSESSMENT

Exposure assessment determines potential receptors, both currently and associated with future use, the pathways that may result in human exposure, the concentrations of chemicals at the point of exposure, and the concentration of each chemical absorbed by an exposed individual on a daily basis (chronic daily intake [CDI]).

5.3.1 Characterization of Exposure Pathways

The potential receptors, both current and future, were evaluated. For current exposure, the most likely potential receptors are children exposed to shallow surface soils while trepassing on the Site on an infrequent basis. For the future use of the Site, the potential receptors are workers that may be exposed to soil from all depths during construction activities.

5.3.1.1 Current Use Scenario

Observations during the remedial investigation and evidence of Site use support an exposure pathway of trespassers, particularly children. There are low density private residential areas located to the east of the Site. Private residences and light industrial and commercial establishments are located to the south and west of the Site. Bordering the Site to the north, a 15-acre parcel of land owned by Tilcon Mineral Inc. contains miscellaneous equipment and debris. There is no evidence of consistent use of the Site such as dirt bike trails to suggest that children from the nearby residences play at the Site on a regular basis.

There is evidence, however, that pre-teenage children are potentially exposed while walking along the active railroad bed. Although there is no evidence that these children actively play on the Site, the risk assessment was based on a worst case assumption that there is regular use of the Site by area children.

The exposure scenario for this risk assessment will assume conservatively that younger children (8 to 12 years of age) use the Site as an infrequent play area and that exposure is through soil ingestion and dermal contact. Younger children (less than 6 years old) were not selected since the Site is located a significant walking distance from the private residences.

It will be assumed that the children play at the Site during the warm weather months, May to September. Chemical intake occurs via ingestion of soil and skin absorption through direct contact.

5.3.1.2 Future Use Scenario

A future use scenario was developed around exposure by workers during construction of a manufacturing facility. The Site is zoned for manufacturing uses only (N2). The zoning cannot be changed to residential because a 60-foot frontage is required for residential use and the Sealand property has only 57 feet of frontage. Property to the east of the Site is also zoned for manufacturing use. The active railroad bordering one side of the Site significantly reduces the likelihood that the Site will be developed for residential use.

The exposure assumptions will be based on adult males who contact the chemicals of potential concern in the soil via ingestion and skin contact during construction of a manufacturing facility. Inhalation of fugitive dust is not considered a potential pathway because there is negligible potential for dust generation during construction activities. The water table beneath the Site is shallow and soil excavated during construction will necessarily be wet or damp. Also, good construction practices call for wetting of the soils as an additional fugitive dust control.

As noted in Section 5.2.3, PAHs, semivolatile chemicals of potential concern, are wide-spread in the environment, particularly near railroad beds and roadways. The high concentrations of PAHs in the background sample is evidence for mutliple sources of these chemicals. In accordance with EPA risk protocols, it is not appropriate to subtract the background concentration of chemicals from the onsite concentration. A separate calculation of the risk associated with exposure to PAHs in the background sample was performed to put the risk calculated from Site soil in to a perspective of risks typically found near railroad lines.

5.3.2 Identification of Exposure Pathways

Exposure pathways include all the various ways in which humans come in contact with the chemicals of potential concern, either currently or at some time in the future. Identification of exposure pathways is developed from a fate and transport evaluation followed by an analysis of exposure pathways or the likelihood that human or environmental receptors will contact the chemicals and the way in which any potential contact may occur.

5.3.2.1 Fate and Transport Evaluation

The fate and transport evaluation considers the properties of the chemicals of potential concern, the media in which the chemicals are found, and the likelihood that the chemicals will persist and/or migrate to other media.

The focus of the fate and transport study is polynuclear aromatic hydrocarbons (PAHs) in soil because these chemicals comprise 17 of the 26 chemicals of potential concern. PAHs, mixtures of organic chemicals made up of benzene rings, are by-products of the incomplete combustion of organic material. Although combustion of petroleum products represents a major source of PAHs in the environment, combustion of any organic material including wood, coal, charcoal and even garbage can result in ash and smoke containing PAHs.

The chemical properties of individual PAH compounds depend on the number of benzene rings. Chemicals with few benzene rings such as naphthalene with two rings tend to be the most water soluble, mobile in the groundwater and also susceptible to degradation by bacteria. PAHs with higher numbers of benzene rings such as benzo(a)pyrene with five rings tend to remain strongly bound to soil particles because the larger molecular weight PAHs are highly water-insoluble. These higher weight PAHs are also more persistent.

PAHs tend to bind to soil material and generally do not contaminate the groundwater. Any PAH compounds that do solubilize into the groundwater are likely to be degraded by bacteria (ATSDR, 1988; EPA, 1984). This is supported by the absence of PAHs in the groundwater at the Site.

Currently, the cap precludes human or environmental exposure to the PAHs and also, significantly reduces infiltration. Therefore the potential for migration into the groundwater is also reduced.

Future uses of the Site that involve disruption of the cap could result in exposure to the PAHs. However, even in the absence of a cap under some future use scenario, the probability that PAHs will migrate into the groundwater is negligible.

The results of the fate and transport evaluation indicate that soil is the principal medium of concern.

5.3.2.2 Exposure Pathways Analysis

The soil represents the only exposure pathway for the chemicals of potential concern. The media of concern is soil and the chemicals of potential concern are all the semivolatile organic chemicals detected and nickel and mercury. The exposure pathways identified are (1) ingestion of soil and (2) dermal absorption of contaminants.

The objective of the exposure assumptions is to determine how much of the chemical is actually taken into the body (dose). The dose received on a daily basis is expressed as the milligrams of contaminant per kilogram of body weight per day (mg/kg/day).

In risk assessment, it is seldom possible to measure specific dosage for each identified exposure pathway. As a result, it is necessary to use an estimation of dose based upon a series of assumptions such as how much soil the average person ingests. These assumptions were developed from the most current Superfund risk assessment guidance documents (EPA, 1989a, 1989b and 1989c). The assumptions used in calculating the exposure for each pathway are presented in Table 5-2. The methods and calculations for exposure dose are presented in Appendix XII.

There are three variables in the calculation of risk associated with the time of exposure. The exposure duration describes how long the person is in contact with the chemical on a daily basis. The exposure frequency describes how often the person engages in the activity that leads to exposure. The averaging time is the time period over which exposure is assessed.

For this risk assessment the averaging period is the same for all pathways and both current and future use but the exposure frequency and duration vary. The averaging period for carcinogenic effects is a 70-year lifetime and the averaging period of noncarcinogenic effects is 1 year.

5.3.2.3 Ingestion of Soil

Ingestion of soil results as a part of normal mouthing behavior. Children may inadvertently or intentionally (pica behavior) ingest soil while playing outside. Adults can ingest soil while eating, smoking or participating in outdoor activities. The amount of soil ingested by the different age groups has been quantified and documented. (EPA, 1989b)

TABLE 5-2

ASSUMPTIONS USED IN CALCULATING EXPOSURE

SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

		Reference
INGESTION OF SOIL		
Current Use		
Ingestion Rate (mg/day)	100	EPA, 1989c
Body Weight (kg) - Child	32	EPA, 1989b
Exposure Frequency (days/year)	100	Site Specific
Exposure Duration (years)	4	Site Specific
Future Use		
Ingestion Rate (mg/day)	100	EPA, 1989c
Body Weight (kg) - Adult	70	EPA, 1989c
Exposure Frequency (days/year)	120	Site Specific
Exposure Duration (years)	1	Site Specific
DERMAL ABSORPTION FROM SOIL		
Current Use		
Skin surface area (sq. cm)- Child	4,970	EPA, 1989b
Skin adherence factor (mg/sq. cm)	2.77	EPA, 1986g
Absorption factor (percent)	1.8	EPA, 1988
Exposure frequency (events/year)	100	Site Specific
Exposure duration (years)	4	Site Specific
Body weight (kg) - Child	32	EPA, 1989c
Future Use		
Skin surface area (sq. cm) - Adult	3,120	EPA, 1989b
Skin adherence factor (mg/sq. cm)	2.77	EPA, 1986g
Absorption factor (percent)	0.9	EPA, 1988
Exposure frequency (events/year)	120	Site Specific
Exposure duration (years)	1	Site Specific
Body weight (kg) - Adult	70	EPA, 1989c

