File on eDOCs [✓ Yes] No
Site Name Sinclair Refinery
Site No. 902003
County Allegany
Town Wellsville
Foilable [✓ Yes] No
File Name Documents / Reports
Scanned & eDOC

report. HW902003. 1991-03. Remedial_Investigation_Vol_IV_of_IV.

REMEDIAL INVESTIGATION REPORT

FOR THE

SINCLAIR REFINERY SITE
Wellsville, New York

VOLUME IV OF IV
APPENDIX K

PREPARED FOR
ARCO
BY
EBASCO
An ENSERCH® Engineering and Construction Company

MARCH 1991

Appendix K
EPA's Endangerment Assessment

MAR 01 1991

EXPRESS MAIL

John A. A. Zannos
Project Manager
Atlantic Richfield Company (ARCO)
515 South Flower Street
Los Angeles, CA 90071

Re: Sinclair Refinery Site, Wellsville, New York
Remedial Investigation/Endangerment Assessment

Dear Mr. Zannos:

The purpose of this letter is to transmit to ARCO the revised Final Endangerment Assessment (EA) for the above referenced site and to respond to ARCO's letter of November 9, 1990 regarding finalization of the Sinclair Refinery Remedial Investigation (RI).

Enclosed please find the revised Final EA for the Sinclair Refinery site in Wellsville, New York. The revised document incorporates the following changes:

- Page 2-11 indicates that the metal concentrations in soils may be attributable to local background levels.

- Page 2-20 deletes benzo(a)pyrene from the selected indicator chemicals at the offsite tank farm.

- The chemical concentration in air (CA) and the Lifetime Average Daily Exposure (LADE) in table 3-6 were corrected due to a math error (the CA and LADE were an order of magnitude too high and E-06 became E-07).

Because of these three changes, the following pages and tables also required adjustment: Page 3-23, Page 3-29, Table 3-6, Page 3-35, Page 3-38, Table 3-11, Table 4-2, Table 4-5, Table 4-6, Table 4-8, Table 4-9, Table 4-12, Page 4-17, Table 4-13, Table 4-14, Table 4-17, Table 4-18, Page 5-2, and Page 5-3.

Please also note that after these changes were made, the highest non-carcinogenic risk from the site remains the inhalation of barium and lead dust particles by adults that work and attend vocation school on the refinery site. The chronic hazard index for the inhalation route is 9.45E-02. The previous version of the report cited a value of 9.45E-01 for this route. Since the non-carcinogenic hazard index for this exposure point does not exceed unity (nor did it in the original calculation), adverse non-carcinogenic effects are not expected.

Referencing ARCO's letter to the U.S. Environmental Protection Agency (EPA) dated November 9, 1990, three points of conflict were raised by ARCO regarding the site EA. The inclusion of benzo(a)pyrene as an indicator compound at the Off-Site Tank Farm and the fact that mean inorganic compound levels and associated risks were determined without regard to local background levels have been addressed as explained above. The remaining point of conflict involved Versar's selection of parameters for the flow and contaminant transport calculations. EPA and Versar chose to present a conservative scenario for contaminant flow by using the highest gradient on site and one of the highest hydraulic conductivity values. Although this combination of aquifer characteristics does not truly represent site hydrogeological conditions, their use constitutes a "worst-case" scenario for groundwater flow. The spatial extent of contaminants was addressed by averaging contaminant flow from several river-fronting segments centered around monitoring wells MW-7, -9, -10, -11, -27, -32, and -55, all of which occur close to the site boundary along the Genesee River. Ultimately, however, no site risk was associated with the ingestion of contaminants via surface water at the site, even using the worst-case scenario. Therefore, even if ARCO considers Versar's approach geologically unrealistic, the issue becomes irrelevant.

The final point raised in ARCO's November 9 letter regarded the presentation of the EA and ARCO's own Risk Assessment (RA) in the RI. As previously stated by EPA and expressed in a letter from EPA to ARCO dated October 9, 1990, EPA Region II policy is and has been for EPA to develop risk assessments in RI/FSs conducted by Potentially Responsible Parties (PRPs). Therefore, ARCO will submit the site RI with the EPA EA, presented either as a section of the RI document itself or under separate cover as a clearly identified addendum to the RI. ARCO then has the option of submitting their own RA separately to EPA, whereby it will be included in the administrative record but not the RI/FS. The RI will, then, make no reference to the RA performed by ARCO. Any necessary changes to the RI to comply with this policy should be done accordingly.

Upon receipt of this letter and in accordance with paragraph 29 of the Administrative Order on Consent between ARCO and EPA, which was signed by EPA on July 28,1988, ARCO will have twenty (20) business days to submit the revised RI report to EPA.

If you have any questions on this matter, please contact Michael Negrelli, Sinclair Refinery project manager, at (212) 264-1375.

Sincerely yours,

Carole Petersen, Chief
New York/Caribbean Superfund Branch II

Enclosure

cc (letter only):

R.W. Simmons - ARCO
M.D. Smith - ARCO
J. White - NYSDEC
M. Marshall - USDOJ
C. Berns - USEPA
K. Lynch - USEPA
S. Schofield - CDM-FPC
S. Odland - CDM-FPC

cc (with enclosure):

T. Granger - Ebasco

WORK ASSIGNMENT NO. C02064
EPA CONTRACT NO. 68-W9-0002
DOC. NO. 0100y

REVISED FINAL ENDANGERMENT ASSESSMENT
SINCLAIR REFINERY SITE
WELLSVILLE, NEW YORK

SUBMITTED TO:

CDM FEDERAL PROGRAMS CORPORATION
SUITE 200
13135 LEE JACKSON MEMORIAL HIGHWAY
FAIRFAX, VIRGINIA 22033

SUBMITTED BY:

VERSAR, INC.
6850 VERSAR CENTER
SPRINGFIELD, VIRGINIA 22151

JUNE 25, 1990

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APPENDICES

1.0 INTRODUCTION

CDM Federal Programs Corporation (FPC) received a work assignment (Contract No. 68-W9-0002, WA No. C02064) to provide technical support to the U.S. Environmental Protection Agency (EPA) as part of the second phase of the remedial investigation/feasibility study (RI/FS) being conducted for the Sinclair Refinery located in Wellsville, New York, by the potentially responsible party. Through a subcontract with CDM FPC, Versar will provide the technical support which included the completion of this Endangerment Assessment.

1.1 Objective and Scope

The objective of this Endangerment Assessment is to provide the U.S. EPA with an evaluation of the risks the Sinclair Refinery site poses to both human health and the environment under baseline conditions. Current EPA guidance manuals were used during the preparation of the report which include: Risk Assessment Guidance for Superfund-Human Health Evaluation Manual, 1989, Superfund Public Health Evaluation Manual, 1986, Exposure Factors Handbook, 1989, and Superfund Exposure Assessment Manual, 1988. The methods described within this Federal guidance materials are intended to provide a conservative evaluation of site risks.

The site consists of a landfill and the refinery. A Record of Decision (ROD) was signed in 1985 for the landfill on the Sinclair Refinery site. Therefore, this report is intended to support EPA's future ROD for only the refinery portion of the site. This report evaluates baseline conditions; therefore, it does not determine the risks associated with specific remedial actions, currently under consideration by the U.S. EPA, that may be incorporated into the pending Remedial Response Plan.

1.2 Site Description and History

The Sinclair Refinery site, adjacent to the Town of Wellsville in Allegheny County, New York, occupies approximately 102.5 acres (Figure 1-1). The site consists of a 12.5-acre landfill in the southeast sector, which was used as a disposal area by the refinery, and a 90-acre portion where the refinery processing, storage and administration operations were conducted (Figure 1-2). In addition, there is a small 6.6-acre offsite tank farm, approximately 2,000 feet west of the main refinery site.

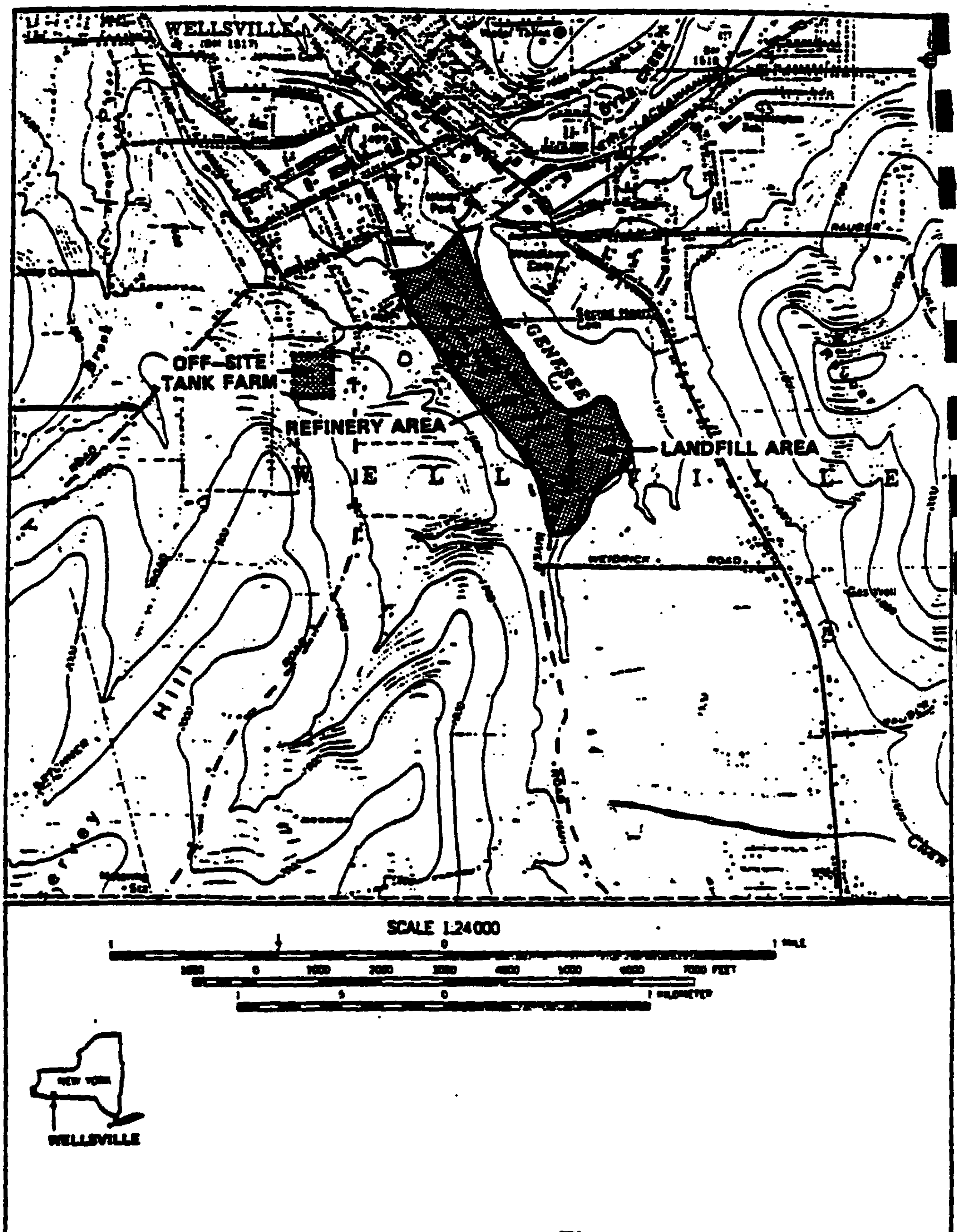
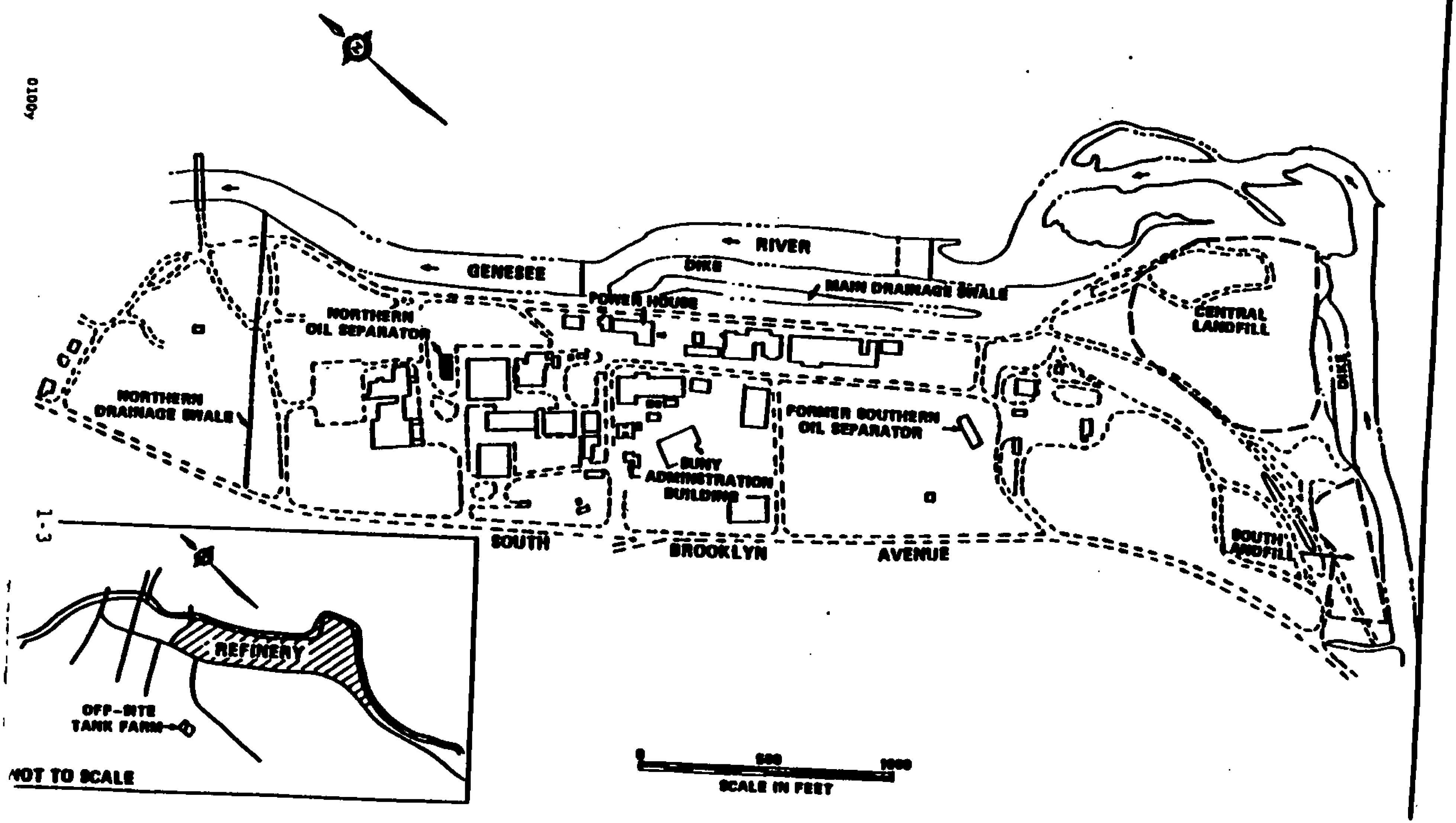


Figure 1-1 Sinclair Refinery Vicinity Map (Ebasco, 1989)



ADAPTED FROM SMC MARTIN PHASE I SITE MAP

Figure 1-2 Sinclair Refinery Site Map (Ebasco, 1989)

Oil refining operations have taken place at the site since the late 1800s. The Sinclair Refinery Company purchased the refinery in 1924 and operated it until 1958 when a fire halted operations. Sinclair Refining Company sold parcels of the site to several entities, including the Town of Wellsville. The Town of Wellsville subsequently conveyed some of the parcels to various interests, most of whom currently occupy the refinery portion of the site. These buyers include a branch campus of the State University of New York (SUNY), which maintains a trade and vocations school at the site. In 1969, the Sinclair Refinery Company merged with the Atlantic Richfield Company (ARCO).

In the mid-1970s, debris from the landfill was reported to have washed onto the banks of the Genesee River downstream from the Sinclair Landfill. Reports from the community and site inspections, conducted by the New York State Department of Environmental Conservation (DEC) in the fall of 1981, indicated that site conditions warranted proposing the site for the National Priorities List (NPL). In January 1983, drums and other waste materials were removed from the floodplain downstream from the landfill. In March 1983, a dike was constructed to separate the Genesee River from the eroding face of the landfill. The Sinclair Refinery site was listed on the NPL on September 8, 1983. A Cooperative Agreement, signed by the New York DEC and the EPA Region II that year, identified DEC as the lead agency responsible for the oversight of the remedial cleanup activities for the Sinclair Refinery Superfund site.

In 1984, DEC initiated a RI/FS for the landfill portion of the site. SMC Martin completed a Phase I Remedial Investigation and submitted a report in 1985. A Record of Decision (ROD) was signed in 1985 for the landfill on the Sinclair Refinery site. Also in 1985, EPA authorized the relocation of the surface water intake for the village of Wellsville public water supply to a location upstream from the refinery site. The relocation of the surface intake was completed in the Spring of 1988. Ebasco, under contract for ARCO, completed an additional Remedial Investigation and submitted the draft report in 1989.

The 1989 Draft RI Report, prepared by Ebasco, used mostly SMC Martin data which was not fully validated according to the Region II standard operating procedures which are based on National Contract Laboratory Program (CLP) Functional Guidelines for CLP Data Review. The RI data package received from Ebasco had 1,067 classes (i.e., volatile organics, semivolatile organics, and inorganics) of analytical results, 751 or 70 percent originated from the SMC Martin remedial investigation. In accordance with the EPA's decision, this endangerment assessment report will be based on the data used in Ebasco's 1989 Draft RI Report.

1.3 Report Organization

Section 2 of this report presents the site characterization. This section includes the results of the comprehensive review of the data package which leads to the selection of chemicals of potential concern. This section will also discuss and illustrate the spacial distribution of soil contaminants in order to identify the contaminant migration pathways that could adversely affect either human or ecological receptors on or near the site.

Section 3 presents the exposure and toxicity assessments. The exposure assessment characterizes the exposure setting and potential pathways attributed to the refinery portion of the site. The fate and transport mechanism of the chemicals of potential concern will be summarized. The exposure assessment will provide an estimation of exposure point concentrations for the potentially significant contaminant migration pathways. Monitoring data was used whenever possible in order to provide reasonable estimates of contaminant levels at potential receptor points. If receptor point monitoring data was not available, conservative dispersion and transport models were used to determine downgradient contaminant levels. Finally, the exposure assessment concludes with an estimation of chemical intakes using standard EPA exposure scenario calculations.

The toxicity assessment portion of Section 3 summarizes the carcinogenic and noncarcinogenic toxicity values for the chemicals of potential concern along with their identified state and Federal Standards. This section will also include toxicity profiles for each of the chemicals of interest.

Section 4 quantitatively presents the risk evaluation for carcinogenic and noncarcinogenic chemicals to both human health and the environment. The carcinogenic and non-carcinogenic risk analysis will evaluate numerically the adverse impacts that may result from exposure to the chemicals onsite representative of baseline conditions. This section will also provide a qualitative evaluation of the potential risks to human receptors followed by a discussion of the uncertainties and assumptions used.

2.0 SITE CHARACTERIZATION

2.1 Data Summary

The U.S. EPA Region II provided Versar with two sets of analytical data. One set of data was collected by SMC Martin, who initiated the RI, but only completed Phase I of the investigation. Ebasco, Inc. completed Phase II of the RI in August 1988 by collecting additional samples. Tallies for samples collected by each principal investigator for each media are presented below:

		SMC	EBASCO
Ground Water	Volatile organics	73	39
	Semivolatile organics	73	24
	Inorganics	73	47
Soil	Volatile organics	129	34
	Semivolatile organics	129	33
	Inorganics	129	118
Surface Water	Volatile organics	51	9
	Semivolatile organics	27	0
	Inorganics	51	12
	TOTAL	751	316

The objective of the Phase II study was to gather data to determine the nature and extent of additional remedial actions: thus, locations which were most likely to indicate the presence of contaminants were targeted for sampling. Samples were analyzed for the Hazardous Substance List (HSL) [i.e., volatile organics, semivolatile organics (base/neutral/acid extractable organics), metals, and cyanide], the Target Compound List (i.e., volatile organics, and semivolatile organics), and the Target Analyte List (i.e., metals and cyanide). A listing of the compounds and elements resolved by the analytical methods used is presented in Table 2-1.

TABLE 2-1 LIST OF CHEMICALS ANALYZED FOR AT SINCLAIR REFINERY SITE *

VOLATILE ORGANIC COMPOUNDS

Chloromethane
Bromomethane
Vinyl Chloride
Chloroethane
Methylene Chloride
Acetone
Carbon Disulfide
1,1-Dichloroethene
1,1-Dichloroethane
Trans-1,2-Dichloroethene
Chloroform
1,2-Dichloroethane
2-Butanone
1,1,1-Trichloroethane
Carbon Tetrachloride
Vinyl Acetate
Bromodichloromethane
1,1,2,2-Tetrachloroethane
1,2-Dichloropropane
Trans-1,3-Dichloropropene
Trichloroethene
Dibromochloromethane
1,1,2-Trichloroethane
Benzene
cis-1,3-Dichloropropene
2-Chloroethylvinyl Ether
Bromoform
2-Hexanone
4-Methyl-2-Pentanone
Tetrachloroethene
Toluene
Chlorobenzene
Ethylbenzene
Styrene
Total Xylenes

TENTATIVELY IDENTIFIED VOCs

Cyclohexanes
Total Alkyl Cyclohexanes

SEMIVOLATILE ORGANIC COMPOUNDS

Phenol
bis (2-Chloroethyl) Ether
2-Chlorophenol
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Benzyl Alcohol
1,2-Dichlorobenzene
2-Methylphenol
bis (2-Chloroisopropyl) Ether
4-Methylphenol
N-Nitroso-Di-n-Propylamine
Hexachloroethane
Nitrobenzene
Isophorone
2-Nitrophenol
2,4-Dimethylphenol
Benzoic Acid
bis (2-chloroethoxy) Methane
2,4-Dichlorophenol
1,2,4-Trichlorobenzene
Naphthalene
4-Chloroaniline
Hexachlorobutadiene
4-Chloro-3-Methylphenol
2-Methylnaphthalene
Hexachlorocyclopentadiene
2,4,6-Trichlorophenol
2,4,5-Trichlorophenol
2-Chloronaphthalene
2-Nitroaniline
Dimethyl Phthalate
Acenaphthylene
3-Nitroaniline
Acenaphthene
2,4-Dinitrophenol
4-Nitrophenol
Dibenzofuran
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Diethyl Phthalate

SEMIVOLATILES (CONTINUED)

4-Chlorophenyl Phenyl Ether
Fluorene
4-Nitroaniline
4,6-Dinitro-2-Methylphenol
N-Nitrosodiphenylamine
4-Bromophenyl Phenyl Ether
Hexachlorobenzene
Pentachlorophenol
Phenanthrene
Anthracene
Di-N-Butyl Phthalate
Fluoranthene
Pyrene
Butyl Benzyl Phthalate
3,3'-Dichlorobenzidine
Benzo(A)Anthracene
bis (2-Ethylhexyl) Phthalate
Chrysene
Di-N-Octyl Phthalate
Benzo(b)Fluoranthene
Benzo(k)Fluoranthene
Benzo(a)Pyrene
Indeno (1,2,3-cd) Pyrene
Dibenzo(a,h)Anthracene
Benzo(g,h,i)Perylene

INORGANIC METALS AND CYANIDE

Aluminum
Antimony
Arsenic
Barium
Beryllium
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Manganese
Mercury
Nickel
Potassium
Selenium
Silver
Sodium
Thallium
Vanadium
Zinc

Cyanide

MISCELLANEOUS INORGANIC COMPOUNDS

Phenols (ug/L in aqueous samples)
Total Dissolved Solids
Total Organic Carbon

* From SMC Martin and Ebasco Inc. R.I. date sets.

The data was compiled and evaluated to determine the classes of contaminants identified on site. Appendix A represents a summary of concentrations for all compounds and elements detected at the Sinclair Refinery site. Versar eliminated the results from ground-water samples that were filtered prior to laboratory submittal to provide more conservative concentrations of compounds in the ground water. When a compound was not detected, half the detection limit was used to calculate the mean. Rejected data was omitted from the calculations of means. Table 2-2 presents summary statistics for the compounds by media [i.e., ground water (GW), surface water (SW), and soil locations (SL)]. Summary statistics include frequency, maximum concentrations and the geometric mean, as well as acceptable intakes for subchronic and chronic exposure (AIS and AIC), carcinogenic potency factors (CPF), severity of effect rating values (RVe), and carginogenic weight of evidence scores. The RVes are unitless ingeters ranging from 1 to 10 (i.e., death or pronounced life sortening), corresponding to the levels of severity of effects. The weight of evidence ratings qualify the level of evidence that supports designating a chemical as a human carcinogen from E (i.e., no evidence) to A (i.e., sufficient evidence).

Approximate sample locations for ground water, soil (i.e., composite surface soil, auger soil borings, offsite tank farm, and oil water separator), and surface water are presented in Figures 2-1, 2-2, 2-3, 2-4, 2-5 and 2-6. Soil samples were collected from three depth intervals in auger borings: shallow (0-0.5 feet), middle (2-4 feet), and deep (8-10 feet).

Of the volatile organics, methyl chloride, acetone, benzene, ethylbenzene, and xylenes (ortho-, meta- and para- isomers) were the most prevalent compounds observed in over 50 percent of the samples collected. The geometric means for vinyl chloride and benzene in ground water exceed the maximum contaminant levels (MCLs) promulgated under the Safe Drinking Water Act.

TABLE 2-2
SUMMARY STATISTICS OF COMPOUNDS DETECTED AT SINCLAIR REFINERY

	HITS/TOTAL ANALYSES			MEAN (PPB)			MAX (PPB)			ORAL			RVe	Weight of Evidence
	GW	SW	SL	GW	SW	SL	GW	SW	SL	AIS	AIC	CPF		
VOAs														
VINYL CHLORIDE	2/77	0/26	0/136	5.48			94					2.95E-01	10	A
METHYL CHLORIDE	4/77	8/26	64/136	4.25	7.53	12.56	5	9700	4964		6.00E-02	7.50E-03	10	B2
ACETONE	18/77	18/26	65/136	26.63	10.67	31.13	8500	6000	78000				5	
TRANS-1,2-DICHLOROETHENE	0/77	11/26	3/136	-	3.97	2.64	-	3300	2970				5	
2-BUTANONE	0/61	8/18	12/119	-	7.53	6.79	-	6800	36000	5.00E-01	5.00E-02		10	
TRICHLOROETHENE	1/77	6/26	1/136	2.50	3.35	2.64	2.5	5000	5940			1.10E-02	5	B2
BENZENE	24/77	13/26	41/136	28.24	3.45	3.65	1200	3300	1450			2.90E-02	5	A
4-METHYL-2-PENTANONE	1/77	2/26	8/136	5.23	6.01	6.62	14	20000	5100	5.00E-01	5.00E-02		4	
1,1,2,2-TETRACHLOROETHANE	1/77	0/26	9/136	2.61		3.17	7		2100				5	C
TOLUENE	17/77	5/26	11/136	3.71	0.66	0.69	390	54	1666.5	4.00E-01	3.00E-01		7	
ETHYLBENZENE	18/77	7/26	12/136	7.49	3.25	3.67	170	3800	3600	1.00E+00	1.00E-01		4	
TOTAL XYLENES	23/77	8/26	22/136	39.19	3.71	4.63	1500	2700	26000	4.00E+00	2.00E+00		10	
BNAs														
PHENOL	0/62	2/25	8/162	-	5.01	159.66	-	15	1100	4.00E-01	4.00E-02		4	
1,4-DICHLOROBENZENE	0/62	4/25	0/162	-	4.98		-	29				2.40E-02	4	B2
NITROBENZENE	1/62	7/25	2/162	8.48	5.02	164.54	8200	20	240	5.00E-03	5.00E-04		-	
2-METHYLNAPHTHALENE	8/62	3/25	28/162	17.68	5.81	229.03	270	710	37000				-	
DIBENZOFURAN	0/62	0/25	6/162	-		163.56	-		670					
N-NITROSODIPHENYLAMINE	0/62	5/25	4/162	-	5.70	167.48	-	970	580			4.90E-03	-	B2
PHENANTHRENE	3/62	3/25	29/162	7.28	5.72	141.09	53	240	22000				-	
DI-n-BUTYLPHTHALATE	0/62	7/25	45/162	-	4.04	345.99	-	5	6800				8	
PYRENE	1/62	2/25	24/162	5.48	5.76	151.43	18	180	30000				-	
BUTYLBENZYLPHTHALATE	0/62	7/25	11/162	-	5.93	167.56	-	1710	1900					
BENZO[a]ANTHRACENE	0/62	0/25	15/162	-		167.84			17000					B2
BIS[2-ETHYLHEXYL]PHTHALATE	0/62	12/25	38/162	-	8.23	364.07	-	4360	135000				-	
BENZO[k]FLOURANTHENE	0/62	6/25	15/162	-	6.68	198.88	-	575	22000					
BENZO[a]PYRENE	0/62	1/25	18/162	-	5.04	183.88	-	7.1	19000				8	B2
INORGANICS														
AL	14/78	7/26	94/229	10864.0	97.4	254836.0	113000	556	22700000				-	
SB	0/78	0/26	19/229	-		6152.7	-		182300		4.00E-04		10	
AS	14/78	7/26	188/224	114.2	6.4	7738.2	884	89	572000		1.00E-03		9	A
BA	15/78	10/26	94/229	929.8	103.7	41488.7	2360	268	3130000		5.00E-02		10	
BE	8/78	1/26	100/229	2.9	2.5	548.8	7.6	4	51000		5.00E-03		-	B2
CU	14/78	4/26	215/226	109.4	12.3	17695.5	956	33	1183000				5	
FE	15/78	7/23	95/229	92534.9	89.2	240242.4	280000	20300	43600000				-	
PB	15/78	13/26	224/230	57.2	5.1	30006.4	249	155	1190000				10	
MN	15/78	10/26	96/229	59.5	21.6	18078.2	31500	8970	3660000	5.00E-01	2.00E-01		-	
HG	0/73	5/26	71/198	-	0.1	45.0	-	2.2	9400	2.00E-03	2.00E-03		7	
NI	14/76	14/26	201/215	84.4	33.0	16638.6	362	1622	357000	2.00E-02	2.00E-02		10	
VN	14/78	0/26	93/228	24.1		6945.1	149		30000	7.00E-03	7.00E-03		6	
ZN	15/78	16/21	212/219	3797.1	19.2	62039.1	21500	330	2037000	2.00E-01	2.00E-01		8	