Compiled by: BCM Engineers Inc. (BCM Project No. 00-6018-03)

Current Use

The 50th percentile body weight of children aged 8 to 12 years old averages to 32 kg (EPA, 1989b). This value was selected as the weight of children trespassers on the Site. The amount of soil ingested by the children is assumed to be 100 mg per day. This value is considered to be an overestimation of normal soil ingestion behavior for individuals 5 to 18 years old (Calabrese et al., 1987, as described in EPA, 1989b). The 100 mg/day is also a recommended value for children over the age of 6 years old (EPA, 1989c). The exposure frequency is based on children trespassing at the Site from May to September (5 months times 5 days per week times 4 weeks per month equals 100 days), for a duration of 4 years. The assumption of 5 days per week is considered a reasonable estimate for children during the summer months (EPA, 1989c).

Future Use

The future use scenario assumes that the workers weigh 70 kg and ingest 100 mg soil per day (EPA, 1989c). The construction exposure duration is based on workers exposed for 5 days per week for 24 weeks (120 days) during the course of 1 year.

5.3.2.4 Dermal Exposure

Chemicals in soil can enter the body via skin absorption. The dose received through dermal contact with soil is calculated from information on the ability of the soil to adhere onto the skin (skin adherence factor), the amount of skin in contact with the soil (skin surface area), the ability of the chemical to desorb from the soil matrix and absorb across the skin (absorption factor), and the frequency of playing and working activities on a daily basis per year.

Current Use

For children playing on the Site, it is assumed that the child's hands, arms and legs are exposed to the soil (4970 cm^2). (EPA, 1989b) Factors for soil adherence to skin are limited. Values have been established for potting soil (1.45 mg/cm^2) and kaolin clay (2.77 mg/cm^2) (EPA 1989c, and EPA, 1986g). Superfund Public Health Evaluation Manual (EPA, 1986g) recommends that both values be used in the calculation to present an exposure range. For this risk assessment a skin adherence factor of 2.77 mg/cm^2 was used to present the most conservative exposure estimated. Absorption factor used for children was 1.8 percent. This value was developed for a chemical compound with similar properties and structure to the semivolatile chemicals (EPA, 1988). Exposure duration and frequency remains the same as the ingestion pathway (100 days per year over a 4-year period).

Future Use

Construction workers are assumed to have their hands and arms exposed (3120 cm^2) (EPA,1989b). Skin adherence is the same as for children (2.77 mg/cm^2); however, the absorption factor for adults is 0.9 percent (EPA, 1988). Exposure duration and frequency remain the same as the ingestion pathway (120 days).

5.3.3 Soil Exposure Concentrations

The soil data were evaluated to determine which samples would best represent the selected scenarios. The data from soil samples were then combined to estimate exposure concentrations.

5.3.3.1 Data Selection

Current Use

The shallow (0 to 2 feet) soil samples outside the cap area were used in the risk assessment. These samples include S02(0-2)-S, S12(0-2)-S, S13(0-2)-S and S14(0-1)-S. The maximum concentration detected for the chemicals of potential concern was used to estimate the risk for worst-case analysis.

Contaminated soil onsite was capped with a clay layer which varies in thickness from approximately 0.5 feet to 4 feet as determined by the remedial investigation soil boring/sampling program. The top soil layer above the cap is several inches thick. It is highly unlikely that children playing in this area would dig through the thickness of the cap and be exposed to the higher contaminated soil. In addition, there are no visible signs of intrusive activity into or through the capped area.

The risk associated with the surface background sample [S1(0-2)-S] was also calculated because many of the chemicals of potential concern were found in the background sample.

Future Use

Construction activities were assumed to occur throughout the Site and at all depths of the soil.

The risk associated with the surface background sample [S1(0-2)-S] was also calculated because many of the chemicals of potential concern were found in the background sample.

5.3.3.2 Data Calculations

All 1990 RI Site data (not including background samples) were combined to estimate a most probable concentration of each chemical of potential concern for each pathway. The calculated probable concentration was then used to calculate a Reasonable Maximum Exposure (RME) concentration. The compound concentrations used in the risk assessment are presented in Table 5-3. Methods used in handling of chemical data are in accordance with guidance received from EPA Region III and Risk Assessment Guidance for Superfund (EPA, 1989c).

The Most Probable Concentration

The most probable concentration was obtained using all RI Site-related sample data. Data from duplicate samples were averaged into a single data point prior to use in any calculation.

Distributions of environmental data can follow many patterns. A typical pattern for environmental data is a log normal distribution. The most quantitative form of statistical analysis, parametric statistics, requires that the arithmetic average only be calculated directly when the data are normally distributed. There are methods for adjusting log normal data to establish a normal distribution prior to calculating the average or most probable concentratrion.

Statistical evaluation (SAS Univariate Procedure) of the data for the Sealand Site indicated that a log normal distribution fit the pattern of the data. Using the procedure outlined in EPA Region III guidance, the data values were normalized and the arithmetic average of the normalized data was calculated. The arithmetic mean of the normalized data equals the geometric mean of the raw data. This calculated mean was used as the most probable concentration from which a RME was calculated.

Incorporation of Non-detected and Questionable Data

Two key issues in the calculation of the most probable concentration are (1) the method used to incorporate questionable or non-detected data, and (2) the method used to calculate the upper bound 95 percent confidence interval of the most probable concentration (EPA 1989a).

When a chemical is not found in a sample, the laboratory reports the value as non-detected above a certain level. This means that if the chemical is present, the concentration is below the detection limit reported. However, it is also possible that the chemical was not present in the sample.

There are several approaches for use of data reported as non-detected. The data can be excluded from the data base, listed as zero, or listed as one-half the detection limit. For this risk assessment, one half the detection limit was used for data which was reported as less than the detection limit. Method detection limits were obtained from the contract laboratory.

TABLE 5-3

CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN USED IN RISK ASSESSMENT

SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Chemical (ug/kg)	Current Use Maximum	Future Use RME	Background Sample S01(0-2)S
Nickel	33,500	25,000	22,800
Mercury	130	370	100 *
Phenol	330 *	336	330 *
4-Methylphenol	165 *	225	165 *
Benzoic Acid	1,700	303	45
Naphthalene	55	2,477	170
Acenaphthene	165 *	446	44
Fluorene	165 *	1,111	165 *
Anthracene	165 *	869	160
Fluoranthene	210	2,786	1,300
Pyrene	160	3,210	1,200
Benzo(a)anthracene	160	1,548	900
Chrysene	210	1,587	1,100
bis(2-Ethylhexyl)phthalate	165 *	186	165 *
Benzo(b)fluoranthene	370	2,012	3,000
Benzo(a)pyrene	160	1,969	830
Ideno(1,2,3-cd)pyrene	78	722	300
Dibenzo(a,h)anthracene	165 *	488	130
Nitrosodiphenylamine **	165 *	368	165 *
Di-n-butyl phthalate **	165 *	166	165 *

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* Data were reported as not detected. Value listed represents one-half the detection limit as a conservative estimate of concentration.

** Detected once in EPA split samples

RME - Reasonable maximum exposure is defined as the upper bound 95 percent confidence interval of the most probable concentration.

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When a compound was detected (quantified or estimated) but the value is questionable because the chemical was also found in a related blank, one half the reported sample value was used.