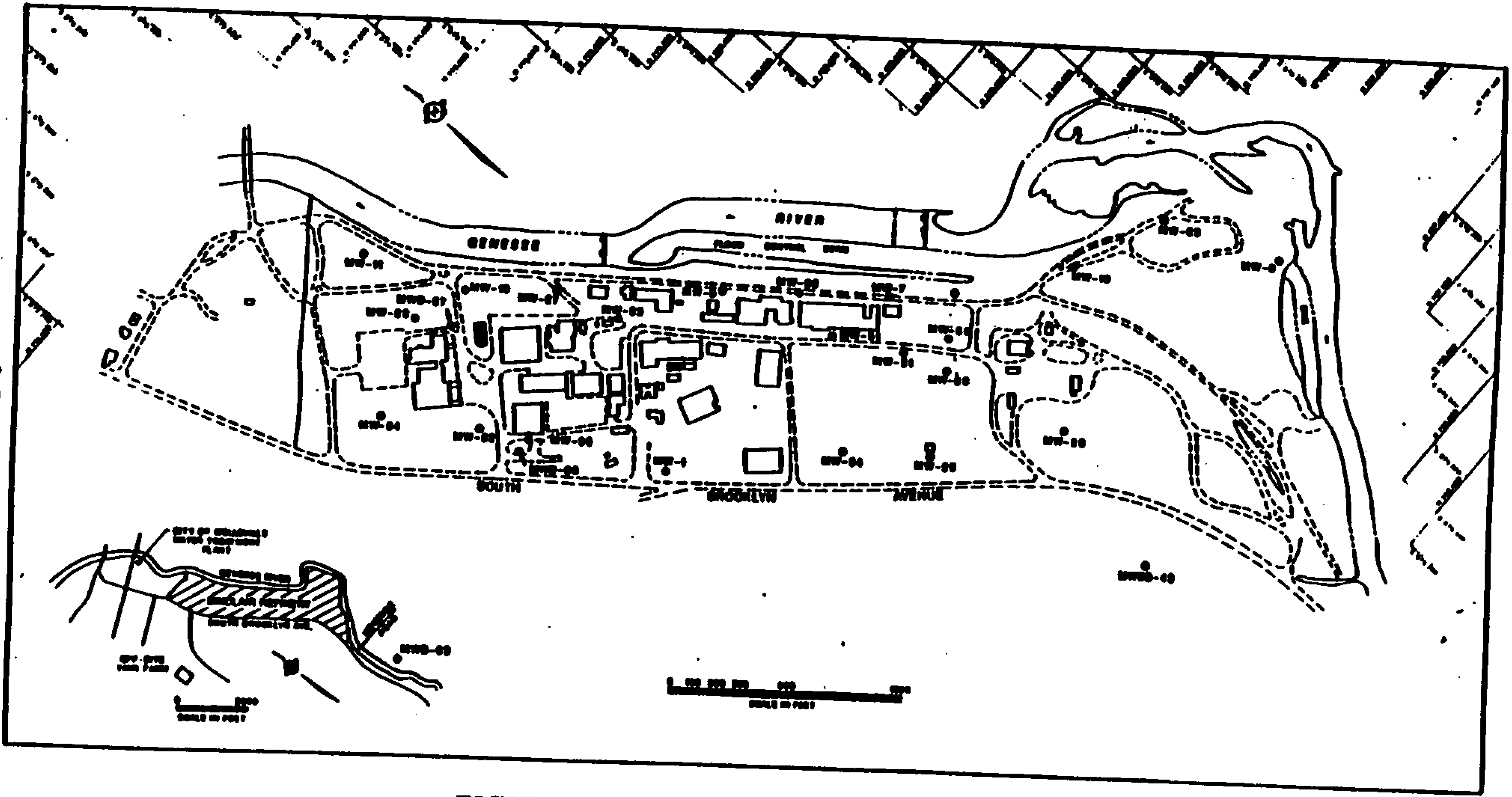


FIGURE 2-1 Shallow and Deep Ground Water Monitoring Well Locations

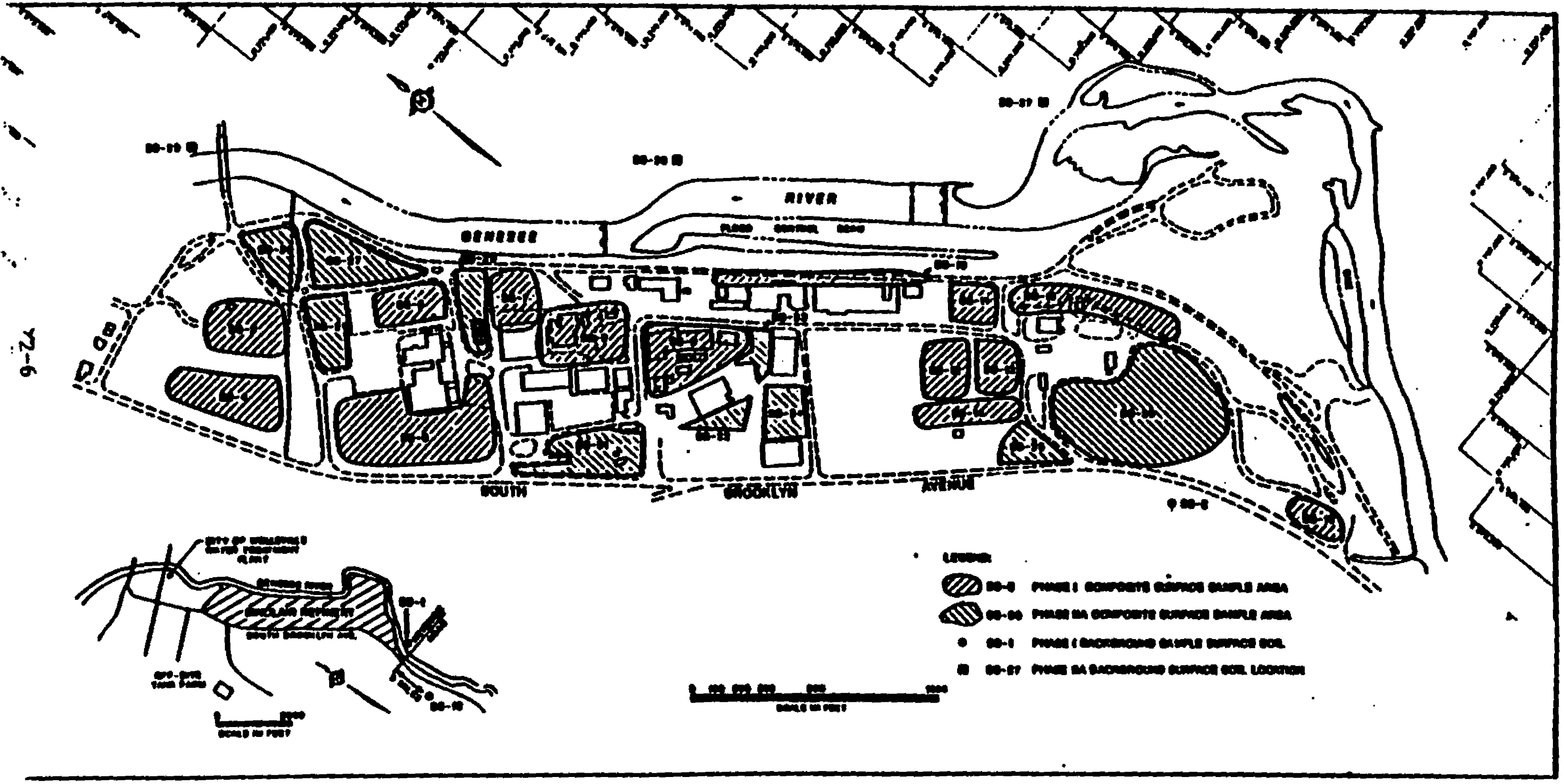


Figure 2-2 Surface Soil Composite Sampling Areas (Ebasco, 1989)

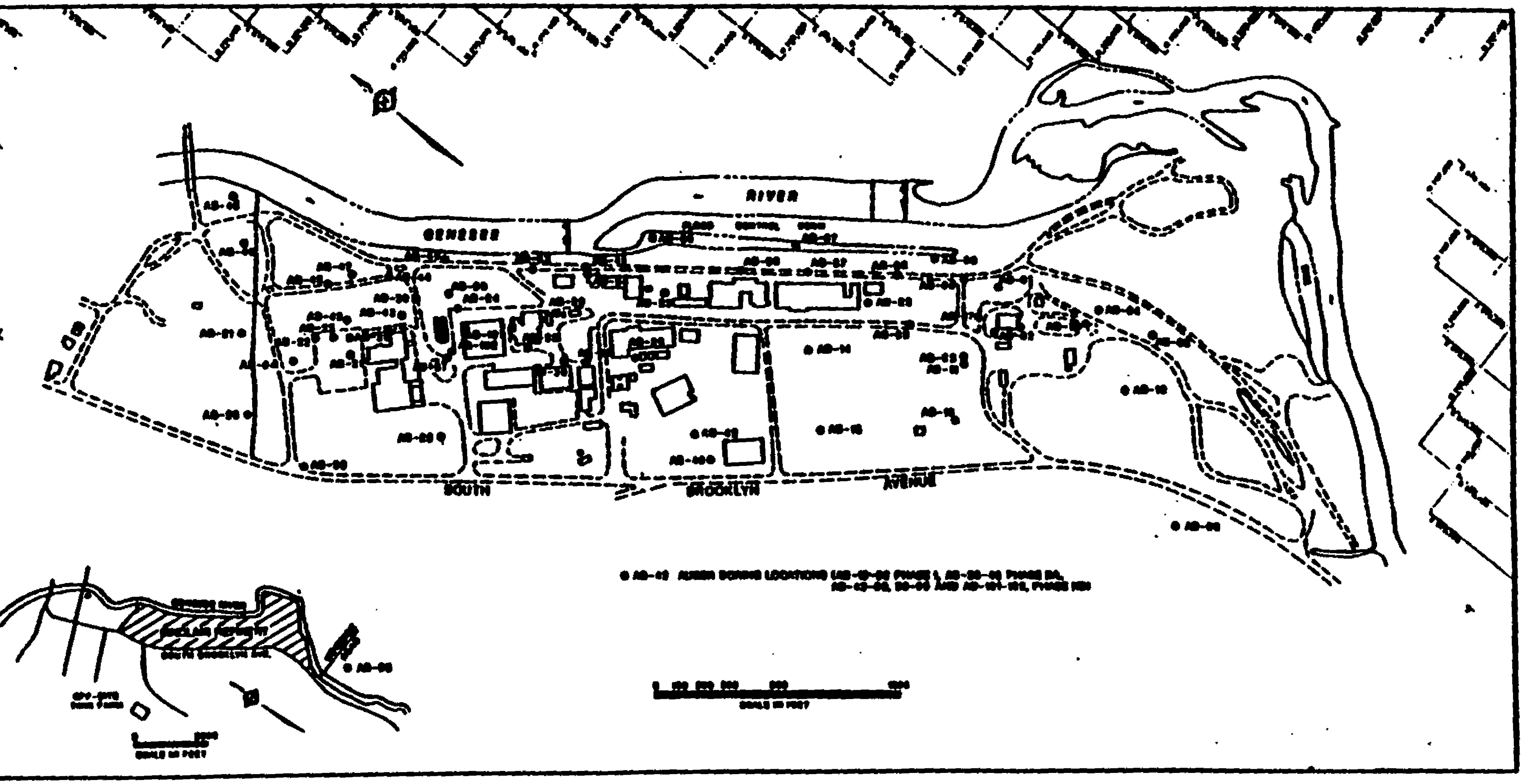


Figure 2-3 Soil Auger Boring Sampling Locations (Ebasco, 1989)

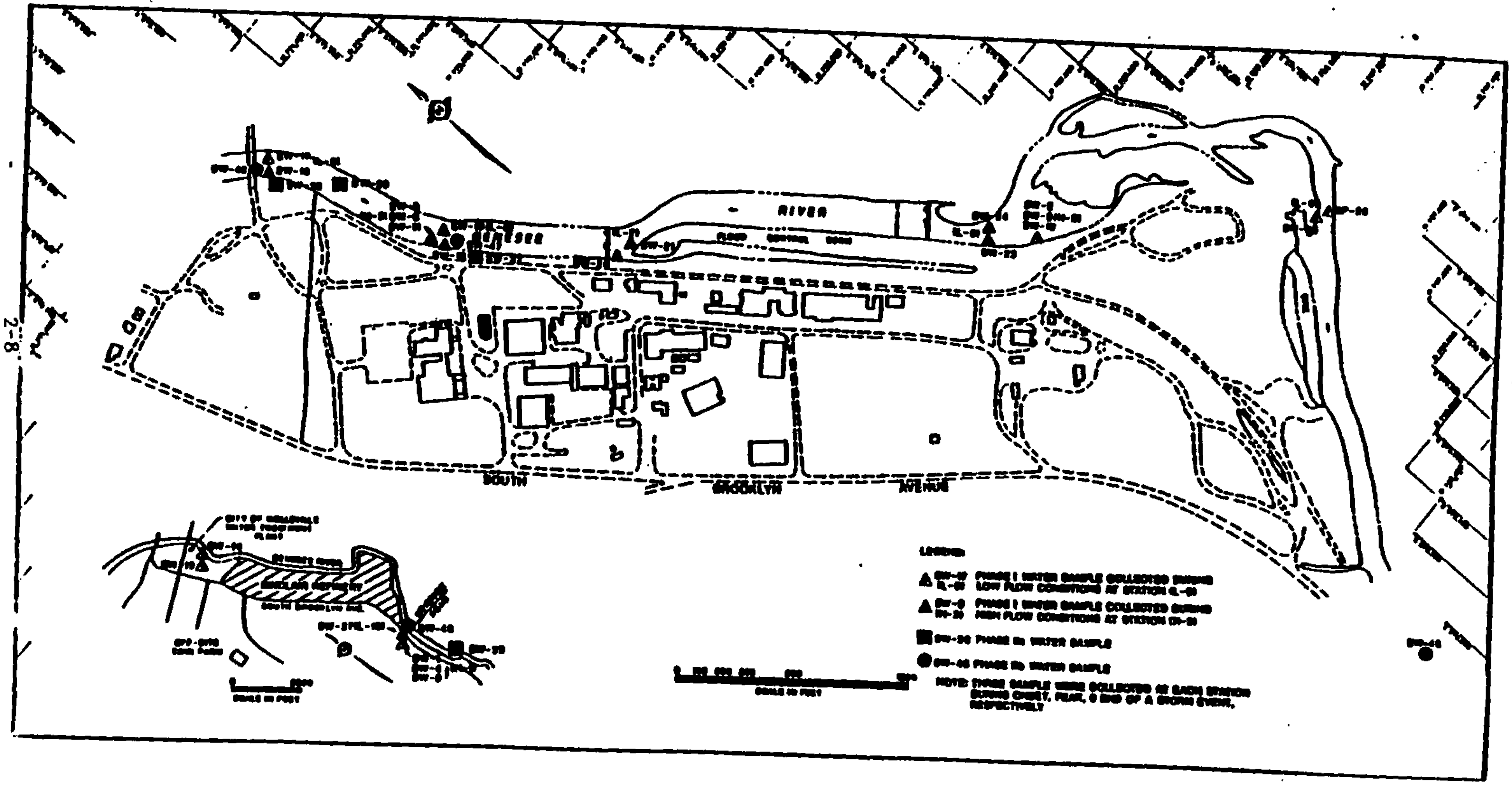


Figure 2-4 Surface Water Sampling Locations (Ebasco, 1989)

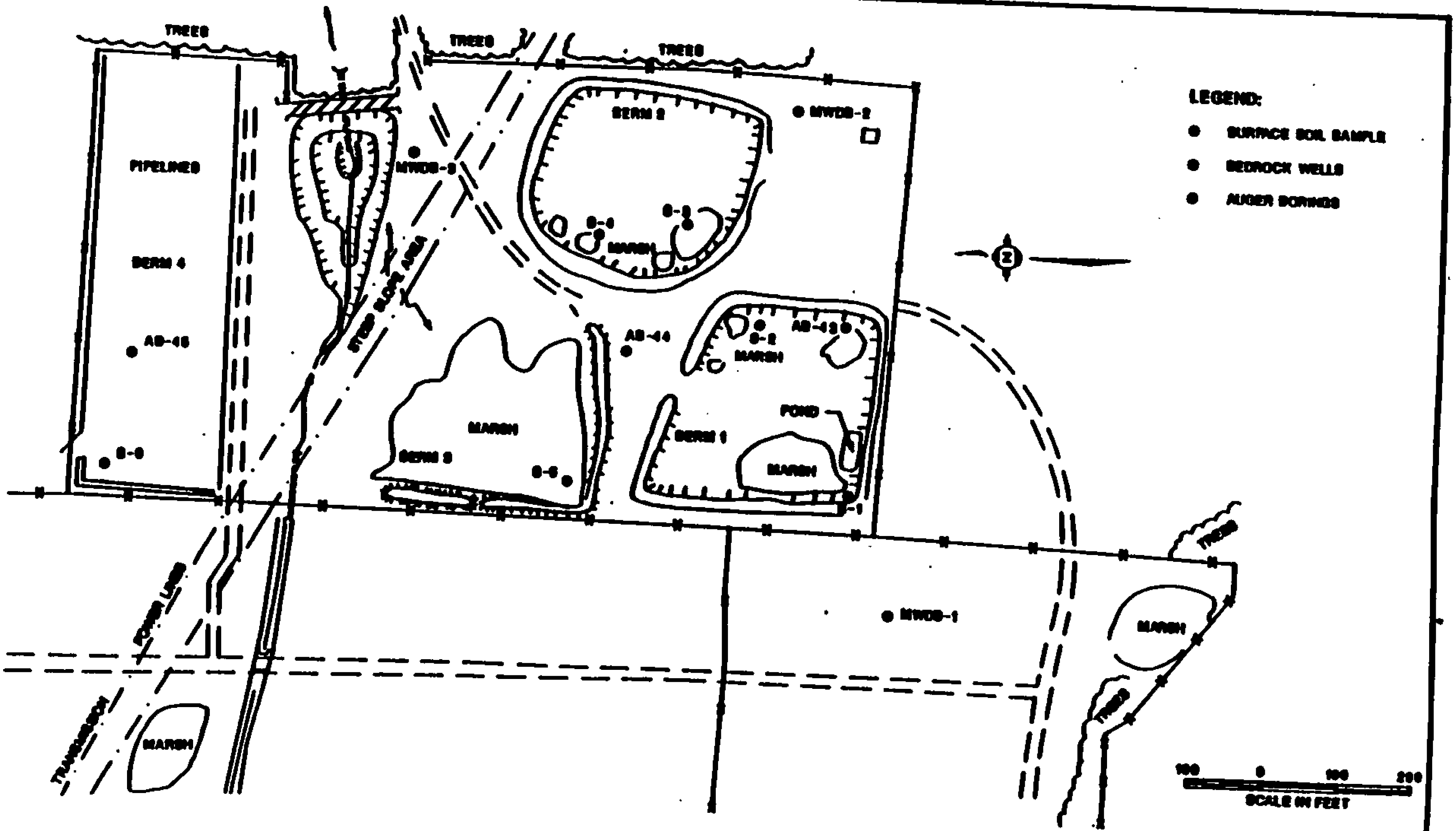


Figure 2-5 Offsite Tank Farm
Sampling Locations (Ebasco, 1989)

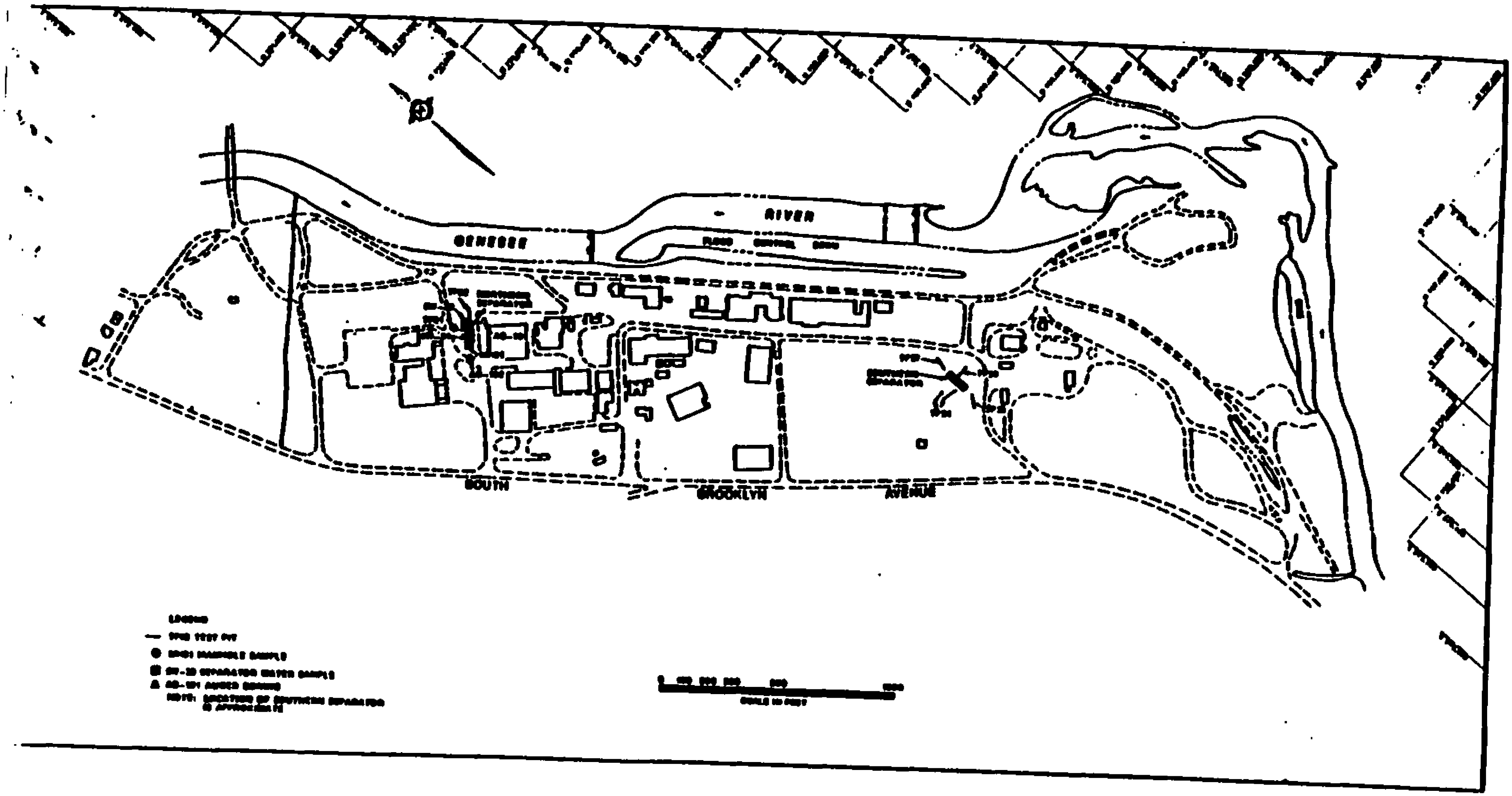


Figure 2-6 Oil Water Separator Sampling Locations (Ebasco, 1989)

Semivolatile organics were predominantly found in soil. Over 30 percent of the semivolatile organic hits were phthalate esters. However, phthalate compounds are common laboratory contaminants, and may not be indicative of site contamination. Additionally, none of the SMC Martin data, comprising over 70 percent of the data, has been validated, so laboratory contamination cannot be discounted. Only four semivolatile organics were present in ground-water samples: nitrobenzene, 2-methylnaphthalene, phenanthrene, and pyrene. Surface water semivolatile organics were detected at a greater frequency than in ground water, suggesting some contribution from the surface soils in the vicinity.

Metal contaminants were prevalent in all media. When compared to ground-water geometric means, MCLs were exceeded for arsenic (50 ppb) and lead (50 ppb). In addition, the secondary drinking water standard for iron (300 ppb) was exceeded. Metal contamination in soils is often difficult to assess since most metals are naturally occurring constituents served from the underlying bedrock. In order to determine if levels of metals found in soil samples at the Sinclair Refinery site represent an increased health risk, comparisons were made to regional ranges and averages. As shown in Table 2-3, the mean concentrations for lead and copper, which typify the region geological formation, were slightly exceeded; however, these levels may be partially attributable to local background levels.

2.2 Contaminant Distribution

This section will focus on both the horizontal and vertical extent of contamination as it relates to soil contamination. It is reasonable to assume that the contamination in the refinery area originally resulted from surface sources (e.g., oil-water separators, operational spills, storage units). Therefore, an evaluation of contaminant distribution trends in the soil will provide useful input in the selection of applicable and significant exposure pathways for exposure assessment.

TABLE 2-3
TOTAL COMPARISON OF METAL CONCENTRATIONS IN SOIL AT SINCLAIR REFINERY SITE

METALS (ppm)	Observed Concentration Ranges	Geometric Mean (All Samples)	Typical Background Concentrations in Tioga Series, N.Y. Soils (a)
ALUMINUM	20 - 22700	254.836	
ANTIMONY	0.68 - 182.3	6.153	
ARSENIC	0.1 - 572	7.738	
BARIUM	20 - 3130	41.489	
BERYLLIUM	0.115 - 51	0.549	
CADMIUM	0.5 - 21.6	0.618	
CALCIUM	500 - 68800	828.590	
CHROMIUM	1 - 96	9.059	
COBALT	2.7 - 25	5.993	
COPPER	1.1 - 1183	17.695	18.8
IRON	10 - 43600	240.242	
LEAD	0.5 - 1190	30.006	15.0
MAGNESIUM	486.5 - 12000	951.622	
MANGANESE	1.5 - 3660	18.078	
MERCURY	0.02 - 9.4	0.045	
NICKEL	0.9 - 357	16.639	26.7
POTASSIUM	14 - 2500	587.232	
SELENIUM	0.125 - 7.9	0.517	
SILVER	0.0235 - 40.7	1.085	
THALLIUM	0.23 - 11.6	1.099	
VANADIUM	4.4 - 30	6.945	
ZINC	2 - 2037	62.039	67.9

Notes: (a) USDA, Soil Conservation Service Study (1985)

Figure 2-7 depicts the relative contaminant levels by class for the shallow, medium, and deep soil strata. As illustrated, the volatile organic compound (VOC) and base/neutral/acid (BNA) concentrations are approximately equivalent in each soil strata. However, metal concentrations in the subsurface soils are significantly higher. This contaminant distribution suggests that subsurface soil contamination, although less available for direct exposure (e.g., soil ingestion, dermal contact), will likely contribute to ongoing ground water contamination as the soluble metals continue to leach.

Because past operations at the refinery site were likely to produce soil contamination at the surface, and because ground-water and surface water contamination often stems from the diffusion of contaminants from the soil, detailed evaluation of the areal distribution of contaminants in surface soils is warranted. Figures 2-8, 2-9, and 2-10 depict the results of analyses of surface soil samples for VOCs, BNAs, and metals as three-dimensional surface reflecting contaminant plots using SURFER®, a computer graphics program (Golden Software, 1989). The plots depicting the areal extent of surface soil contamination are oriented such that the lower left corner of the three-dimensional figures corresponds to the lower left corner of map views of the site presented in this endangerment assessment and the RI report. With this orientation, the view is towards the Genesee River (east) with the northern site features on the left and the southern features on the right. The vertical axis reflects the actual concentration of contaminants, with units of parts per billion.

Salient features at the site are identified and located relative to the concentration surface. In general, contaminant distribution portrayed on these plots indicates higher VOC concentrations in the southern portion of the site, and evenly distributed BNA concentrations towards the eastern portion of the site. The following discussion highlights the anomalous areas of contamination and provides details on the position of those "hot spots" relative to past and present site features.

FIGURE 2-7

CONTAMINANT DISTRIBUTION WITH DEPTH

(BNAs & METALS IN PPT, VOCS IN PPB/10)

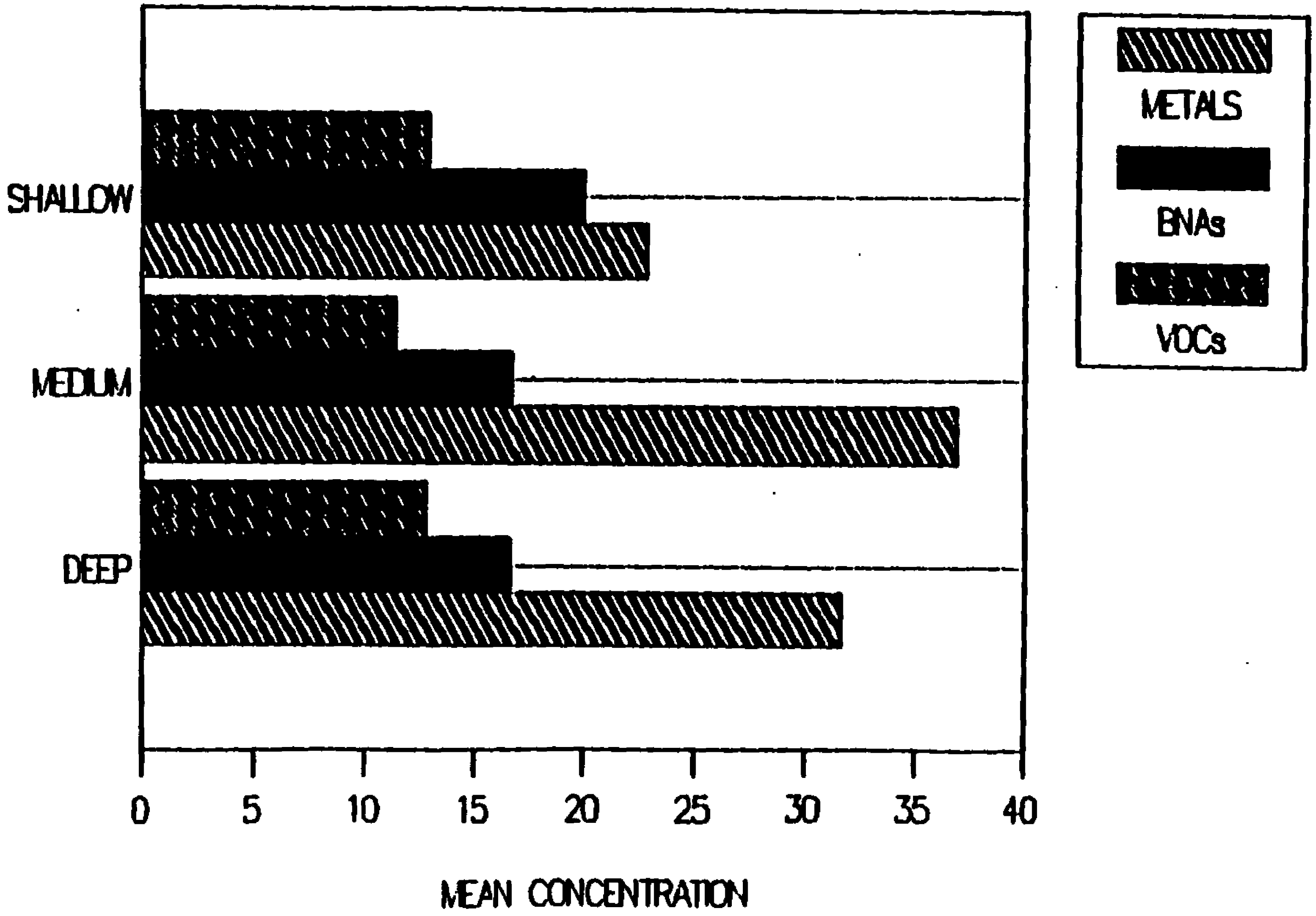


FIGURE 2-8

VOC CONCENTRATIONS IN SURFACE SOILS

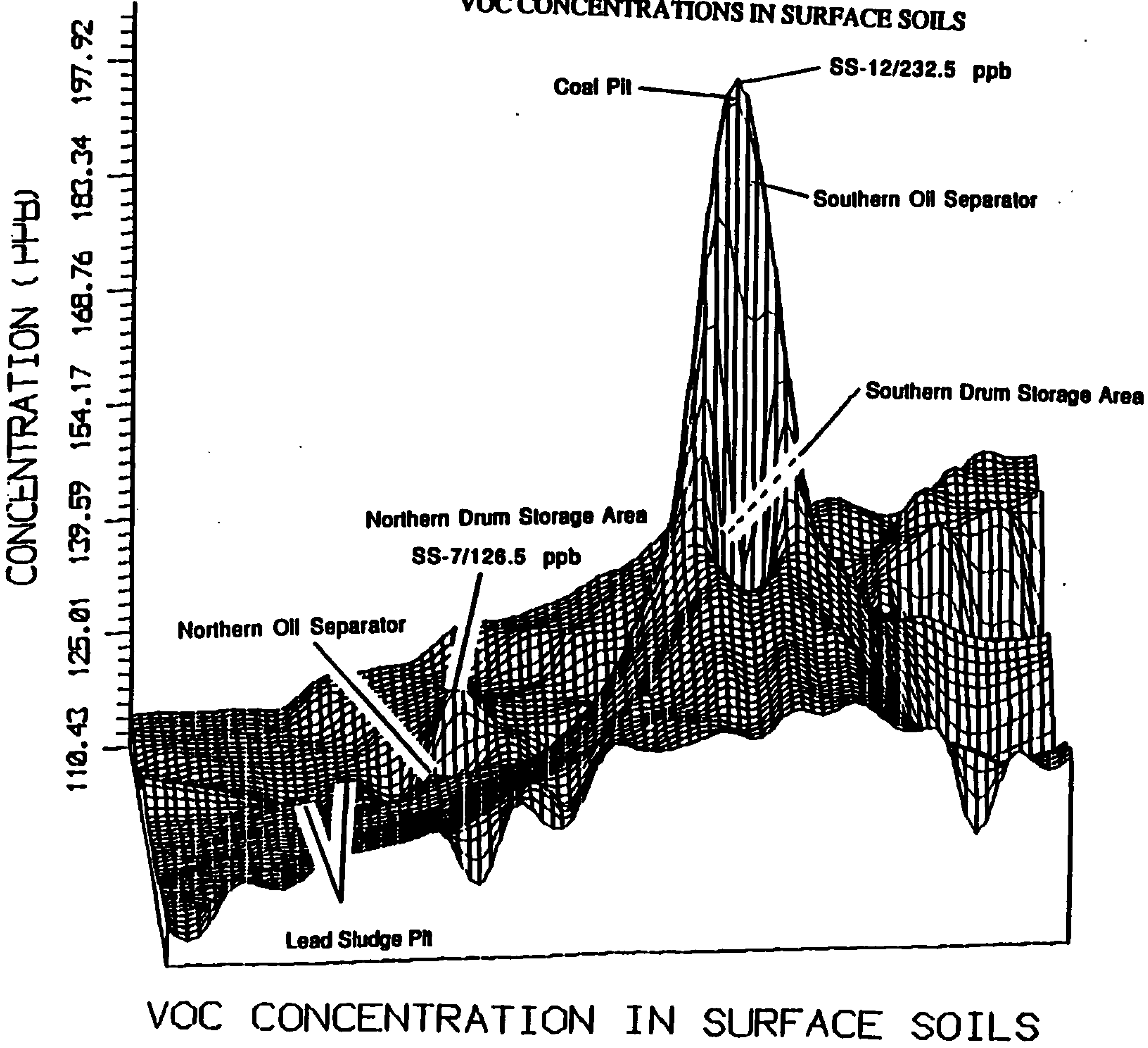
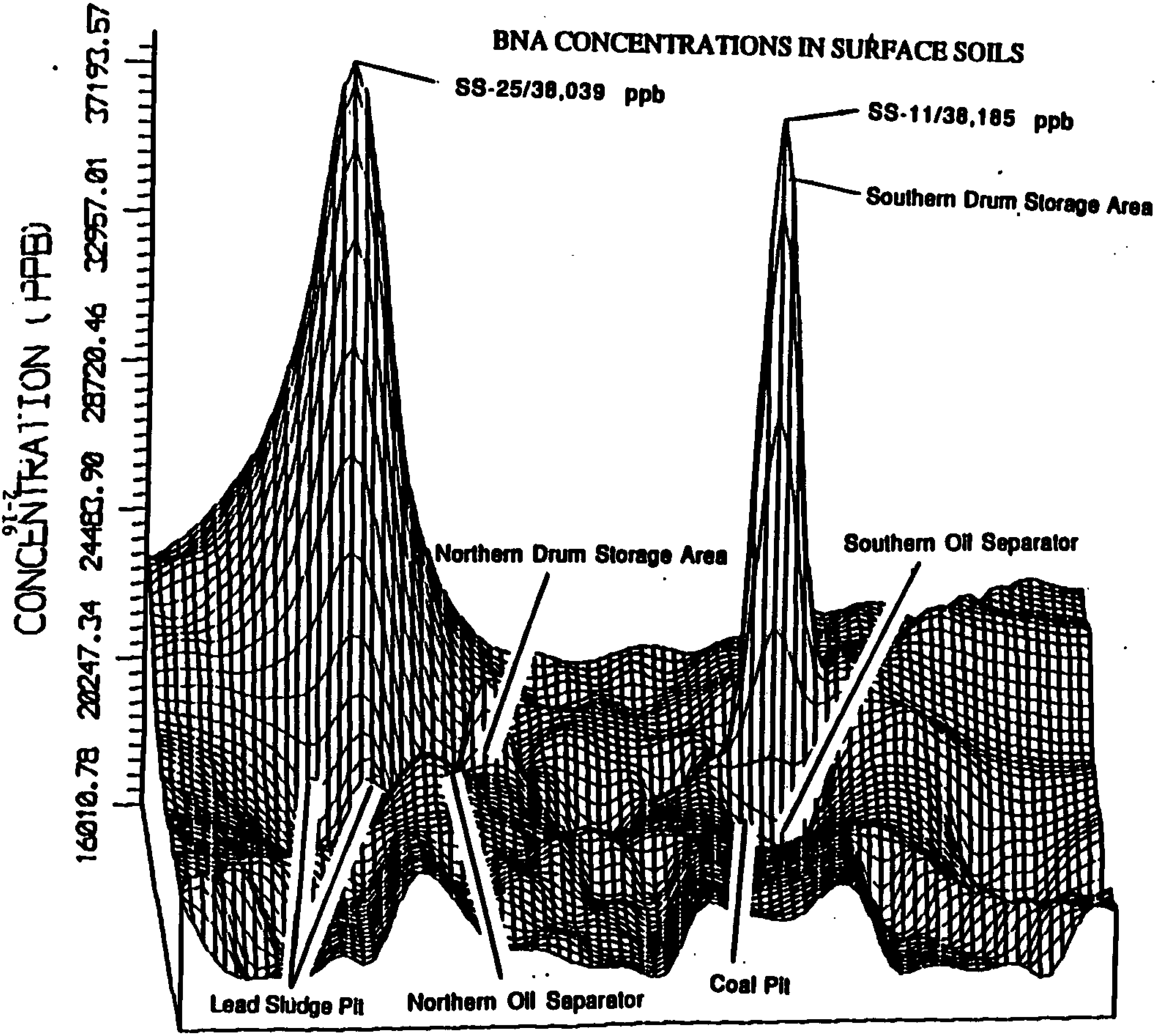