Incorporation of Coeluted Data

In the chemical analysis, benzo(b)fluoranthene and benzo(k)fluoranthene coeluted, meaning that the concentrations for each compound were indistinguishable. The concentration reported by the laboratory actually represents both chemicals together. Using this concentration for both chemicals in the risk assessment would result in an over-estimation of the risk. To minimize this over-estimation, the reported concentration is assumed to be entirely benzo(b)fluoranthene. Based on the relative potency estimates derived for PAHs (Clements Assoc., 1988), benzo(b)-fluoranthene is the more toxic of the two.

Reasonable Maximum Exposure (RME)

Prior to 1989, EPA protocol required that the risk associated with the maximum concentration be evaluated. However, current protocol recognizes that the maximum concentration does not represent a reasonable exposure concentration. At this time, EPA recommends that the 95 percent upper-bound confidence interval be used to represent an RME.

In simpler terms, the average or mean represents the central observation or most commonly observed concentration if a very large number of samples (e.g., greater than 100,000) were collected. If the data behave according to certain assumptions, in 50 percent of the samples the actual concentration is predicted to be lower than the average and in 50 percent of the samples the concentration may be higher than the average.

The RME is used to account for the fact that the actual number of samples is relatively small for accurately predicting the average. The RME is a statistical estimate of the highest average concentration predicted to occur in 95 out of 100 sets of samples.

The RME is a conservative estimate of the risk since it assumes that a concentration equal to the upperbound confidence interval of the average for every chemical of concern is present in the Site soil.

The methods and equations used to calculate the RME are presented in detail in Appendix XIII. The calculation methods are those recommended by EPA risk assessment protocol and presented in Gilbert, 1987.

5.3.4 Identification of Uncertainties

Exposure assessment assumptions are selected to estimate an upperbound concentration and a conservative level of chemical that individuals take into their bodies.

Exposure assumptions tend to estimate the risk for a large percentage of the population and, therefore, are protective of human health. Each of the assumptions and its basis were discussed in detail in Section 5.3.2.

The estimated exposure concentrations tend to be conservative for two reasons. First, the exposure concentrations are calculated by using one-half the detection limit for samples with non-detect results. It is likely that for many of the samples, the chemicals are not present at all. Also, the RME represents an upperbound confidence interval concentration. The rational behind the use of the RME is that an area of higher concentrations may not have been detected.

5.3.5 Summary of Exposure Assessment

The only medium of concern identified was the soil. The exposure pathways identified were ingestion of soil and dermal contact. Exposure pathways for future use of the Site are considered to be the same as the current usage (ingestion of soil and dermal contact). The current use scenarios assume children (8 to 12 years old) use the Site as a play area during the warm weather months and are exposed to the surface soils. In the future use scenarios, workers are exposed to all soil depths throughout the Site during construction of a facility.

5.4 TOXICITY ASSESSMENT

The toxicity profiles provided in Appendix XIV summarize chemical and toxicological information on the chemicals of potential concern. Unless otherwise noted, the technical toxicological profiles were obtained from the Integrated Risk Information System (IRIS).

EPA toxicologists derived toxicity values after an extensive review of the available data for each chemical. Although data from epidemiological studies on human exposure is the most valuable, generally the only data available are laboratory studies with animals. There is some uncertainty in results from using laboratory studies with animals since the animals are usually exposed to high doses of chemicals for short periods of time. Dose-response evaluations utilize this data to assess the potential for health effects in humans exposed to low doses for long periods.

Toxicity values for each parameter can differ depending on the way humans are exposed to the chemical. Chemicals can be taken into the body through the gastrointestinal tract after ingestion of soil, sediment, or water (oral); into the lungs after inhalation of vapors or particulates in the air (inhalation); and into the body through the skin after contact with chemicals in soil, sediment, or water (dermal).

Some chemicals are not as potent via one exposure route versus another. Thus, different health effect factors have been established for each route of exposure. For example, certain metals, such as hexavalent chromium, have been shown to have carcinogenic effects via inhalation but not via ingestion.

Chemicals can also have both carcinogenic and noncarcinogenic effects. Therefore, it is possible that a chemical can have both a carcinogenic health effect factor for oral and inhalation exposure and a noncarcinogenic health factor for oral and inhalation exposure.

Toxicity values, however, are not always available. Toxicity testing of many compounds is limited or the compound may have not been tested at all. In these instances, a quantitative risk analysis cannot be determined. Table 5-1 lists the chemicals of potential concern which have toxicity factors and those that do not.

The toxicity values used for this risk assessment to assess human health effects are presented in Tables 5-4 and 5-5. The following sources were used to identify toxicity values and are listed in order of preferential selection.

Integrated Risk Information System (IRIS)

IRIS is an on-line computer data base that presents toxicological assessments of chemicals and the status of EPA-approved toxicity values. The toxicity values obtained through IRIS are current as of January 1990.

Health Effects Assessment Summary Tables (HEAST)

The EPA Office of Emergency and Remedial Response publishes a quarterly summary of toxicity values from a variety of recognized sources in addition to IRIS. The toxicity values obtained through HEAST were taken from the Fourth Quarter, 1989.

Environmental Criteria and Assessment Office (ECAO)

The ECAO was considered the final authority for information on chemicals without toxicity values in the aforementioned sources. Toxicity values received are noted in Table 5-4 and Appendix XV.

5.4.1 Toxicity Information for Noncarcinogenic Effects

The potential for adverse noncarcinogenic health effects is estimated with a toxicity value known as a reference dose (RfD). RfDs are associated with an adverse health effects which are also referred to as toxicity endpoints. The RfDs and toxicity endpoints for the chemicals of potential concern are listed in Table 5-4.

TABLE 5-4

TOXICITY VALUES: POTENTIAL NONCARCINOGENIC EFFECTS OF CHEMICALS OF POTENTIAL CONCERN

SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Chemical	Oral Chronic RfD (mg/kg-day)	RfD Confidence Level	Critical Target	RfD Source	Uncertainty and Modifying Factors UF	MF
Nickel	0.02	Medium	Body Weight	IRIS	100	3
Mercury	0.0003	...	Body Weight	HEAST	...	...
Phenol	0.6	Low	Body Weight	IRIS	100	1
4-Methylphenol	0.05	Medium	Neurotoxicity	IRIS	1,000	1
Benzoic Acid	4	Medium	No Effect	IRIS	1	1
Naphthalene	0.004	...	Internal Lesions	HEAST	10,000	...
Acenaphthene	0.06	...	Liver	ECAO	3,000	1
Fluorene	0.04	...	Blood	ECAO	3,000	1
Anthracene	0.3	...	No Effect	ECAO	3,000	1
Fluoranthene	0.04	...	Liver, Blood	ECAO	3,000	1
Pyrene	0.03	...	Kidney	ECAO	3,000	1
bis(2-Ethylhexyl)phthalate	0.02	Medium	Liver	IRIS	1,000	1
Di-n-butyl phthalate	0.1	Low	Mortality	IRIS	1,000	1

IRIS - Integrated Risk Information System
HEAST - Health Effects Assessment Summary Table
ECAO - Environmental Criteria and Assessment Office, USEPA

Compiled by: BCM Engineers Inc. (BCM Project No. 00-6018-03)

TABLE 5-5

TOXICITY VALUES: POTENTIAL CARCINOGENIC EFFECTS OF CHEMICALS OF POTENTIAL CONCERN

SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Chemical	Slope Factor (mg/kg-day)-1	Weight-of-Evidence Classification	Tumor Site	Source of Slope Factor
Benzo(a)anthracene	3.22	B2	Stomach *	EPA, Region III
Chrysene	3.22	B2	Stomach *	EPA, Region III
bis(2-Ethylhexyl)phthalate	0.014	B2	Liver	IRIS
Benzo(b)fluoranthene	3.22	B2	Stomach *	EPA, Region III
Benzo(a)pyrene	3.22	B2	Stomach	EPA, Region III
Ideno(1,2,3-cd)pyrene	3.22	B2	Stomach *	EPA, Region III
Dibenzo(a,h)anthracene	3.22	B2	Stomach *	EPA, Region III
Nitrosodiphenylamine	0.0049	B2	Bladder	IRIS

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* Limited number of studies are available for PAHs, tumor site based on studies with Benzo(a)pyrene.