FIGURE 2-9

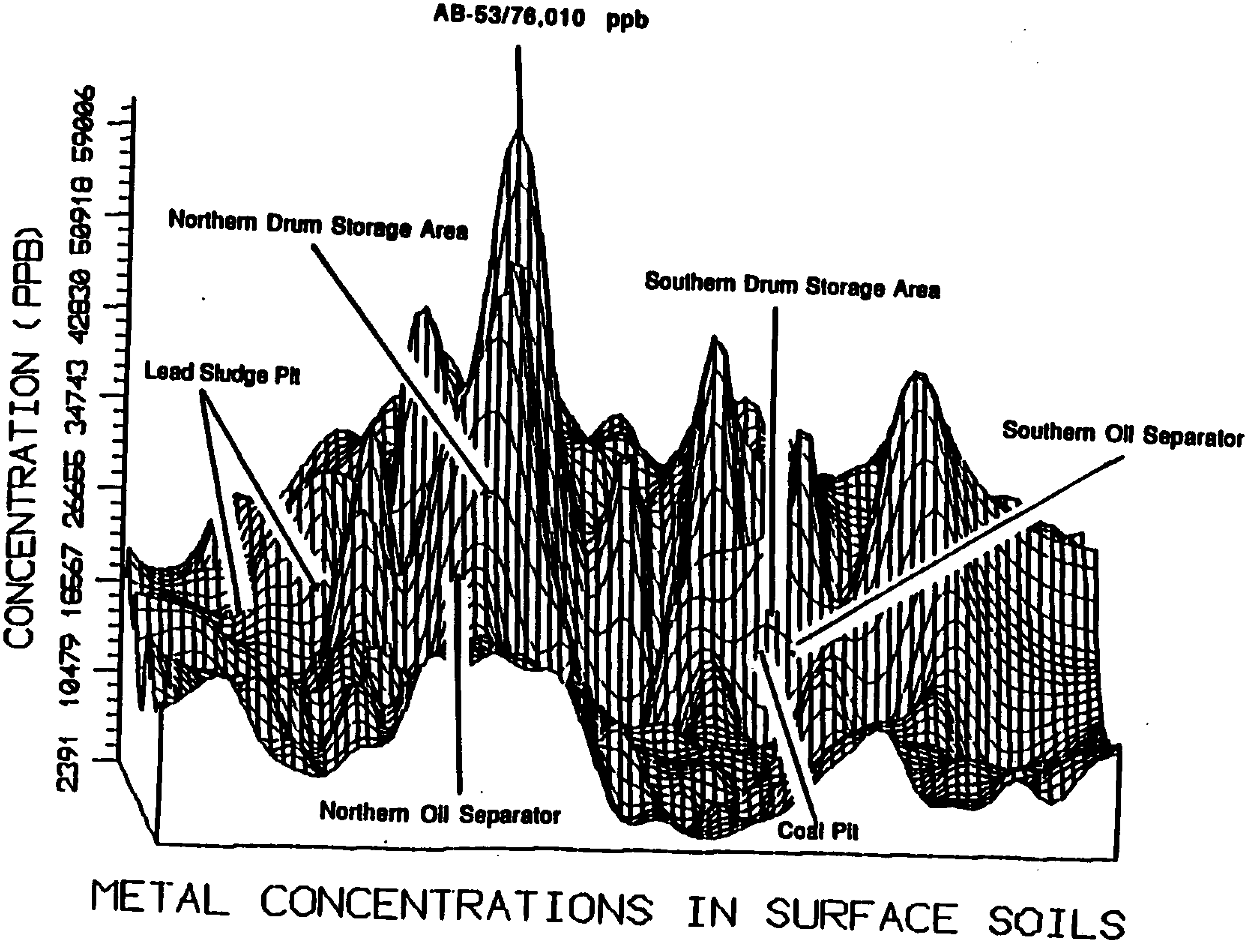
BNA CONCENTRATIONS IN SURFACE SOILS



BNA CONCENTRATION IN SURFACE SOILS

FIGURE 2-10

METAL CONCENTRATIONS IN SURFACE SOILS



An anomalous high peak was generated in the diagram of volatile organic compound concentrations (Figure 2-8). As noted in the figure, this peak (hot spot) has a concentration of 232.5 ppb. This area of maximum contamination is defined by the concentration from analysis of surface soil sample SS-12 which resulted primarily from elevated levels of methyl chloride. This sample was taken at the location of a previously used coal pit, just west of the southern drum storage area and the southern oil separator used at the refinery. Relatively high levels of VOCs are found in the remainder of the southern portion of the site. The anomalous high VOC concentration is approximately 300 feet south of the Mapes Industries facility, 300 feet west of the Otis Eastern storage yard, and 500 feet southeast of the Butler-Larkin facilities. A small peak (126.5 ppb) from sample SS-07 stands out in the otherwise low northern portion of the site. The minor peak is at the same location as the northern drum storage area.

Two very high peaks stand out on the diagram of total concentrations for the base/neutral/acid extractable compounds (Figure 2-9). One high point with a value of 38,185 ppb (from sample SS-11), which resulted from elevated concentrations of a number of compounds such as anthracene, benzo(a)anthracene and benzo(a)pyrene, was identified at the southern drum storage area. This peak in BNA levels is located between the Mapes Industries and Otis Eastern facilities, approximately 200 feet from each. The area around the former coal pit and the southern oil separator contains relatively low levels of contamination. A secondary peak (38,039 ppb from sample SS-25) was identified in the north east portion of the site attributed by elevated levels of phenol and di-n-butylphthalate, and appears to reflect a trend towards increasing concentrations nearer the Genesee River. This secondary peak is located just northeast of the lead sludge pits, the northern oil separator, and the northern drum storage area used at the Sinclair Refinery. The high contaminant levels at this peak are from a drainage swale sample approximately 700 feet north of the National Fuel Company building.

The plot of metal concentrations for the Sinclair Refinery site (Figure 2-10) does not demonstrate significant hot spots or anomalies as were shown in the plots for BNAs and VOCs. Instead, there appears to be a trend of increased concentrations on the eastern portion of the site towards the Genesee River with an area of high values along a line just east of center for the site. The high values range from 40,000 ppb to 75,000 ppb along this area, 25,000 to 40,000 ppb to the east of this area, and 2,500 ppb to 10,000 ppb in the mid-western portions of the site. The northern drum storage area is just west of the highest peak in the diagram (26,010 ppb from sample AB-53).

This evaluation of lateral contaminant distribution is intended to help in the identification process for exposure pathways at the Sinclair Refinery site. By graphically presenting the relationships between contaminant distribution in surface soils, and past and present site features, current and future risk to human health can be more accurately assessed.

2.3 Selection of Chemicals of Potential Concern

This endangerment assessment focuses on site contaminants that have been identified through a screening process as posing potentially the most significant adverse effect on human health or the environment. These "indicator" chemicals are selected based on consideration of the contaminants (1) intrinsic toxicological properties, (2) quantity and prevalence at the site, and (3) physical and chemical properties affecting the mobility through various media.

The indicator chemical selection process was based on the approach outlined in the Superfund Public Health Evaluation Manual (SPHEM October 1986). The geometric mean of the monitoring data concentrations for detected site contaminants was used as the representative concentration value. In cases where a compound was not detected, the geometric mean was calculated using a concentration of 1/2 the detection limit to approximate the compound's concentration. The highest detected concentration ranked and compared for each media separately. The selection process also involved a comparison of the relative prevalence in each impacted media. The final phase of the selection process involved a qualitative evaluation of other pertinent contaminant properties (e.g., vapor pressure, environmental persistence, and solubility) that could influence the extent or rate of release. Table 2-4 shows the calculations used to establish a ranking of the contaminants by media and toxicological effect.

The selection process for the Sinclair Refinery site identified eleven contaminants, including four volatile organic compounds, two semivolatile organic compounds, and five metals. One semivolatile compound, benzo(a)pyrene was not detected in any samples collected from the offsite tank farm. Benzo(a)pyrene will not be evaluated for the offsite tank farm.The selected chemicals upon which this endangerment assessment will be based are listed below.

<u>Chemicals of Potential Concern</u>

Volatile Organic Compounds

methyl chloride (chloromethane)
trichloroethene
benzene
xylene

Semivolatile Organic Compounds

nitrobenzene
benzo(a)pyrene (excluded for the offsite tank farm)

Inorganic Metals

arsenic
barium
lead
nickel
zinc

The following section will evaluate the migration routes and related exposure pathways for each of these contaminants of concern. The receptors and resulting chemical intakes will then be estimated based upon either monitoring data or conservative dispersion modeling approaches that use data from identified waste sources.

TABLE 2-4
RANKINGS FOR INDICATOR CHEMICAL SELECTION

	HITS			MEAN (PPB)			MAX (PPB)			ORAL			RfD	Wt. of Ev.	IS VALUE				RANK			
	GW	SW	SL	GW	SW	SL	GW	SW	SL	AIS	AIC	CPF			NON-CARCINOGENS		CARCINOGENS		NC	NC	PC	PC
VOAs															ISMAX	ISMEAN	ISMAX	ISMEAN	MEAN	MAX	MEAN	MAX
PC VINYL CHLORIDE	5			0.41			460					2.95E-01	10	A	40.36	0.561700	1.0734	0.027481	16	15	8	7
NC METHYL CHLORIDE	30	8	64	0.04	7.53	12.30	260	9700	4964		6.00E-02	7.50E-03	10	B2	877.9	0.018378	13.07135	0.010771	6	13	6	8
NC ACETONE	90	18	65	40.74	10.07	31.13	8500	8000	78000				8		142	0.600350	0	0	12	14		
NC TRANS-1,2-DICHLOROETHENE	8	11	3	3.55	3.07	2.04	6400	3300	2970				8		330.6	0.209932	0	0	10	10		
NC 2-BUTANONE		8	12		7.53	0.79		6800	36000	5.00E-01	5.00E-02		10		52.71	0.058305	0	0	14	24		
PC TRICHLOROETHENE	2	6	1	2.04	3.35	2.06	660	5000	5900			1.10E-02	8	B2	5250	3.015203	10.00050	0.006696	3	6	7	10
PC BENZENE	3	13	41	23.12	3.45	3.05	1200	3300	1450			2.90E-02	8	A	306.1	2.030079	25.44356	0.193051	9	9	4	9
NC 4-METHYL-2-PENTANONE	8	2	8	6.01	6.01	6.02	3300	20000	5100	5.00E-01	5.00E-02		6		614	0.212170	0	0	7	17		
PC 1,1,2,2-TETRACHLOROETHANE	3		9	2.07		3.17	21		2100				8	C	9.003	1.214909	1.000377	0.126572	19	11	10	6
NC TOLUENE	33	5	11	2.66	0.60	0.09	530	54	1600.5	4.00E-01	3.00E-01		7		2.790	0.013045	0	0	22	25		
NC ETHYLBENZENE	32	7	12	7.74	3.29	3.07	1100	3000	3600	1.00E+00	1.00E-01		4		41.8	0.005125	0	0	15	21		
NC TOTAL XYLENES	30	0	22	16.65	3.71	4.63	1700	2700	26000	4.00E+00	2.00E+00		10		11.90	0.073201	0	0	18	22		
															0	0	0	0				
															0	0	0	0				
NC PHENOL	3	2	8	5.47	5.01	159.00	43	15	1100	4.00E-01	4.00E-02		4		8.051	1.024155	0	0	21	12		
NC 1,4-DICHLOROBENZENE		4			4.90			29				2.40E-02	4	B2	1.905	0.250376	0	0	23	16		
NC NITROBENZENE	4	7	2	7.10	5.02	104.54	8200	20	240	5.00E-03	5.00E-04		-		0	0	0	0				
- 2-METHYLNAPHTHALENE	20	3	20	13.82	5.01	229.03	340	710	37000				-		0	0	0	0				
DIBENZOFURAN			6			103.56			670						0	0	0	0				
- N-NITROSODIPHENYLAMINE	3	5	4	8.66	5.70	107.48	100	970	500			4.90E-03	-	B2	0	0	0	0				
PC PHENANTHRENE	7	3	29	6.22	5.72	101.09	90	240	22000				-		0	0	0	0				
NC DI-n-BUTYLPHTHALATE	16	7	45	6.15	4.04	345.99	35	5	6800				8		1.346	0.196745	0	0	24	19		
PC PYRENE	4	2	24	5.39	5.70	151.43	24	100	30000				-		0	0	0	0				
- BUTYLBENZYLPHTHALATE		7	31		5.93	107.30		1710	1900						0	0	0	0				
PC BENZO(a)ANTHRACENE			15			107.04			17000					B2	0	0	0.4947	0.004804			11	11
PC BIS(2-ETHYLHEXYL)PHTHALATE	24	12	30	13.32	0.23	364.07	690	4360	135000				-		0	0	2.493421	0.007617			8	9
PC BENZO(k)FLUORANTHENE		6	15		0.60	199.30		575	22000						0	0	0	0				
PC BENZO(a)PYRENE	12	1	10	5.94	5.04	103.00	13	7.1	19000				8	B2	0.374	0.159567	84.42	27.29339	25	20	3	2
															0	0	0	0				
															0	0	0	0				
- AL	34	7	94	370.96	87.44	254035.90	113000	856	22700000				-		0	0	0	0				
NC SB			10			6152.72			102300		4.00E-04		10		39.50	1.335141	0	0	17	18		
PC AS	20	7	108	10.09	6.30	7730.24	684	89	572000		1.00E-03		8	A	2117	122.0558	3713.996	70.30506	8	3	1	1
NC BA	47	10	94	230.61	103.70	41408.69	2350	260	3130000		5.00E-02		10		10287	949.362	0	0	1	1		
PC BE	9	1	100	2.59	2.53	940.70	7.6	4	51000		5.00E-03		-	B2	0	0	23.142	5.961104			5	4
NC CU		4	215		12.33	17695.49		33	1183000				5		65.79	9.441720	0	0	13	6		
NC FE	59	7	95	920.00	89.15	240242.41	280000	20300	43600000				-		0	0	0	0				
NC PB	23	13	224	7.55	5.10	30006.37	249	155	1190000				10		275.4	0.077394	0	0	11	7		
NC MN	50	10	86	121.80	21.03	18078.19	31500	8970	3460000	5.00E-01	2.00E-01		-		0	0	0	0				
NC HG		5	71		0.12	44.90		2.2	9400	2.00E-03	2.00E-03		7		9.062	0.083668	0	0	20	23		
PC NI	24	14	201	23.99	32.98	16630.55	362	1622	357000	2.00E-02	2.00E-02		10		6900	144.0444	375.6435	7.744063	2	2	2	3
NC VA	18		93	24.78		6945.87	149		30000	7.00E-03	7.00E-03		6		564.4	94.21700	0	0	8	4		
NC ZN	75	21	212	600.09	19.17	62039.08	21500	330	2037000	2.00E-01	2.00E-01		8		2311	73.74102	0	0	4	5		

3.0 EXPOSURE/TOXICITY ASSESSMENT

This section will begin with a discussion of the physical and chemical characteristics of the contaminants of potential concern at the site. The exposure setting will then be characterized with respect to the spacial distribution of contamination. Next, the potential contaminant migration pathways will be defined for each impacted media. Finally, chemical exposures will be estimated for the significant pathways.

3.1 Fate and Transport/Toxicity Summary

This section includes a summary of the fate and transport mechanism for each chemical of concern along with a condensed toxicity profile including Federal/State health based standards. A more comprehensive analysis of these topics for each chemical is appended to this report. Intermedia transfer of contaminants from soil to either the air or ground water are considered potential migration pathways for the Sinclair Refinery Site. Table 3-1 summarizes the standards for the contaminants.

3.1.1 Methyl Chloride

Methyl chloride (chloromethane) (CH_3Cl) is a gas at normal temperatures; it has a boiling point of -23.7°C. The low organic carbon partition coefficient (Koc), which is a measure of the tendency for organics to be adsorbed by soil or sediment, of methyl chloride (35 mg/g) and high water solubility (6,450-7250 mg/l) indicate loose bonding with soil particles and therefore the chemical is most likely to be found in water and air. The high vapor pressure of methyl chloride (4,310 mmHg) suggest that the major transport and fate mechanism is volatilization from soil and surface water.

Reference doses and carcinogenic potency factors are not available for methyl chloride. The Occupational Safety and Health Act (OSHA) Permissible Exposure Limit - Time Weighted Average (PEL-TWA) is 210 milligrams per cubic meter (mg/m^3). MCLs and New York ambient water quality standards are not established for methyl chloride. The New York

TABLE 3-1
ENVIRONMENTAL STANDARDS

	OSHA PEL-TWA[1] (mg|m^3)	EPA MCL[2] (ug|l)	NY Ambient Ground Water Criteria[3] (ug|l)	EPA WQC For Protection Of Aquatic Life Freshwater Acute Toxicity[2] ug/l	EPA WQC For Protection Of Aquatic Life Freshwater Chronic Toxicity[2] ug/l	AWQC For Protection Of Human[2] Health (mg|l) ug/l
Methyl Chloride	105	ND	50 (guidance value)	ND	ND	
Trichloroethene	270	5	10	45,000*	ND	
Benzene	30	5	"Not Detected"	5,300*	ND	
Xylene	435	10,000	50 (guidance value)	ND	ND	
Nitrobenzene	ND	ND	30 (guidance value)	27,000	ND	
Benzo (a) Pyrene	ND	ND	"Not Detected"	ND	ND	
Arsenic	0.2	50	25	ND	ND	
Barium	0.5 (sol. comp)	5,000	1,000	ND	ND	
Lead	0.05	50	25	80**	3.2**	50 ug/l
Nickel	1.0	50	ND	1,400**	60**	23.4 ug/l
Zinc	5(zinc oxide)	5,000 (SMCL)	5,000	130	110	5 (organoleptic)

ND - Not determined, no data available

* - Lowest value known to be toxic

** - Hardness dependent criteria (100 mg/l used)

[1] ACGIH, Threshold Unit Value and Biological Exposure Indices for 1988-89

[2] CERCLA Compliance With Other Laws Manual, August 8, 1988

[3] NYSDEC Ambient Water Quality Standards and Guidance Values

ambient ground-water quality guidance is 50 ug/l. The EPA ambient water quality criteria for the protection of human health estimates a carcinogenic risk of 10^{-6} with a lifetime exposure of 0.19 micrograms per liter (ug/l). Criteria for the protection of aquatic life have not been determined.