IRIS - Integrated Risk Information System

PAH slope factor of 3.22 was recommended by EPA, Region III based on the double-stage model.

Compiled by : BCM Engineers Inc. (BCM Project No. 00-6018-03)

Reference Dose

The model to determine RfDs from the dose-response assessment assumes that there is a concentration for noncarcinogens below which there is little potential for adverse health effects over a lifetime of exposure. The RfD is designed to represent this threshold level.

The RfD is calculated from the highest chronic (long-term) exposure level that did not cause adverse effects (the no-observed-adverse-effect-level or NOAEL) in animals. The NOAEL is divided by an uncertainty factor to account for any uncertainty such as using data on animals to predict effects on humans and an allowance for sensitive individuals. Uncertainty factors range from 1 to 10,000, based on the confidence level associated with the data. The resulting RfD (mg/kg of body weight per day) is used to quantify the risk.

Toxicity Endpoint

The determination of adverse impact for noncarcinogens is based on a wide variety of responses ranging from increases in organ weight, changes in blood chemistry, to death. Noncarcinogenic effects are also defined by the toxicity endpoint in laboratory animals used to identify the RfD.

5.4.2 Toxicity Information for Carcinogenic Effects

The EPA approach for evaluations of carcinogens assumes that exposure to any level of a carcinogen, no matter how low, has a certain probability of causing cancer. The toxicity value calculated for carcinogens is known as the slope factor (SF). The weight-of-evidence is a qualitative descriptor that is important to the interpretation of carcinogenic risk. The SFs and weight-of-evidence for the chemicals of potential concern are listed in Table 5-5.

Slope Factors

The SF is calculated with a mathematical model that draws a line based on data from laboratory animals exposed to high doses and extends it to predict potential increases in cancer rates for humans who are exposed to low doses. Then confidence intervals are calculated for the line. The slope of the line which represents the 95-percent confidence interval is known as the slope factor or potency factor. The use of the upperbound confidence interval means that there is a 95-percent probability that the actual risk will be less than that predicted by the model. The units for the SF are (mg/kg of body weight per day)$^{-1}$.

For polynuclear aromatic hydrocarbons, benzo(a)pyrene (BaP) is considered to be the most toxic PAH. In performing a risk assessment it is often assumed that all PAHs are of equivalent toxicity. This approach will likely over-estimate the risk associated with these compounds since all the other PAHs are not equivalent to BaP in potency.

Relative potency estimate (or equivalency) factors have been determined for a number of PAHs (Table 5-6) which allows adjustment of the concentration of individual PAHs to a level which is equivalent to BaP (Clement Associates, Inc., 1988). The toxicity value for BaP can then be used with other PAHs which have equivalency factors.

In the Scope of the Sealand Risk Assessment, BCM proposed to use equivalency factors established by Clement Associates (1988). In the proposed National Primary and Secondary Drinking Water Regulations, EPA classified seven PAHs as Group B2 carcinogens and eight other PAHs as Group D, Federal Register (40 CFR Part 141, July 25, 1990). Several compounds listed in Clement Associates' listing (pyrene, and benzo(g,h,i)perylene) are listed as Group D along with anthracene, fluoranthene, and fluorene. Due to the insufficient information on carcinogenic potential, pyrene, anthracene, fluoranthene, and fluorene were only considered for noncarcinogenic effects. Benzo(g,h,i)-perylene does not have a reference dose and therefore was not considered in the calculations.

The ECAO does not recommend use of these toxicity equivalency factors since these values have not been reviewed. However, EPA Region III does prefer the use of equivalency factors for other PAHs, and this risk assessment followed Region III guidance.

The recommended oral carcinogenic toxicity factor for benzo(a)pyrene is 6.5. Region III toxicologists prefer the use of the value of 3.22 which is derived from a double-state model. This risk assessment uses the Region III value of 3.22.

Weight-of-Evidence

The weight-of-evidence reflects the degree of confidence in the data used to determine that the chemical is a human carcinogen. EPA toxicologists recognize that the risks associated with a known human carcinogen, based on epidemiological studies, should be evaluated differently than a chemical which causes tumor production in a limited number of laboratory animals. Each carcinogen is assigned to a group depending on the quality and quantity of evidence for carcinogenicity in humans and animals. The definitions for the groups are presented in Table 5-7.

5.4.3 Chemicals Without Available EPA Toxicity Values

Omission of chemicals without EPA toxicity values from the risk calculations add some uncertainty to the final risk results. This uncertainty is, however, low in magnitude. All the identified chemicals of potential concern have EPA toxicity values, except for 2,4-dimethylphenol, 2-methylnaphthalene, dibenzofuran, phenanthrene, dimethyl phthalate, acenaphthylene, and benzo(g,h,i)perylene. These chemicals along with the TICS were not included in the risk assessment.

TABLE 5-6

SUMMARY OF RELATIVE POTENCY ESTIMATES DERIVED FOR PAHS

SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Anthanthrene	0.32
Benzo(a)pyrene	1.0
Benzo(e)pyrene	0.004
Benzo(a)anthracene	0.145
Benzo(b)fluoranthene	0.14
Benzo(j)fluoranthene	0.061
Benzo(k)fluoranthene	0.066
Benzo(g,h,i)perylene	0.022
Chrysene	0.0044
Cyclopentadieno(cd)pyrene	0.023
Dibenzo(a,h)anthracene	1.11
Indeno(1,2,3-cd)pyrene	0.232
Pyrene	0.081

Source: Interim Final Report "Comparative potency approach for estimating the cancer risk associated with exposure to mixtures of polycyclic aromatic hydrocarbons." Clement Assoc., Inc., Fairfax, VA. April 1988.

TABLE 6-7

EPA CATEGORIES FOR POTENTIAL CARCINOGENS

SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

EPA Category	Group Description	Evidence
Group A	Human Carcinogen	Sufficient evidence from epidemiologic studies to support a causal association between exposure and cancer in humans
Group B1	Probable Human Carcinogen	Limited evidence in humans from epidemiologic studies
Group B2	Possible Human Carcinogen	Sufficient evidence in animals, inadequate evidence in humans
Group C	Possible Human Carcinogen	Limited evidence in animals and/or carinogenic properties in short-term studies
Group D	Not Classified	Inadequate evidence in animals
Group E	No Evidence	No evidence in at least two adequate animal tests or in both epidemiologic and animal studies

Source: EPA, 1986

5.4.4 Uncertainties Related to Toxicity Information

The dose-response assessment for the majority of chemicals relies on an extrapolation of known effects on animals at high exposures to humans at low exposure doses. The use of data based on animal studies to predict impacts on humans is an area of uncertainty, particularly because different species of animals respond with different sensitivities to chemicals. Also, there are many models available which extrapolate animal data to humans and the toxicity values generated from the same data by different models can vary substantially. The models used by the EPA tend to be conservative and are unlikely to underestimate the risk. The method used by the EPA for SFs uses a 95-percent upperbound confidence interval, which means that while the actual risk is unlikely to be higher, it could be much lower.

5.5 RISK CHARACTERIZATION

The risk characterization combines the exposure dose with the toxicity value to estimate a numerical value for the risk. There are several differences between the numerical value used to describe risk for carcinogens (cancer risk) and the value used for noncarcinogens (hazard index, HI). The methods and results for this risk assessment are presented separately for carcinogens and noncarcinogens.