3.1.2 Trichloroethene

Trichloroethene (C_2HCl_3) has a Koc value of 126 mg/g indicating that it forms loose bonds with soil particles. This factor in addition to a high water solubility of 1,000 mg/l, gives trichloroethene a significant leaching potential.

It does, however, possess some ability to adsorb to organic materials and will bioaccumulate to a certain extent. The significant transport and fate mechanism for trichloroethene is volatization from soil and surface water (vapor pressure = 60 mmHg).

Trichloroethene is a probable human carcinogen (EPA Group B2) with a carcinogenic potency factor of 1.3×10^{-2} $(mg/kg/day)^{-1}$ for the inhalation route and 1.1×10^{-2} $(mg/kg/day)^{-1}$ for the oral route. Reference doses have not been established for trichloroethene. The OSHA PEL-TWA for trichloroethene is 540 mg/m^3. The EPA has set the MCL at a stringent 5 ug/l and the New York ambient groundwater (source of potable water supply) quality standard was set at 10 ug/l. The EPA has reported the lowest value known to be toxic (acute) in aquatic organisms for freshwater to be 45 mg/l. The EPA has estimated a human carcinogenic risk of 10^{-6} associated with a lifetime exposure to a concentration of 2.7 ug/l.

3.1.3 Benzene

Benzene's (C_6H_6) relatively low Koc value (83 mg/g) and relatively high water solubility (1,780 mg/l) indicate that it has a tendency to leach from the soil. Its major transport process is volatization from soil and surface water (vapor pressure = 75 mmHg). Data have shown that benzene may be photo-oxidized rapidly in the atmosphere and thus atmospheric destruction of benzene is the significant fate process (Clement, 1985).

Benzene is an identified human carcinogen (EPA Group A) with a carcinogen potency factor of 2.9 x 10^{-2} [$(mg/kg/day)^{-1}$] for both the oral and inhalation routes. Reference dose have not been established for benzene. The OSHA PEL-TWA is 10 mg/l. The EPA has set the MCL for benzene at a stringent 5 ug/l. The New York ground-water quality standard was set at "not detectable". The EPA has reported the lowest value known to be toxic (acute) in aquatic organism for freshwater to be 5,300 ug/l. The EPA has estimated a human carcinogenic risk of 10^{-6} associated with a lifetime exposure of 0.66 ug/l.

3.1.4 Xylene

Xylene [$C_6H_4(CH_3)_2$] has a relatively high Koc value of 240 mg/g and a comparatively low solubility of 160 mg/l. It has a tendency to bind with sediment in water and with organics in soil. Xylene therefore has a small potential for leaching into ground water. The significant transport and fate of xylene are volatilization (vapor pressure = 10 mmHg) and ultimately photo-oxidation (Clement, 1985).

Reference dose and carcinogenicity have not been determined for xylene. The OSHA PEL-TWA is 435 mg/m^3. The U.S. EPA has not promulgated an MCL for xylene (the proposed maximum contaminant level is 440 ug/l). New York has not promulgated an ambient water quality standard (the ambient ground-water quality guidance value is 50 ug/l).

3.1.5 Nitrobenzene

Nitrobenzene has a relatively high solubility (1,900 mg/l) and low Koc value (35 mg/g). These factors indicate that leaching and surface water runoff are the major transport processes from nitrobenzene. The aquatic fate of nitrobenzene includes both photochemical and biological degradation.

Reference doses for nitrobenzene are 6 x 10^{-3} mg/kg/day (subchronic) and 6 x 10^{-4} mg/kg/day (chronic) for the inhalation route, and 5 x 10^{-3} mg/kg/day (subchronic) and 5 x 10^{-4} mg/kg/day (chronic) for the oral route. The EPA and the NYSDEC have not determined ambient water quality criteria for nitrobenzene. The New York ambient ground-water (source of potable water supply) quality guidance value is 30 ug/l.

3.1.6 Benzo(a)Pyrene

Benzo (a) pyrene is virtually insoluble in water (solubility = 1.2 ug/l) and has an extremely high Koc value (5,500,000 mg/g). As a result, benzo (a) pyrene will adsorb onto suspended particulates and organic matter and be transported by runoff. The fate of benzo(a)pyrene is believed to be biodegration and biotransformation.

Benzo (a) pyrene is a probable human carcinogen (EPA Group B2) with a carcinogenic potency factor of 1.15 x 10^{+1} $(mg/kg/day)^{-1}$ for the inhalation route and 6.1 $(mg/kg/day)^{-1}$ for the oral route.

Reference doses have not been determined for benzo(a)pyrene and EPA has not promulgated any water quality criteria. The New York groundwater (source of potable water supply) quality standard is a stringent "not detectable".

3.1.7 Arsenic

Arsenic (As) is a metal that can be found in both organic and inorganic compounds and can exist in any of four valence states. Arsenic is generally insoluble in water; although some salts are soluble. Mobility of arsenic differs with the state of the chemical, but arsenic is generally highly mobile. Important transport processes for arsenic are sorption by sediment and volatization during high biological activity (arsenic is metabolized by some organisms) (Clement, 1985).

Arsenic is a human carcinogen (EPA Group A). It has a carcinogenic potency factor of 50 $(mg/kg/day)^{-1}$ for the inhalation route and 15 $(mg/kg/day)^{-1}$ for the oral route. Reference doses for arsenic have not been determined. The OSHA PEL-TWA for arsenic is a stringent 500 ug/m^3. The EPA has set the MCL at 50 ug/l and the New York ambient ground-water (source of potable water supply) quality standard is an even lower 25 ug/l. The ambient water quality criterion (USEPA) for the protection of aquatic life (freshwater acute toxicity) is 440 ug/l. The freshwater chronic toxicity criterion has not been determined. The EPA has estimated a human carcinogenic risk of 10^{-5} associated with a lifetime exposure concentration of 0.01 to 1.8 mg/l (U.S.EPA 1989c).

3.1.8 Barium

Barium (Ba) is an insoluble metal that decomposes in water and will form insoluble carbonate or sulfate salts. Barium is generally found in surface and ground waters only in extremely small amounts. Insoluble compounds of barium are not highly toxic, however, barium may become soluble and toxic when combined with chlorides or other ions (Clement, 1985). The major transport and fate process for barium is sediment runoff.

Reference doses for the inhalation route are 1×10^{-3} mg/kg/day subchronic and 1×10^{-4} mg/kg/day chronic, and for the oral route is 5×10^{-2} mg/kg/day for both subchronic and chronic. There are no indications that barium is carcinogenic. The OSHA PEL-TWA is 0.5 mg/m^3 (for soluble compounds). The EPA has set the MCL at 1,000 ug/l and the New York ambient ground water (source of potable water supply) quality standard was set at a low 1.0 mg/l.

3.1.9 Lead

Lead (Pb) is a metal that can be found in three oxidation states. Lead is generally insoluble, although some organic compounds are soluble. Most compounds of lead are not highly mobile in surface and ground water. Major transport and fate processes are atmospheric particulate movements with eventual photolysis and adsorption to inorganic solids and organic materials in aquatic environments.

Lead is a probable human carcinogen (EPA Group B2). Reference doses and a carcinogenic potency factor have not been determined. The OSHA PEL-TWA for lead is 50 ug/m^3. The EPA has set the MCL at 50 ug/l and the New York ambient water quality standard for ground-water (source of potable water supply) was set at a lower 25 ug/l. The EPA ambient water quality criteria for the protection of aquatic life for active lead is $e^{(1.34\ [\ln\ (\text{hardness})]\ -\ 2.014)}$ ug/l (freshwater acute toxicity) and $e^{(1.34\ [\ln\ (\text{hardness})]\ -\ 5.245)}$ ug/l. For the protection of human health, the criterion is 50 ug/l.

3.1.10 Nickel

Elemental nickel (Ni) is insoluble although many nickel compounds are highly soluble. The high solubility of nickel compounds makes nickel a highly mobile metal. In the aquatic environment, sorption and coprecipitation with hydrous iron and manganese oxides make leaching and surface runoff important transport processes for nickel while incorporation into bed sediments is an important fate, although much of the nickel will be deposited to the oceans (Clements, 1985).

Nickel, in the form of refinery dust and nickel subsulfide, is a human carcinogen with carcinogenic potency factors of 0.084 $(mg/kg/day)^{-1}$ (refinery dust) and 1.7 $(mg/kg/day)^{-1}$ (nickel subsulfide). The reference doses for the oral route are 2.0×10^{-2} mg/kg/day for both subchronic and chronic. Reference doses for the inhalation route have not been determined. The OSHA PEL-TWA is 1 mg/m^3. The EPA has not promulgated an MCL for nickel. The New York ambient surface water quality standard and the EPA ambient water quality criteria for the protection of aquatic life (freshwater chronic toxicity) for nickel are $e^{(0.76\ [\ln\ (\text{hardness in ppm})]\ +\ 1.06)}$. A New York standard for ground water has not been determined. For the protection of human health, the criterion is 13.4 ug/l.

3.1.11 Zinc

Zinc (Zn) is a relatively mobile metal that may be found in both suspended and dissolved forms. Leaching from soil or sediment runoff appear to be major transport processes for zinc while sorption of the divalent cation by hydrous iron and manganese oxides, clay mineral, and organic material is an important fate.

The reference doses for the oral route are 2 x 10^{-2} mg/kg/day for both subchronic and chronic. Reference doses for the inhalation route have not been determined. The OSHA PEL-TWA is 5 mg/m^3 for zinc oxide. The EPA has not promulgated an MCL for zinc (the secondary maximum contaminant level (SMCL) is 5,000 ug/l). The New York ambient ground-water (source of potable water supply) quality standard is also 5,000 ug/l. The EPA ambient water quality criteria for the protection of aquatic life is $e^{(0.83 (\ln (\text{hardness})] + 1.95)}$ ug/l (freshwater acute toxicity) and 47 ug/l (freshwater chronic toxicity). For the protection of human life the organoleptic criterion is 5 mg/l.

3.2 Characterization of Exposure Setting

The physical setting for the Sinclair Refinery site, and the offsite tank farm, plays an important role in evaluation of potential exposures and risks. The following sections summarize the salient features of physical setting as they apply to the assessment of risk. A more detailed discussion of the physical characteristics of the site is found in the RI report prepared by Ebasco (1989).

3.2.1 Geology/Hydrogeology

The Sinclair Refinery site is located in Western New York in the Allegheny Plateau region of the Appalachian Uplands Physiographic province. This geologic region is characterized by Devonian and Upper Mississippian sandstone, shale, and conglomerate overlain by unconsolidated pleistocene and holocene glacial and fluvial deposits. Oil and gas wells are present in the vicinity of the site and several large oil fields are located to the north and south (Ebasco 1989).

The site itself is immediately underlain by fill material composed of sand, silt, clay, gravel, slag, concrete, and construction debris. This fill, which ranges from 0.5 to 8 feet thick, was dominantly used in the central portion of the site for grading purposes. Discontinuous fifteen to thirty foot thick fluvial sand, silt, clay, and gravel deposits comprise the uppermost natural soils at the site (Ebasco 1989).

Glacial deposits, which directly underlie these surface soils, are dominated by up to 100 feet of glaciolacustrine clay. Monitoring wells that penetrated the clay deposit encountered gravel, sand, and silt below. In most areas of the site, the clay layer was encountered at between 15 and 30 feet below the surface. In the northwestern portion of the site, the clay was found to be more variable in depth and thickness. In one of the auger borings, the clay was never encountered in the 50 foot deep hole. Two nearby wells encountered thin clay beds at depths of 64 and 75 feet, while a third nearby well encountered 10 feet of clay at a depth of 15 feet. This irregularity is attributed to ancient river channels that have dissected the glaciolacustrine clay deposits (Ebasco 1989).

No wells or borings on the site were drilled to bedrock. However, at the off site tank farm, auger borings encountered bedrock at depths between 9 and 27 feet. An earlier seismic profile indicates that the bedrock under the site dips steeply from approximately 70 feet below South Brooklyn Avenue to more than 250 feet below the Genesee River (Ebasco 1989).

Information obtained from the RI suggests that there are at least three hydrologic units beneath the site: an upper aquifer of recent fluvial deposits, an aquitard of glaciolacustrine clay, and one more lower aquifer of glacial sands. Sandy, silty, and gravelly soils comprise the 10 to 20 foot thick upper (water table) aquifer, which includes the saturated fluvial deposits overlying the glaciolacustrine clay. Lenses as much as 1,000 feet long and 15 feet thick of less permeable clay and silty clay have been encountered in the upper aquifer. A laterally extensive glaciolacustrine clay and silty clay deposit underlies the surface aquifer. Variable thickness within this aquitard, or confining layer, is due to the presence of ancient river channels. The lower (confined) aquifer, which is composed of glacial sands, silts, and clays, is 70 to 250 feet thick and extends down to bedrock beneath the site (Ebasco 1989).

Hydrologic properties of the water table aquifer were determined through well observation and well tests. The potentiometric surface was evaluated to generate hydraulic gradients for the site. The highest hydraulic gradients (1.6 feet per 100 feet) were identified in the northern and southern portions of the site, with minimum values (0.6 feet per 100 feet) in the central area. Ground-water flow is generally into the Genesee River from the west and southwest. Two pump tests and 20 slug tests performed on the water table aquifer yielded hydraulic conductivities from 5 to 245 feet per day (Ebasco 1989). Pump test data for well MW-56 indicate an apparent boundary condition in the aquifer, which was interpreted as an aquifer inhomogeneity with an area of low transmissivity farther away from the well. Pump tests from well MW-57 produced anomalous data, where a portion of the data was masked by later values. Pump tests used to determine aquifer properties may have provided inconsistent conclusions but the differences in hydraulic properties between the northern and central portions of the site were apparent in the pump test results. Slug test results provided support for the pump test data but are considered less accurate than the pump test method (Ebasco 1989). Infiltration at the site was determined using double-ring infiltrometer tests. Results indicate the highest infiltration rates were in the central portion of the site where the cover material is dominantly well sorted sand. Low infiltration rates from the northern portion of the site are attributable to the poorly sorted and clayey surface soils (Ebasco 1989).

3.2.2 Demographics/Current Site Use

The Wellsville refinery site is located in Allegheny County, astride the border between the Town and Village of Wellsville. Population data from the U.S. Bureau of Census (Ebasco, 1989) indicate sparse populations in the area. Allegheny County has 50,500 residents, the Town of Wellsville, 7,940, and the Village of Wellsville, 5,070. Three public schools and a university dormitory are located within one mile of the refinery. Four residences are located immediately south of the refinery. At least twenty additional residences are located adjacent to the abandoned offsite tank farm.

Nine private and government groups own parcels of land at the site, many of which are vacant at present. Businesses operating at the site include: Butler-Larkin, Inc.; Current Controls, Inc.; Mapes Industries, Inc.; National Fuel Company, Inc.; Otis Eastern Service, Inc.; and Release Coatings, Inc. Butler-Larkin manufactures oil, gas, and water well drilling equipment, and completion equipment at the site. Mapes Industries manufactures finished wood products on site and Current Controls manufactures electrical components. Release Coatings produces a chemical to facilitate the release of molded products from molds. Otis Eastern maintains storage facilities for construction equipment at the site. National Fuel maintains a vehicle storage lot and customer service office on the site. The SUNY at Alfred campus is an agricultural and technical college with auto repair shops.

Many of the businesses on site generate heavy vehicular traffic. Both National Fuel and Otis Eastern use the site for storage and maintenance of large fleets of trucks and heavy construction equipment. Great numbers of passenger vehicles use the roads on site related to employment at the site and the vocational college.

Hazardous materials are generated on site and have been noted in NYSDEC documents (Ebasco 1989). In the mid-1980s, NYSDEC found evidence of illegal disposal of hazardous waste inside and outside the Butler-Larkin and Mapes Industries buildings. These wastes, which allegedly included solvents, paint solid residue, cutting oil, and waste from a phosphatizing process, reportedly were discharged, either directly or indirectly, into the main drainage swale and the Genesee River (Ebasco 1989). Ebasco observed the application of an asphaltic coating to pipelines, and surface soils, in the Butler-Larkin facility. Steam cleaning of engines, with no facility to trap waste oil, was observed at the SUNY auto shop (Ebasco 1989).

3.2.3 Climatology

Wellsville, and the rest of New York, is in the moist continental climatic regime, with warm, humid summers, dominantly sub-freezing winters, and abundant rainfall throughout the year. The hilly terrain in the vicinity of Wellsville is in the Western Plateau climatic division of New York state. Specific weather information for this division is provided by the U.S. Department of Commerce (Ebasco 1989). Based on data collected from 1941-1970, the average daily temperature varies from a high in July of 68.1°F, to a low in January of 23.°F. Precipitation for the same period ranges from 2.18 inches in February to 43.79 inches in May. Annual precipitation for the entire climatic division averages 37.3 inches (Ebasco, 1989).

More detailed weather information for the area of Wellsville is not available due to the scarcity of weather stations in that part of the state. The nearest weather station to the site is 69 kilometers away, in Bradford, Pennsylvania (Gem 1989). Data gathered at the Bradford station from 1951 to 1980 yields average daily temperatures ranging from 19.9°F in January to 76.5°F in July, with an annual average daily temperature of 43.5°F. Precipitation at the Bradford weather station ranges from 2.88 inches in February to 4.26 in June, with an annual total of 42.71 inches (NOAA 1982).

3.2.4 Topography

The Sinclair Refinery Site lies in the floodplain of the Genesee River among the rolling hills and mountains of south-central Pennsylvania. The surrounding topography is dominated by gently rolling hills with maximum elevations of 2,000 to 2,200 feet above mean sea level (msl) and moderate to steep slopes leading to valleys as low as 1,500 feet above msl. The area in the immediate vicinity of the site is generally flat terrain sloping gently to the Genesee River on the eastern border of the site. This flat land is the floodplain for the Genesee River, which lies at about 1,500 feet above msl. The edges of the floodplain are marked by an abrupt change in topography. Surface water drainage from the site is northeastward, towards the river. A network of surface culverts and storm sewers carries most of the runoff directly into the Genesee River adjacent to the site. A large drainage swale runs along the northeastern margin of the site, preventing most of the surface runoff from entering the Genesee River (Ebasco 1989).

The offsite tank farm (OSTF) is located to the west of the refinery site on a sloping area on a hill adjacent to the site. The OSTF is situated at approximately 1,650 feet above msl. A small stream, which drains towards the refinery site, bisects the OSTF area. This stream terminates at the drainage swale along the north end of the refinery. Previous tank locations are identified by 15-foot high berms, which have produced pools or wet areas at the OSTF (Ebasco 1989).

3.3 Identification of Potential Exposure Pathways

This section incorporates the information from the previous analyses to develop a list of potential contaminant exposure pathways associated with the site. The remaining sections of this chapter will identify and evaluate the potentially significant migration pathways, and conclude with an estimation of exposure point concentrations and related chemical intakes.

Several chemical migration pathways are possible for contaminant releases at the Sinclair Refinery including surface water, ground water, soil, and air. Table 3-2 summarizes the potential migration pathways and human receptors. The following is a discussion of the migration pathways identified for each impacted media at the Sinclair Refinery site.

3.3.1 Air Pathways

There are two pathways for contaminant release into the air, both amendable to chemical constituents at the site. The first, is volatization which occurs when chemicals evaporate directly from soil to air. Since air sampling was not performed at this site, actual volatile organic compound (VOC) concentrations in the ambient atmosphere are undetermined. As discussed in Section 3.2, the VOCs are distributed equally in the surface and subsurface soils. In addition, only 3 of the 14 surface soil auger borings samples found VOCs above their respective detection limit. Based on this evaluation of VOC distribution, exposure to VOCs would be expected to be a concern only under limited circumstances. For example, excavation workers could be exposed to VOCs especially since excavation activities would disturb the soil and release contaminants trapped in soil pore spaces. The contaminants which may be released through this pathway include methyl chloride, trichloroethene, benzene, and xylene. Since all of these contaminants have relatively high vapor pressures, they can be expected to readily volatilize into the atmosphere if exposed to the air. The volatilization pathway is considered to be of less concern than the other air pathway, fugitive dust inhalation.

The release of fugitive dust particles is expected to dominate exposures via air at this site. This pathway was identified as potentially significant since the roadways and parking areas on this site are covered with a thin surface of gravel which facilitates the generation of dust due to vehicular traffic. Facility members of the

TABLE 3-2
POTENTIAL MIGRATION PATHWAY AND EXPOSURE ROUTE EVALUATION

Potential Migration Pathway	Potential Exposure Route	Possible Human Receptors			
		Onsite Occupants	Local Resident	Onsite Temp. Workers	Onsite Trespassers
Air	VOC Inhalation	X	X	X	X
	Dust Inhalation	X		X	X
Soil	Ingestion			X	X
	Dermal Contact			X	X
Surface Water	Ingestion		X		
	Fish Ingestion		X		
	Dermal Contact		X		
Ground Water	Ingestion		X*		
	Dermal Contact		X*		

*Ground water impacts surface water media - ground water not used as drinking water source.

SUNY campus indicated that during dry conditions, the property has a dust problem caused by automobile and truck traffic. The contaminants that are of particular concern include the metals and semi-volatile organic compounds which are generally sorbed onto soil particles. Intake results when the soil particles are inhaled, and the chemicals are desorbed in the lungs.

3.3.2 Soil Pathways

Contaminants present in soil will contribute to air contamination through volatilization and dust emissions and ground-water contamination through infiltration. However, the only direct routes of exposure identified are through either inadvertent soil ingestion or dermal absorption. Inadvertent soil ingestion is typically evaluated in the context of the normal mouthing behavior of children between 1 and 6 years of age. An evaluation of soil ingestion exposure is viable because an elementary school is located approximately 1-mile from the site. Although a portion of the site is currently occupied by the SUNY Campus and various commercial interests, a larger portion is not secured and easily accessible. The contaminants of concern that have the highest ingestion toxicity values include arsenic, nitrobenzene, benzo(a)pyrene, and lead, all of which were detected in the surface soils.

Dermal absorption of contaminants through the skin boundary is another potential route of exposure of soil, however, the significance of this pathway is likely to be negligible in comparison with the soil ingestion scenario. In addition, dermal absorption is known to be more significant in aquatic media where a greater skin surface area is contacted with dissolved contaminants.

3.3.3 Surface Water Pathways

Contaminant loading to the surface water adjacent to the site likely occurs through migration of contaminants with ground water as it flows from the site to the river, and through deposition of suspended contaminants in surface water run-off. The potential exposure routes involving surface water include: (1) residential ingestion during periods when the public drinking water intake, located downgradient of the site, from surface water is used, (2) ingestion of fish caught near the site, and (3) dermal contact with the surface water during recreation.

As previously discussed, a new drinking water intake for the Town of Wellsville was installed upstream of the site in 1985. Since that time, the old water intake and treatment plant have been used as a backup system. According to the Public Works Department of Wellsville, the down stream intake is used in emergencies when the upstream intake and treatment system are not working. The downstream intake has been used, on the average one day per month during the initial start-up period, but the Public Works Department expects the frequency to decline over time (MacFarquar, D. 1989). Therefore, the risks associated with the ingestion of surface water will reflect only current conditions. This exposure is expected to be substantially reduced once the new treatment plant becomes the sole drinking water intake system.

According to a local resident, local children have been observed fishing in the Genesee River at the Village of Wellsville, however, he states that it is relatively uncommon (MacFarquar, D. 1989). According to the New York State Fish Commission, most of the downstream sport fishing begins approximately 2 miles from the site near the golf course. This portion of the river is stocked and heavily fished. According to the Fish Commission, the section of the river through Wellsville is not stocked.

Dermal contact with surface water is a potential exposure pathway, however there is minimal support for this exposure scenario as being either particularly significant or critical. There are no designated beach areas in the Town of Wellsville, and except for an annual rafting race, the river seems to be used very infrequently for recreational purposes adjacent to and directly downstream of the site. Dermal contact with surface water is expected to be less of a health threat than either the surface water ingestion or fish ingestion exposure scenarios.

3.3.4 Ground-Water Pathways

The results of a water well inventory of the facilities and residences immediately surrounding the Sinclair Refinery site, presented in the RI Report (Ebasco, 1989), indicate that only two wells are currently operational outside the southern portion of the site. One well is located at the Wellsville School District bus garage and the other is jointly owned by four residents north of the Weidrick Road near the southern boundary of the site. The RI Report indicates that these wells have been completed in the deep aquifers. Analytical results from all of the five deep aquifer monitoring wells installed at the site provides no convincing evidence that the deep aquifers have been adversely impacted. In addition, hydraulic gradient data, obtained during the remedial investigation, indicate that the ground-water flow at the site is generally north to northeast towards the Genesee River away from these potential receptors. Due to both limited data on the water quality of the deep aquifer system and the location of the two drinking water wells upgradient of the site, a drinking water exposure scenario for residental ground water was not considered in this assessment. The focus of this assessment was on the contaminants identified in the shallow aquifer under the site. The RI Report did not identify any uses of the water from the shallow aquifer, however, hydraulic gradient data supports the conclusion that the aquifer flows towards the Genesee River.

3.4 Potentially Significant Exposure Pathways

3.4.1 Human Exposure Pathways

All possible exposure routes illustrated in Table 3-2 were evaluated in order to determine the most significant exposure pathways at the Sinclair Refinery site. Four exposure scenarios that could adversely impact human health will be quantitatively evaluated. The four exposure scenarios are as follows:

- Inhalation of volatile organic compounds by excavation workers exposed to subsurface soils,
- Inhalation of fugitive dust emissions of metals and semi-volatile organic contaminants by onsite occupants,
- Inadvertent ingestion of soil contaminants by both excavation workers and trespassing children, and
- Ingestion of dissolved contaminants in surface water by local residents.

3.4.2 Environmental Exposure Pathways

The evaluation of the potential environmental impacts will focus on the Genesee River. The New York State Department of Environmental Conservation, Division of Regulatory Affairs, provided a regional map indicating the locations of sensitive environmental populations and surface water catagories. From this information, it was determined that the closest wetlands is less than 1 mile southeast and hydraulically upgradient of the site (Taft, K. 1989). The closest downgradient wetlands area is more than 3 miles from the site. Information from the New York State Fish Commission indicates that the section of the Genesee River in Wellsville, has a concrete bottom and minimal aquatic vegetation (Evans, J. 1989). The only potential environmental receptors identified are the indigenous fish in the river next to the site. The risks associated with this environmental exposure will be evaluated in the following section. The portion of the Genesee River, where game fish are released and caught, is roughly 2 miles downstream from the site (MacFarquar, D. 1989). The modeling and monitoring surface water contaminant levels are sufficiently low to safely assume that contaminants attributed to the site will not adversely impact the local game fish population.

3.5 Evaluation of Exposure and Chemical Intakes

This chapter includes detailed description and related calculations that lead to estimation of exposure point concentrations for each impacted media through the identified potentially significant exposure pathways.

The chemical intakes for receptors were calculated using formulas recommended by the U.S. EPA (1989). For each different exposure route, specific information was combined to calculate the number of milligrams of chemical consumed per kilogram of body weight each day (mg/kg/day).

The general equation for this calculation is:

$$I = \frac{C \times CR \times EF \times ED}{BW \times AT}$$

where:
I = intake (mg/kg.day),
C = chemical concentration at exposure point (e.g., mg/liter),
CR = contact rate (e.g., liters/day),
EF = exposure frequency (days/yr),
ED = exposure duration (years)
BW = body weight of exposed individual (kg), and
AT = averaging times (days; period over which exposure is averaged).

For each exposure scenario, the units of concentration, C, and contact rate, CR, may change, but the intake, I, has the same units regardless of exposure route. Also, additional route-specific terms may be introduced to account for other important factors such as percent of the chemical actually absorbed by the body.

The values of most of the factors in the intake equation must be assumed. Most of the assumptions are standardized and recommended values published by the EPA in various documents (U.S. EPA 1989a-b). However, some factors are unique to each exposure scenario, and situation-specific assumptions must be made. In these cases, realistically conservative assumptions were used.

Three types of time-dependent intakes can be calculated using the intake equations. Subchronic daily intake (SDI) can be calculated for exposure scenarios in which exposure is limited to a time frame ranging approximately from 90 days to seven years. For the SDI, the overall length of exposure is used for both the ED (years) and AT (days) terms in the intake equation. For exposures lasting longer, the chronic daily intake (CDI) can also be calculated. For the CDI too, the ED and AT represent the same length of exposure (in different units). The SDI and the CDI are used to calculate risks of non-carcinogenic effects. The third type of time-dependent exposure that can be calculated is the Lifetime Average Daily Exposure (LADE). The LADE is used to calculate risks of carcinogenic effects based on exposures averaged over a lifetime. Correspondingly so, the AT for the LADE calculation is always 27,400 days (75 years, U.S. EPA 1989b). However, the ED can vary depending on the length of exposure.

For the purpose of a baseline risk assessment, CDI and LADE exposure scenarios are generally calculated. Subchronic daily intakes are more applicable to those exposures resulting from relatively brief contact with site contaminants. As expected, most of the exposures for CERCLA sites are associated with exposures over extended periods of time. For this Endangerment Assessment Report, the only legitimate subchronic exposure identified relates to contracted workers that would be on the site for a finite period of time and potentially exposed to site contaminants in the subsurface through excavation type activities.

The following sections will address contaminant exposures and intakes for each identified significant migration pathway by media.

3.5.1 Air Pathway

Two transport processes may be present at the Sinclair Refinery site which have the potential for air contamination: fugitive dust exposure and volatile organic exposure. Fugitive dust can be generated by vehicular traffic on unpaved roadways and parking lots on the site. These unpaved roads are covered in dirt or gravel and allow contaminated soil to be carried into the air. In addition, volatile organics in air can be generated by volatilization of organics in subsurface soil exposed through excavation. A probable scenario would involve the excavation of a trench to access utility transmission conduits.

Fugitive dust exposure. Wind transported dust may be an inhalation hazard at the Sinclair Refinery site. Based on laboratory analysis of samples collected from the ground surface at the site, surface soils on site are contaminated by BNAs and metals. The exposure pathway expected for these compounds is as windblown, or fugitive dust. Fugitive dust may be released into the air through vehicular traffic. The site is presently in use and more than a thousand vehicles per day may drive on and off the site.

In order to assess the contaminant concentrations present onsite due to fugitive dust emissions, details about site usage were acquired. Map and site observations and interviews with site personnel provided most of the information necessary to estimate the rate of dust generation. The fugitive dust emission calculations require information about the mass fraction of a contaminant in particulate emissions, vehicle-kilometers per hour travelled onsite, percent of silt in the road surfaces, vehicle speed, weight and number of wheels, and the number of days per year with at least 0.245 mm (0.01 inches) of precipitation.

The emission rate calculation for vehicle induced dust emissions at the Sinclair Refinery site is as follows (GRI, 1988):

$$Q_{10} = [\alpha \; E_{10} \; Vk]$$

Where:

Q_{10} = emission rate of particles 10 microns and smaller (mg/hr),
α = mass fraction of contaminant in particulate emissions (mg/kg),
E_{10} = an emission factor (kg), and
Vk = vehicle-kilometers travelled onsite in one hour, totaled across all vehicles (1/hr).

The mass fraction of contaminant in particulate emissions, α, was approximated using the mean contaminant concentrations in surface soils acquired from the site investigation. These values are found in Table 3-3 of this report.

According to site personnel, daily vehicular traffic onsite involves approximately 893 vehicles. The vehicle-kilometers travelled onsite, Vk, was estimated using 0.305 km as the average distance travelled onsite per day. Given an average of 8-hours per day of site usage, the average vehicle-kilometers travelled onsite in one hour was determined to be 34.0 1/hour (i.e., 893 vehicles x 0.305 km/vehicle ÷ 8 hours).

TABLE 3-3
MEAN CHEMICAL CONCENTRATIONS IN SURFACE SOILS AND DUST EMISSION RATES AT THE SINCLAIR REFINERY SITE

CONTAMINANT	GEOMETRIC MEAN (mg/kg)	EMISSION RATE (g/s)
Arsenic	8.80E+00	2.07E-05
Barium	5.65E+01	1.33E-04
Benzo(a)pyrene	1.89E-01	4.43E-07
Lead	7.03E+01	1.65E-04
Nickel	1.83E+01	4.29E-05
Nitrobenzene	1.65E-01	3.87E-07
Zinc	8.28E+01	1.94E-04

The emission factor, E_{10}, used herein differs slightly from the one used in the SEAM (U.S. EPA, 1988), which is based on data from heavier equipment (up to 142 metric tons as opposed to a maximum of 26 tons). In addition, because particle size analysis to determine percent silt less than 10μ was performed on surface sediment, the silt term was modified to reflect observed site conditions. The emission factor was calculated as follows:

$$E_{10} = 0.85\ (s)\ (S/24)^{0.8}\ (W/7)^{0.3}\ (w/6)^{1.2}\ ((365-p)/365) \quad \text{(GRI, 1988)}$$

Where:

E_{10} - emission factor for an unpaved road per vehicle-kilometer of travel (kg),
s - percent silt of particles less than 10μ in road surface ($0 < s < 100$) (percent),
S - mean vehicle speed (km/hr),
W - mean vehicle weight (metric tons, kkg),
w - mean number of wheels (unitless), and
p - number of days per year with at least 0.254μ (0.01 inches) of precipitation (unitless).

Silt content on site was determined through a particle size analysis. Boring AB-56, located on a well-travelled gravel roadway, was taken as a representative location. The percentage of silt (< 10mm) at that location was 7.5 percent (EBASCO, 1984).

Vehicles using the site vary in weight and number of wheels. Telephone interviews were conducted with a variety of facilities and businesses on site. Based on this investigation, 848 cars, 20 ten wheel trucks, and 25 eighteen wheel trucks travel on the site every day providing a total of 893 vehicles for the site. The mean number of wheels was estimated to 4.5.

The average weight for cars was estimated at 4,000 pounds, 38,500 pounds for trucks. The average weight for trucks was calculated assuming the trucks enter (exit) full and exit (enter) empty. This method provides an average of the full and empty weights of each type of truck. The 10-wheeled trucks commonly weigh 22,000 pounds empty and 55,000 pounds full, yielding an average of 38,500 pounds. Eighteen wheel trucks weigh 30,000 pounds empty and 80,000 pounds full, providing and average of 55,000 pounds. Using these average weights, the numbers of vehicles, the average vehicle weight for all vehicles using the site was estimated as 6,200 pounds (2.8 metric tons).