5.5.1 Carcinogenic Risk Characterization

5.5.1.1 Methods

Carcinogenic risk is calculated by multiplying the exposure dose (chronic daily intake [CDI]) times the slope factor. The resulting value is the probability of an increase in the incidence in cancer and should not be directly interpreted in terms of the number of cases of cancer in the exposed population. The risk level of 1×10^{-6} can also be viewed as a one in one million probability that there will be one additional case of cancer.

Cancer risk estimates for the same chemical in different exposure pathways are added together. Also, cancer risks for different chemicals are added together to determine the risk associated with exposure to all the chemicals.

5.5.1.2 EPA Guidance on Cancer Risk

EPA has not established an acceptable level of risk. A range of cancer risks of 1×10^{-4} to 1×10^{-6} has been identified in the National Contingency Plan for Superfund Sites. This means that target risk levels should be between an upper limit of a 1 in 10,000 probability of cancer incidence to a lower limit of 1 in 1,000,000. A total cancer risk of 1×10^{-6} is often used as a benchmark by state and federal regulatory agencies.

5.5.1.3 Discussion and Interpretation of Cancer Risk Results

The results of the cancer risk calculations for each exposure scenario are presented in Appendix III. Tables 5-8 through 5-11 present the risk associated with each chemical and pathway for the current and future use scenarios along with total site and background risk.

Results

All the cancer risk estimates calculated for current and future use of the Site are lower than the range specified for Superfund Sites. The results are discussed as the summation of risk from both ingestion and dermal contact (Table 5-16).

For the sum of the current exposure scenarios, the cancer risk associated with trespassing on the Site of 1×10^{-7} is less than the risk in the background area of 3×10^{-7}. The reason for the lower risk associated with onsite activities is that there is no exposure to the contaminated soil at the Site. The risk assessment shows that the risk due to exposure to the maximum concentration in any soil sample from around the cap is similar to natural background. This result is consistent with the data which shows a limited number of chemicals at concentrations above background in surface soil outside the capped area.

For future use, the cancer risk associated with the reasonable maximum exposure values of [illegible] $\times 10^{-7}$ and 6×10^{-8}, respectively, for onsite and background. The risk associated with future use of the Site includes short term exposure during construction activities to the contaminated soil under the cap. The approximately two to three fold increase in the risk associated with onsite exposure as compared with background reflects the higher concentrations under the capped area.

A General Discussion of Cancer Risks

It is helpful to consider the estimated cancer risks associated with this Site in the context of normal everyday risks. The cancer risk associated with natural background radiation is greater than 1×10^{-4} and the risk from smoking is greater than 3×10^{-2}, or 3 in 100. Strictly speaking, unavoidable risks such as natural radiation and voluntary risks such as smoking can not be compared to those risks associated with chemicals contamination due to human activities. This information on risk is included to provide the reader some perspective on various levels of cancer risk.

The target risk range identified for Superfund sites is consistent with that for other federal agencies that make risk based decisions. A review of criteria for foods, pesticide use, and occupational safety shows that other agencies such as the Food and Drug Administration (FDA) and

[illegible]

[illegible]

[illegible]

Chemical	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Exposure Pathway: Ingestion of Soil					
Benzo(a)anthracene	[illegible]	[illegible]	[illegible]	[illegible]	
Chrysene	[illegible]	[illegible]	[illegible]	[illegible]	
bis(2-Ethylhexyl)phthalate	[illegible]	[illegible]	[illegible]	[illegible]	
Benzo(b)fluoranthene	[illegible]	[illegible]	[illegible]	[illegible]	
Benzo(a)pyrene	[illegible]	[illegible]	[illegible]	[illegible]	
Indeno(1,2,3-cd)pyrene	[illegible]	[illegible]	[illegible]	[illegible]	
Dibenzo(a,h)anthracene	[illegible]	[illegible]	[illegible]	[illegible]	
Polychlorinated biphenyls *	[illegible]	[illegible]	[illegible]	[illegible]	
					[illegible]
Exposure Pathway: Dermal Absorption of Contaminants					
Benzo(a)anthracene	[illegible]	[illegible]	[illegible]	[illegible]	
Chrysene	[illegible]	[illegible]	[illegible]	[illegible]	
bis(2-Ethylhexyl)phthalate	[illegible]	[illegible]	[illegible]	[illegible]	
Benzo(b)fluoranthene	[illegible]	[illegible]	[illegible]	[illegible]	
Benzo(a)pyrene	[illegible]	[illegible]	[illegible]	[illegible]	
Indeno(1,2,3-cd)pyrene	[illegible]	[illegible]	[illegible]	[illegible]	
Dibenzo(a,h)anthracene	[illegible]	[illegible]	[illegible]	[illegible]	
Polychlorinated biphenyls *	[illegible]	[illegible]	[illegible]	[illegible]	
					[illegible]
				[illegible]	[illegible]

* [illegible]

Compiled by: [illegible]

TABLE 5-10

CANCER RISK ESTIMATES - CURRENT USE BACKGROUND

SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Chemical	CDI (mg/kg-day)	Slope Factor	Weight of Evidence	Chemical Specific Risk	Total Exposure Pathway
Exposure Pathway: Ingestion of Soil					
Benzo(a)anthracene	1.8E-10	3.22	B2	6E-10	
Chrysene	1.2E-09	3.22	B2	4E-09	
bis(2-Ethylhexyl)phthalate	8.1E-09	0.014	B2	1E-10	
Benzo(b)fluoroanthene	2.1E-08	3.22	B2	7E-08	
Benzo(a)pyrene	4.1E-08	3.22	B2	1E-07	
Ideno(1,2,3-cd)pyrene	3.4E-09	3.22	B2	1E-08	
Dibenzo(a,h)anthracene	7.0E-09	3.22	B2	2E-08	
Nitrosodiphenylamine *	8.1E-09	0.0049	B2	4E-11	
					2E-07
Exposure Pathway: Dermal Absorption of Contaminants					
Benzo(a)anthracene	4.4E-10	3.22	B2	1E-09	
Chrysene	3.0E-09	3.22	B2	1E-08	
bis(2-Ethylhexyl)phthalate	2.0E-08	0.014	B2	3E-10	
Benzo(b)fluoroanthene	5.3E-08	3.22	B2	2E-07	
Benzo(a)pyrene	1.0E-07	3.22	B2	3E-07	
Ideno(1,2,3-cd)pyrene	8.5E-09	3.22	B2	3E-08	
Dibenzo(a,h)anthracene	1.7E-08	3.22	B2	6E-08	
Nitrosodiphenylamine*	2.0E-08	0.0049	B2	1E-10	
					6E-07
				TOTAL EXPOSURE	8E-07

---

* Detected once in EPA split samples

Compiled by: BCM Engineers Inc. (BCM Project No. 00-6018-03)

TABLE 5-11

CANCER RISK ESTIMATES - FUTURE USE BACKGROUND

SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Chemical	CDI (mg/kg-day) RME	Slope Factor	Weight of Evidence	Chemical Specific Risk	Total Exposure Pathway
Exposure Pathway: Ingestion of Soil					
Benzo(a)anthracene	2.4E-11	3.22	B2	8E-11	
Chrysene	1.7E-10	3.22	B2	5E-10	
bis(2-Ethylhexyl)phthalate	1.1E-09	0.014	B2	2E-11	
Benzo(b)fluoranthene	2.9E-09	3.22	B2	9E-09	
Benzo(a)pyrene	5.6E-09	3.22	B2	2E-08	
Ideno(1,2,3-cd)pyrene	4.7E-10	3.22	B2	2E-09	
Dibenzo(a,h)anthracene	9.7E-10	3.22	B2	3E-09	
Nitrosodiphenylamine *	1.1E-09	0.0049	B2	5E-12	
					3E-08
Exposure Pathway: Dermal Absorption of Contaminants					
Benzo(a)anthracene	2.3E-11	3.22	B2	8E-11	
Chrysene	1.6E-10	3.22	B2	5E-10	
bis(2-Ethylhexyl)phthalate	1.1E-09	0.014	B2	2E-11	
Benzo(b)fluoranthene	2.8E-09	3.22	B2	9E-09	
Benzo(a)pyrene	5.4E-09	3.22	B2	2E-08	
Ideno(1,2,3-cd)pyrene	4.6E-10	3.22	B2	1E-09	
Dibenzo(a,h)anthracene	9.4E-10	3.22	B2	3E-09	
Nitrosodiphenylamine *	1.1E-09	0.0049	B2	5E-12	
					3E-08
				TOTAL EXPOSURE	6E-08

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* Detected once in EPA split samples

RME - Reasonable Maximum Exposure is defined as the upper bound 95 percent confidence interval of the most probable concentration

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Occupational Safety and Health Organization (OSHA) frequently make risk-based decisions within this range. Sometimes risk-based decisions have used cancer risks as high as 1 x 10^{-3} (Rodericks, et al., 1987).

The interpretation of cancer risk is complicated by the absence of guidance from the federal government on acceptable risk. Instead, the decision to remediate a Site and the determination of a clean-up levels is made on a case-by-case basis within the Superfund target range.

5.5.2 Noncarcinogenic Risk Characterization

5.5.2.1 Methods

The numerical value for noncarcinogenic risk is the Hazard Index (HI). The HI is the ratio of the exposure dose to the RfD and is calculated by dividing dose (chronic daily intake or CDI) by the RfD. The HI is not strictly an estimate of the risk, but a number which compares CDI to a level considered to have limited potential for lifetime health effects. Hence, HI values greater than 1 indicate that exposure exceeded the acceptable daily level while HI values less than 1 show that exposure is lower.

Similar to cancer risks, the HI values for each chemical are summed together to assess the overall potential for noncarcinogenic effects. This approach was developed by EPA based on the assumption that simultaneous subthreshold exposures to numerous chemical compounds can result in an adverse health effect (EPA, 1986).

5.5.2.2 EPA Guidance on Hazard Indices

EPA has not established specific guidance for acceptable HI values. However, since an HI value of 1 indicates that lifetime exposure has limited potential for causing an adverse effect in sensitive populations, values that are less than one can generally be considered acceptable. Values greater than one are usually given closer attention. For values greater than one, the magnitude of the uncertainty factor and toxicity endpoint are included in the evaluation.

5.5.2.3 Discussion and Interpretation of Hazard Indices

The results of the HI calculations for each exposure pathway are presented in Appendix XII. Tables 5-12 through 5-15 present the HI associated with each chemical and pathway for the current and future use scenarios along with their associated background risks.

The maximum HI values for all chemicals for ingestion and dermal contact added together, 0.007 for current use and 0.006 for future use, are more than 2 orders of magnitude below the trigger HI value of 1. Therefore,

TABLE 5-12

CHRONIC HAZARD INDEX ESTIMATES - CURRENT USE

SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Chemical	CDI (mg/kg/day)	RfD (mg/kg-day)	Hazard Index	Pathway Hazard Index
Exposure Pathway: Ingestion of Soil				
Benzoic Acid	1.5E-06	4	0.0000004	
Mercury	1.1E-07	0.0003	0.0004	
Nickel	2.9E-05	0.02	0.001	
Naphthalene	4.7E-08	0.004	0.00001	
Acenaphthene	1.4E-07	0.06	0.000002	
Anthracene	1.4E-07	0.3	0.0000005	
Fluoranthene	1.8E-07	0.04	0.000004	
Pyrene	1.4E-07	0.03	0.000005	
Phenol	2.8E-07	0.6	0.0000005	
4-Methyl phenol	1.4E-07	0.05	0.000003	
Fluorene	1.4E-07	0.04	0.000004	
bis(2-Ethylhexyl)phthalate	1.4E-07	0.02	0.000007	
Di-n-butyl phthalate *	1.4E-07	0.1	0.000001	
				0.002
Exposure Pathway: Dermal Absorption of Contaminants				
Benzoic Acid	3.6E-06	4	0.000001	
Mercury	2.8E-07	0.0003	0.0009	
Nickel	7.1E-05	0.02	0.004	
Naphthalene	1.2E-07	0.004	0.00003	
Acenaphthene	3.5E-07	0.06	0.000006	
Anthracene	3.5E-07	0.3	0.000001	
Fluoranthene	4.5E-07	0.04	0.00001	
Pyrene	3.4E-07	0.03	0.00001	
Phenol	7.0E-07	0.6	0.000001	
4-Methyl phenol	3.5E-07	0.05	0.000007	
Fluorene	3.5E-07	0.04	0.000009	
bis(2-Ethylhexyl)phthalate	3.5E-07	0.02	0.00002	
Di-n-butyl phthalate *	3.5E-07	0.1	0.000004	
				0.005
			TOTAL EXPOSURE	0.007

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* Detected once in EPA split samples

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TABLE 5-13

CHRONIC HAZARD INDEX ESTIMATES - FUTURE USE

SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Chemical	CDI (mg/kg/day)	RfD (mg/kg-day)	Hazard Index	Pathway Hazard Index
Exposure Pathway: Ingestion of Soil				
Nickel	2.3E-05	0.02	0.001	
Mercury	3.4E-07	0.0003	0.001	
Phenol	3.1E-07	0.6	0.0000005	
4-Methylphenol	2.1E-07	*0.05*	*0.000004*	
Benzoic Acid	2.8E-07	4	0.0000001	
Naphthalene	2.3E-06	0.004	0.0006	
Acenaphthene	4.1E-07	0.06	0.00001	
Fluorene	1.0E-06	0.04	0.00003	
Anthracene	8.1E-07	0.3	0.000003	
Fluoranthene	2.6E-06	0.04	0.00006	
Pyrene	3.0E-06	0.03	0.0001	
bis(2-Ethylhexyl)phthalate	1.7E-07	*0.02*	*0.000009*	
Di-n-butyl phthalate *	1.6E-07	0.1	0.000002	
				0.003
Exposure Pathway: Dermal Absorption of Contaminants				
Nickel	2.3E-05	0.02	0.001	
Mercury	3.4E-07	0.0003	0.001	
Phenol	3.1E-07	0.6	0.0000005	
4-Methylphenol	2.1E-07	0.05	0.000004	
Benzoic Acid	2.8E-07	4	0.00000007	
Naphthalene	2.3E-06	0.004	0.0006	
Acenaphthene	4.1E-07	0.06	0.000007	
Fluorene	1.0E-06	0.04	0.00003	
Anthracene	7.9E-07	0.3	0.000003	
Fluoranthene	2.5E-06	0.04	0.00006	
Pyrene	2.9E-06	0.03	0.00010	
bis(2-Ethylhexyl)phthalate	1.7E-07	0.02	0.000008	
Di-n-butyl phthalate *	1.5E-07	0.1	0.000002	
				0.003
			TOTAL EXPOSURE	0.006

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* Detected once in EPA split samples

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TABLE 5-14

CHRONIC HAZARD INDEX ESTIMATES - CURRENT USE BACKGROUND

SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Chemical	CDI (mg/kg/day)	RfD (mg/kg-day)	Hazard Index	Pathway Hazard Index
Exposure Pathway: Ingestion of Soil				
Benzoic Acid	3.9E-08	4	0.00000001	
Mercury	8.6E-08	0.0003	0.0003	
Nickel	2.0E-05	0.02	0.001	
Naphthalene	1.5E-07	0.004	0.00004	
Acenaphthene	3.8E-08	0.06	0.000001	
Anthracene	1.4E-07	0.3	0.0000005	
Fluoranthene	1.1E-06	0.04	0.00003	
Pyrene	1.0E-06	0.03	0.00003	
Phenol	2.8E-07	0.6	0.0000005	
4-Methyl phenol	1.4E-07	0.05	0.000003	
Fluorene	1.4E-07	0.04	0.000004	
bis(2-Ethylhexyl)phthalate	1.4E-07	0.02	0.000007	
Di-n-butyl phthalate *	1.4E-07	0.1	0.000001	
				0.001
Exposure Pathway: Dermal Absorption of Contaminants				
Benzoic Acid	9.5E-08	4	0.00000002	
Mercury	2.1E-07	0.0003	0.0007	
Nickel	4.8E-05	0.02	0.002	
Naphthalene	3.6E-07	0.004	0.00009	
Acenaphthene	9.3E-08	0.06	0.000002	
Anthracene	3.4E-07	0.3	0.000001	
Fluoranthene	2.8E-06	0.04	0.00007	
Pyrene	2.5E-06	0.03	0.00008	
Phenol	7.0E-07	0.6	0.000001	
4-Methyl phenol	3.5E-07	0.05	0.000007	
Fluorene	3.5E-07	0.04	0.000009	
bis(2-Ethylhexyl)phthalate	3.6E-07	0.02	0.00002	
Di-n-butyl phthalate *	3.5E-07	0.1	0.000004	
				0.003
			TOTAL EXPOSURE	0.004

---

* Detected once in EPA split samples

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TABLE 5-15

CHRONIC HAZARD INDEX ESTIMATES - FUTURE USE BACKGROUND

SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

Chemical	CDI (mg/kg/day)	RfD (mg/kg-day)	Hazard Index	Pathway Hazard Index
Exposure Pathway: Ingestion of Soil				
Nickel	2.1E-05	0.02	0.001	
Mercury	*9.3E-08*	*0.0003*	*0.0003*	
Phenol	3.1E-07	0.6	0.0000005	
4-Methylphenol	1.5E-07	0.05	0.000003	
Benzoic Acid	4.2E-08	4	0.00000001	
Naphthalene	*1.6E-07*	*0.004*	*0.00004*	
Acenaphthene	4.1E-08	0.06	0.0000007	
Fluorene	1.5E-07	0.04	0.000004	
Anthracene	1.5E-07	0.3	0.0000005	
Fluoranthene	*1.2E-06*	*0.04*	*0.00003*	
Pyrene	1.1E-06	0.03	0.00004	
bis(2-Ethylhexyl)phthalate	1.5E-07	0.02	0.000008	
Di-n-butyl phthalate *	1.5E-07	0.1	0.000002	
				0.001
Exposure Pathway: Dermal Absorption of Contaminants				
Nickel	2.1E-05	0.02	0.001	
Mercury	*9.1E-08*	*0.0003*	*0.0003*	
Phenol	3.0E-07	0.6	0.000001	
4-Methylphenol	1.5E-07	0.05	0.000003	
Benzoic Acid	4.1E-08	4	0.00000001	
Naphthalene	1.6E-07	0.004	0.00004	
Acenaphthene	4.0E-08	0.06	0.0000007	
Fluorene	1.5E-07	0.04	0.000004	
Anthracene	1.5E-07	0.3	0.0000005	
Fluoranthene	1.2E-06	0.04	0.00003	
Pyrene	1.1E-06	0.03	0.00004	
bis(2-Ethylhexyl)phthalate	1.5E-07	0.02	0.000008	
Di-n-butyl phthalate *	1.5E-07	0.1	0.000002	
				0.001
			TOTAL EXPOSURE	0.002

---

* Detected once in EPA split samples

Compiled by: BCM Engineers Inc. (BCM Project No. 00-6018-03)

TABLE 5-16

SUMMARY OF RISK

SEALAND LIMITED SITE
MT. PLEASANT, DELAWARE

	Pathway	CANCER RISK	HAZARD INDEX
Current Use	Ingestion	7E-08	0.002
	Dermal	2E-07	0.005
	Total	3E-07	0.007
Current Use - Background	Ingestion	2E-07	0.001
	Dermal	6E-07	0.003
	Total	8E-07	0.004
Future Use	Ingestion	7E-08	0.003
	Dermal	6E-08	0.003
	Total	1E-07	0.006
Future Use - Background	Ingestion	3E-08	0.001
	Dermal	3E-08	0.001
	Total	6E-08	0.002

Compiled by: BCM Engineers Inc. (BCM Project No. 00-6018-03)

potential noncarcinogenic health effects for all pathways under current and future use conditions are expected to be negligible.

5.5.3 Uncertainties in Risk Characterization

Areas that represent some uncertainty in the risk assessment include carcinogenic and non-carcinogenic effects of chemicals in mixtures and the presence of any unknown chemicals.

There is very little information on the toxicological effects of mixtures. In some cases, the presence of several chemicals together may result in an enhancement of the overall toxicity (synergistic) effects. Other chemicals mixed together may result in fewer toxic effects (antagonism).

Lastly, the chemical analyses were for specific parameters. The chemicals evaluated are those that have been identified as the most important chemicals in air, soil, and water. The possibility exists that other chemicals are present that were not detected.

The toxicity profiles, contained in Appendix XIV, include both technical profiles (IRIS) and general toxicity information on chemicals which were not contained in IRIS. The general profiles represent a broad spectrum of studies that are available on health effects for those chemicals. The results of these studies may or may not have undergone extensive review to determine their significance or validity. The technical profiles discuss the adequacy of the studies presented and define those which EPA considers adequate to support an assessment of the adverse health effects of the chemical.

5.6 ENVIRONMENTAL ASSESSMENT

The environmental assessment determines the potential for adverse health effects to the environment using essentially the same approach as the risk assessment used for human health, with the addition of a Site biological survey. The steps include a description of relevant aspects of the Site, identification of chemicals of potential concern, exposure pathways, toxicity assessment, and risk characterization. The final step is a survey of the Site conducted by a trained field biologist to determine any observable impacts.

An environmental assessment conducted as part of the risk assessment demonstrated that there are no completed environmental pathways at the Site and, also, the nearest environmental receptors are impacted by multiple sources of contamination.

The chemicals of potential concern are only found in soil beneath the cap so there is no potential for surface runoff of contaminated material. There are no chemicals of potential concern in groundwater.

A trained biologist conducted a survey of the Site and surrounding areas on September 7, 1990. As discussed above, the purpose of the survey was to identify any observable impacts. The vegetation that currently exists on the Site shows no signs of stress. Vegetation on the site consists predominantly of herbaceous species with some shrubs. This type of vegetation is expected given the history of the site (e.g., inactive since the mid-1980s). Although there are slight differences in plant communities in different portions of the Site, the predominant vegetation includes goldenrod, ragweed, Queen Anne's lace, clover, evening primrose, asters, and grasses. The predominant shrubs and saplings are multiflora rose, black cherry, and sumac. Vegetation, such as cattails and sedges, occurs in the depressions in the abandoned road that runs along the eastern portion of the Site. The plant communities on the Site likely provide a limited habitat for some wildlife. Figure 5-1 presents photographs from the site taken on September 7, 1990, which show representative areas on the Site.

5.7 CONCLUSIONS OF THE RISK ASSESSMENT

The following paragraphs summarize the Sealand risk assessment:

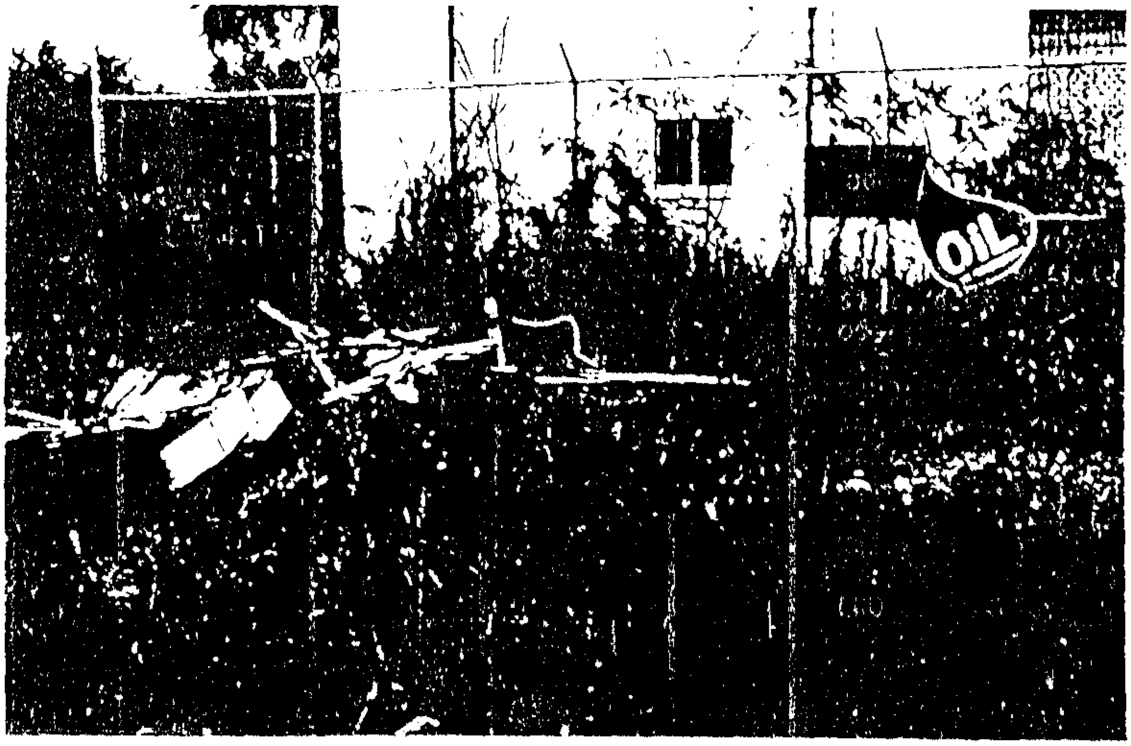
- Risk assessment protocols are designed to be conservative to account for uncertainties such as the extent of contamination and the presence of highly sensitive individuals in the exposed population. The conservative approach is used to assure that the results of the risk assessment will be protective of human health and the environment.

- The chemicals of potential concern at the Site are the semivolatile organic chemicals, and two inorganic chemicals, nickel and mercury. The medium of concern is soil.

- The inorganic chemicals in the groundwater and the volatile organic chemicals in the soil are either within the range of natural background, or detected infrequently and at low concentrations so that their presence as Site-related contaminants is unlikely.

- In the current exposure pathways the cancer risk estimates are below the range suggested for Superfund Sites. The reason for the low risk estimates is that currently there is no exposure to the chemicals in soil beneath the Site.

Looking North From Churchtown Road



Looking West

Figure 5-1
Site Photos
September, 1990

Capped Area Looking North

Capped Area Looking South

BCM Project No. 00-6018-03

Figure 5-1
Site Photos
September, 1990

- The future risk scenario is based on short term exposure by construction workers because the presence of an active rail line bordering the Site and local zoning ordinances preclude development of the property for residential use.

- There is negligible potential for noncarcinogenic effects either currently or in the future. The highest estimate of noncarcinogenic risk is a HI value of 0.007 which is more than two orders of magnitude below the trigger level for HI values of 1.

- The environmental risk assessment conducted for the Site concluded that there are no completed exposure pathways. The contaminated soils are capped and there are no chemicals of potential concern in the groundwater. The nearest environmental receptor of concern, Joy Run, is impacted by multiple sources of contamination (not related to Site activities) including tar spills, numerous piles of asphalt and highway debris between the Site and the creek, and road bed materials dumped along the creek banks.

6.0 CONCLUSIONS

Based on an evaluation of the results of the remedial investigation and the data collected at the Site, the following conclusions can be drawn:

- The direction of groundwater flow (north-northeast) is consistent with previous findings. Water level fluctuations measured in onsite wells for 24 hours did not indicate a potential impact on onsite groundwater flow as a result of offsite groundwater pumping.

- Groundwater can be eliminated from consideration as a source of risk or an exposure pathway. Three volatile organic compounds were detected, but based on low frequency of detection and low concentrations of these compounds they were not considered chemicals of potential concern. Two semivolatile organic compounds (Naphthalene and bis(2-ethylhexyl) phthalate) were present above the detection limit in samples from two onsite wells. Based on low frequency of detection and low concentrations, these compounds were not considered chemicals of potential concern. Inorganic parameters detected are within the range of Site-related background concentrations and therefore were not considered chemicals of potential concern.

- Elevated concentrations of contaminants, particularly semivolatile organic compounds, are present in soil beneath the clay cap. Isolated areas of detectable concentrations of contaminants are also present outside the capped area, but their distribution is sporadic and less concentrated than beneath the capped area.

- The risk assessment indicates that onsite soils do not pose a health risk. The highest concentration of soil contamination is found beneath the clay cap and there is no evidence that the cap has been disturbed. Except for periodic refuse dumping, there is no evidence that the Site is used for recreational or other purposes by nearby residents.

- The total cancer risk for current use exposure via ingestion and dermal contact is 3×10^{-7}. As stated in Section 300.430 (e) of the National Oil and Hazardous Substances Pollution Contingency Plan acceptable exposure levels to known or suspected carcinogens are generally concentration levels that represent an excess upper bound lifetime cancer risk between 10^{-4} and 10^{-6}. The cancer risk associated with future use is 1×10^{-7} onsite and 6×10^{-8} background.

- Chronic hazard indices (HI) are also very low for both current and future use scenarios. An HI value above 1.0 is considered cause for concern. The value for current exposure at the Site totals 0.007. The total future value is 0.006 for ingestion and dermal exposure to soil.

7.0 RECOMMENDATIONS

Based on the conclusions presented in Section 6.0, no additional Site characterization is necessary. The groundwater and soil pathways have been sufficiently characterized and the risks for human exposure and environmental impacts are within acceptable levels. No additional remedial investigation activities are proposed.

REFERENCES

ATSDR, 1988. Toxicological Profile for Benzo(a)pyrene. Agency for Toxic Substances and Disease Registry, Draft.

BCM Engineers Inc., 1989. Work Plan for Remedial Investigation/Feasibility Study, Sealand Limited Site, Mt. Pleasant Delaware. 1989.

EPA, 1990. U.S. Environmental Protection Agency, Field Filtration Policy for Monitoring Well Groundwater Samples Requiring Metals Analysis. EPA Region III QA Directives, Bulletin No. QAD009. April 23, 1990.

EPA, 1989a. U.S. Environmental Protection Agency. Risk Assessment Guidance for Superfund Program. Human Health Evaluation Manual. Part A. Interim Final. July 1989. OSWER 9285.701a.

EPA, 1989b. U.S. Environmental Protection Agency. Exposure Factors Handbook. May 1989. EPA/600/8-89/043.

EPA, 1989c. U.S. Environmental Protection Agency. Risk Assessment Guidance for Superfund Program. Interim Final. Part B. Environmental Evaluation Manual. July 1989. EPA/540/1-89/001.

EPA, 1988. Estimating Exposure to 2,3,7,8-TCDD, Draft. Office of Health and Environmental Assessment. EPA/600/6-88/005A. March 1988.

EPA, 1986a-f. Fedral Register Guidance documents.

EPA, 1986g. U.S. Environmental Protection Agency. Superfund Public Health Evaluation Manual (SPHEM). October 1986. EPA540/1-86-060.

EPA, 1984. Health Effects Assessment for Polycyclic Aromatic Hydrocarbons (PAHs). U.S. Environmental Protection Agency EPA/540/1-86/013.

Gilbert, R.O., 1987. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold Company, New York, New York.

Rodricks, J.V., Brett, S.M., and Wrenn, G.C. "Significant Risk Decisions in Federal Regulatory Agencies." Regulatory Toxicology and Pharmacology. 7:302-320.