Because site specific information was unavailable, the number of days with at least 0.245 mm (0.01 inches) of precipitation was determined from Figure 2-3 of the Superfund Exposure Assessment Manual (U.S. EPA, 1988). The site is between the 150 and 170 day contours so 160 was chosen as a reasonable estimate.

In summary, the values used to calculate the emission factor, E_{10} are:

$s = 7.5$ percent,
$S = 33$ km/hr,
$W = 2.8$ metric tons,
$w = 4.5$, and
$p = 160$ days.

The emission factor, E_{10} was calculated to be 0.248 kg. Fugitive dust emission rates from vehicular traffic at the Sinclair Refinery site are presented in Table 3-3.

The airborne pollutants at the Sinclair Refinery site are expected to have the most impact on individuals working on site. In order to evaluate the contaminant concentrations on site, a model designed for short distances should be used. An alternative was used based on simple conservation of mass in the dispersion of contaminated particles. A near field box model, which is accurate at short downwind distances (i.e., less than 100 meters), was selected because it is applicable to scenarios where the receptor is onsite or very nearby (Pasquill, 1975 and Horst, 1979 as cited in GRI, 1988).

The equations for the near field box model are presented below.

$$C = Q/(H\ W\ u) \qquad \text{(GRI, 1988)}$$

Where:

C = concentration of contaminant in ambient air onsite (g/m^3),
Q = emission rate of contaminant (g/s),
H = downwind height of box (m),
W = width of box (m), and
u = average wind speed through the box (m/s).

The downwind height of the box, H, is estimated using a specific relationship between the length and height of the box. As seen in Table 3-4 (Pasquill, 1975 and Horst, 1979 as cited in GRI, 1988), a box height of 1.4 m, which roughly corresponds to the human breathing zone, provides a distance from source to receptor of 10 m. This value allows evaluation of the onsite risks associated with chemical contaminants in the breathing zone. To provide a concentration comparable with that variability, a distance from receptor to source of 50 meters was chosen. The box height that corresponds to that distance is 3.8 from Table 3-4. Box width of 1,000 m was estimated from the crosswind width of site based on previously used direction of west to southwest.

Average wind speed through the box, u, is estimated with the following equation:

$$u = 0.22 (v) \ln(2.5 H) \qquad \text{(GRI, 1988)}$$

Where:

v = the average annual wind velocity at the site (m/s). This value was determined from the National Weather Service station in Binghamton, New York. The average wind speed was 10.3 miles per hour (4.6 m/s) (Ebasco 1989).

The wind speed, u, which corresponds to the human breathing zone (i.e, H equals 1.4 m) is 1.27 m/s. The wind speed, u, which corresponds to what a worker might be exposed to during 30 years (i.e., H equals 3.8 m) is 2.28 m/s.

TABLE 3-4
PLUME HEIGHTS USED IN NEAR FIELD BOX MODEL

Length of Side of Box, x (m)	Box Height, H (m)
10	1.4
20	2.1
30	2.7
40	3.3
50	3.8
60	4.3
70	4.8
80	5.3
90	5.8
100	6.2

Reference: GRI, 1988, derived from work by Pasquill, 1975 and Horst, 1979.

The resulting concentrations of contaminants in the air from vehicle induced fugitive dust are presented in Table 3-5.

Fugitive dust intake. The equation for calculation of intakes from fugitive dust inhalation is as follows:

$$I = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT}$$

where:

CA = chemical concentration in air (mg/m^3),
IR = inhalation rate (m^3/hr),
ET = exposure time (hrs/day), and
I, EF, ED, BW, and AT are as defined for the general equation (see page 3-20).

This scenario was developed to address possible exposures resulting from inhalation of airborne dust at the site. This scenario assumes adults are at the site for 8 hours per day (ET), and 5 days per week for 50 weeks per year (EF = 250 days per year) for 20 years. Chronic intakes (CDI) and LADE are calculated. The values for the variables used in this scenario are:

CA = air concentration as predicted by modeling in Table 3-5 (mg/m^3),
IR = 1.25 m^3/hr (adult, suggested upper bound value, U.S. EPA 1989)
ET = 8 hours/day, (assumption),
EF = 250 days/yr, (assumption),
ED = 20 years, (assumption),
BW = 70 kg (adult, U.S. EPA, 1989), and
AT = 7,300 days (ED x 365 days/yr) chronic for non-carcinogenic effects
= 27,400 days (75 years x 365 days/yr) for LADE, carcinogenic effects.

The concentrations of contaminants in the air, CA, were predicted using a near-field box model (GRI 1988). This model incorporates into the predictions the amount of dust-preventing precipitation in the area. Therefore, the number of no-dust days versus dusty days has already been accounted for in the calculations. The calculation of intakes via dust inhalation are shown in Table 3-6.

TABLE 3-5
AMBIENT CONCENTRATIONS FOR FUGITIVE DUST (10 M)

COMPOUND	Mean Emission Rate (Qmean) (g/s) (A)	Box Width (W) (m) (B)	Box Height (H) (m) (C)	Wind Speed In Box (um) (m/s) (D)	Mean Ambient Concentration	
					(Cmean) (g/m3)	(Cmean) (mg/m3) (E)
Arsenic	2.07E-05	1000	1.4	1.27	1.17E-07	1.17E-05
Barium	1.33E-04	1000	1.4	1.27	7.49E-07	7.49E-05
Benzo(a)pyrene	4.43E-07	1000	1.4	1.27	2.50E-09	2.50E-07
Lead	1.65E-04	1000	1.4	1.27	9.30E-07	9.30E-05
Nickel	4.29E-05	1000	1.4	1.27	2.42E-09	2.42E-05
Nitrobenzene	3.87E-07	1000	1.4	1.27	2.18E-09	2.18E-07
Zinc	1.94E-04	1000	1.4	1.27	1.09E-06	1.09E-04

AMBIENT CONCENTRATIONS FOR FUGITIVE DUST (50 M)

COMPOUND	Mean Emission Rate (Qmean) (g/s) (A)	Box Width (W) (m) (B)	Box Height (H) (m) (C)	Wind Speed In Box (um) (m/s) (D)	Mean Ambient Concentration	
					(Cmean) (g/m3)	(Cmean) (mg/m3) (E)
Arsenic	2.07E-05	1000	3.8	2.28	2.39E-08	2.39E-06
Barium	1.33E-04	1000	3.8	2.28	1.54E-07	1.54E-05
Benzo(a)pyrene	4.43E-07	1000	3.8	2.28	5.12E-10	5.12E-08
Lead	1.65E-04	1000	3.8	2.28	1.91E-07	1.91E-05
Nickel	4.29E-05	1000	3.8	2.28	4.96E-08	4.96E-06
Nitrobenzene	3.87E-07	1000	3.8	2.28	4.47E-10	4.47E-08
Zinc	1.94E-04	1000	3.8	2.28	2.24E-07	2.24E-05

NOTES:

A = From Table 3-4.

B = From site dimensions on location map.

C = From Table 3-5 box, height of 1.4 m for 10 m distant source. Box height of 3.8 m for 50 m distant source.

D = From supporting calculations in text.

E = Unit conversion, multiple g/m^3 by 1000.

TABLE 3-6

FUGITIVE DUST INHALATION
EXPOSURE POINT: SINCLAIR REFINERY SITE (ADULTS)

CHEMICAL	CA (10 m) (mg/m3)	IR (m3/hr)	ET (hr/day)	EF (days/yr)	ED (yrs)	BW (kg)	AT (days)	Chronic Intake (mg/kg.day)	LADE (Carcinogens) (mg/kg.day)
Arsenic	1.17E-05	1.25	8.00	250	20	70	7.30E+03	1.14E-06	3.05E-07
Barium	7.49E-05	1.25	8.00	250	20	70	7.30E+03	7.33E-06	0
Benzene	0	1.25	8.00	250	20	70	7.30E+03	0	0
Benzo[a]pyrene	2.50E-07	1.25	8.00	250	20	70	7.30E+03	2.45E-08	6.52E-09
Lead	9.30E-05	1.25	8.00	250	20	70	7.30E+03	9.10E-06	0
Methyl Chloride	0	1.25	8.00	250	20	70	7.30E+03	0	0
Nickel	2.42E-05	1.25	8.00	250	20	70	7.30E+03	2.37E-06	6.31E-07
Nitrobenzene	2.20E-07	1.25	8.00	250	20	70	7.30E+03	2.15E-08	0
Trichloroethene	0	1.25	8.00	250	20	70	7.30E+03	0	0
Xylene	0	1.25	8.00	250	20	70	7.30E+03	0	0
Zinc	1.09E-04	1.25	8.00	250	20	70	7.30E+03	1.07E-05	0

Notes: Zeros are shown for volatile compounds (not found in dust).
LADE is calculated only for chemicals potentially carcinogenic via this exposure route.

Volatile organic compounds exposure. The second transport process that may affect air quality at the Sinclair Refinery site is volatization of organic contaminants from soil. A potential exposure route for the subsurface soils is the excavation of a trench for the installation, inspection, replacement, or repair of underground utility transmission conduits (e.g., pipes, cables, and drains). Based on the site size, layout, ground-water depth, and an estimate of utility requirements, a 1-meter wide 2-meter deep trench, 300 meters long was chosen. A trench of this size would be capable of providing access for utility workers to install or repair a wide range of existing utility transmission conduits.

Volatilization is dependent on physical and chemical properties related to the particular chemical in question, and on the site's environmental characteristics. Chemical specific factors which affect its distribution between soil, soil water, soil air, and the atmosphere include: vapor pressure, solubility in water, molecular weight and structure, and type and number of functional groups.

Environmental factors include the contaminants concentration in the soil; soil water content; wind, humidity, and temperature; and sorptive and diffusion characteristics of the soil (e.g., organic matter content, porosity, density, and clay content). Warm, moist, windy conditions will favor volatilization as opposed to cool, dry, calm conditions. Soils that have a high sorptive capacity tend to decrease volatilization rates by binding contaminants, though volatilization will still occur. The relatively high vapor pressures of benzene (95.2 mm Hg), methyl chloride (4,310 mm Hg), and trichloroethene (57.9 mm Hg) compared to water (vapor pressure, 18 mm Hg) will act as a driving force for the migration of VOCs into the gaseous phase, and ultimately into the atmosphere through diffusion. Although xylene has a lower vapor pressure (10 mm Hg), it is appreciable enough to follow a similar pattern as the other VOCs. Generally, compounds having vapor pressures below 0.1 mm Hg (20°C) begin to demonstrate measurably less volatilization potential.

The calculations used to estimate emission rates and exposure point concentrations are provided in Appendix C.1.

Volatile organic compound intake. The equation for intakes of chemicals by inhalation of airborne (vapor phase) chemicals is:

$$I = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT}$$

where:

CA = chemical concentration in air (mg/m^3),
IR = inhalation rate (m^3/hr),
ET = exposure time (hrs/day), and
I, EF, ED, BW, and AT are as defined for the general equation (see page 3-20).

This exposure scenario is an extension of the worker/excavation scenario and was created to address the possibility of workers inhaling volatile contaminants in the air as they work in the excavation area. This scenario was developed to address the possibility of construction workers encountering subsurface soil during excavation activities. The scenario is for adult workers weighing 70 kg, being exposed for 15 days of one year. The short duration of this scenario prevents calculation of the CDI, so only SDI is calculated. Values used for the variables in the equation are:

CA = air concentration as predicted by modeling in Table C-2 (mg/m^3),
IR = 1.25 m^3/hr (adult, suggested upper bound value, U.S. EPA 1989)
ET = 8 hours/day, (assumption),
EF = 15 days/yr, (assumption),
ED = 1 year, (assumption),
BW = 70 kg (adult, U.S. EPA, 1989), and
AT = 15 days (EF only for subchronic exposure) for non-carcinogenic effects

The concentrations of contaminants in the atmosphere in the vicinity of an excavation area were predicted using a near field box model (GRI 1988). Details of the modeling are provided in Appendix C.1. Table 3-7 shows the calculation of intakes for inhalation of volatile organic compounds by excavation workers.

TABLE 3-7

SUBSURFACE SOIL VOLATILES INHALATION
EXPOSURE POINT: SINCLAIR REFINERY SITE (EXCAVATION WORKERS)

CHEMICAL	CA (mg/m3)	IR (m3/hr)	ET (hr/day)	EF (days/yr)	ED (yrs)	BW (kg)	AT (days)	Subchronic Intake (mg/kg.day)
Arsenic	0	1.25	8.00	15	1	70	15	0
Barium	0	1.25	8.00	15	1	70	15	0
Benzene	1.87E-02	1.25	8.00	15	1	70	15	2.67E-03
Benzo[a]pyrene	0	1.25	8.00	15	1	70	15	0
Lead	0	1.25	8.00	15	1	70	15	0
Methyl Chloride	3.39E-02	1.25	8.00	15	1	70	15	4.84E-03
Nickel	0	1.25	8.00	15	1	70	15	0
Nitrobenzene	0	1.25	8.00	15	1	70	15	0
Trichloroethene	4.70E-03	1.25	8.00	15	1	70	15	6.71E-04
Xylene	4.71E-02	1.25	8.00	15	1	70	15	6.73E-03
Zinc	0	1.25	8.00	15	1	70	15	0

Notes: Zeros are shown for non-volatile chemicals

3.5.2 Surface Water Pathway

The equation for intakes of chemicals by ingesting drinking water is:

$$I = \frac{CW \times IR \times EF \times ED}{BW \times AT}$$

where:

CW = chemical concentration in surface water (mg/liter),
IR = ingestion rate (liters/day), and
I, EF, ED, BW, and AT are as defined for the general equation (see page 3-20).

This exposure scenario was created to address the possibility of contaminated water from the Genesee River being used as a supply for the Wellsville public drinking water supply. The scenario assumes that the river water will be used only 15 days out of the year, and that residents will live within the supplied area for 30 years. Standard assumptions of body weight (70 kg) and water ingestion rate (2 liters/day) are used. Chronic and LADE exposures for the drinking of surface water were considered. Values for the variables in the equations are:

CW = monitoring data or predicitions based on ground water modeling,
IR = 2 liters/day, (adult, 90th percentile, U.S. EPA, 1989),
EF = 15 days/yr, (assumption)
ED = 30 years (national upper-bound time (90th percentile) at one residence, U.S. EPA, 1989)
BW = 70 kg (adult, U.S. EPS, 1989), and
AT = 10,950 days (ED x 365 days/yr) for chronic non-carcinogenic effects
= 27,400 days (75 yrs x 365 days/yr) for LADE, carcinogenic effects.

For the water concentrations, CW, downgradient surface water monitoring data were used. The average of data from several monitoring locations was used to create an expected average concentration for each contaminant of concern. However, since the monitoring data represents only the contaminant concentrations at a given time--a "snap shot" of conditions in the river, a means of predicting long-term concentrations in the river was used. The Modified Universal Soil Loss Equation (MUSLE) and the Soil Contamination evaluation Methodology (SOCEM) were used to model migration of contaminants to the river from the site in ground water and in surface runoff, respectively. Details of the MUSLE and SOCEM modeling are provided in Appendix C.2 and C.3, respectively. Table 3-8 shows the calculation of chemical intakes from surface water ingestion using modeled concentrations, while Table 3-9 shows the calculations using monitoring data.

3.5.3 Soil Pathway

The soil pathways include children playing on the site and at the offsite tank farm, and construction workers encountering subsurface soil during excavation activities. The equation for intake of chemicals by ingestion of surface and subsurface soil is:

$$I = \frac{CS \times IR \times CF \times DF \times EF \times ED}{BW \times AT}$$

where:

CS = chemical concentration in soil (mg/kg),
IR = ingestion rate (mg/day),
CF = a conversion factor (10^{-6} kg/mg),
DF = desorption factor (from 0 to 1), and
I, EF, ED, BW, and AT are as defined for the general equation.

The exposure scenario to address the possibility of children who unintentionally ingest contaminated soil playing on the site and at the offsite tank farm assumes that the children weigh 16 kg, play on the site for 100 days out of the year, and accidentally ingest 200 mg of contaminated soil on each of those days. This activity is assumed to continue for 6 years, so CDI and LADE are calculated. Benzo(a)-pyrene was not detected in any samples collected from the offsite tank farm; therefore, benzo(a)pyrene will not be evaluated as an indicator chemical for the offsite tank farm. Without chemical specific desorption information, the desorption factors for all chemicals are set at their maximum value of 1. Values used for the variables in the equation are:

TABLE 3-8
SURFACE WATER INGESTION
BASED ON GROUNDWATER MODELING RESULTS
EXPOSURE POINT: WELLSVILLE RESIDENCES

CHEMICAL	CW (mg/L)	IR (L/day)	EF (days/year)	ED (years)	BW (Adult) (kg)	AT (days)	CDI (mg/kg.day)	LADE (Carcinogens) (mg/kg.day)
Arsenic	1.56E-03	2	15	30	70	10950	1.83E-06	7.32E-07
Barium	1.81E-03	2	15	30	70	10950	2.13E-06	0
Benzene	2.55E-04	2	15	30	70	10950	2.99E-07	1.20E-07
Benzo[a]pyrene	8.26E-06	2	15	30	70	10950	9.70E-09	3.88E-09
Lead	7.72E-05	2	15	30	70	10950	9.06E-08	0
Methyl Chloride	8.26E-06	2	15	30	70	10950	9.70E-09	0
Nickel	2.04E-04	2	15	30	70	10950	2.40E-07	0
Nitrobenzene	1.57E-03	2	15	30	70	10950	1.84E-06	0
Trichloroethene	4.96E-06	2	15	30	70	10950	5.82E-09	2.33E-09
Xylene	1.92E-04	2	15	30	70	10950	2.25E-07	0
Zinc	1.10E-02	2	15	30	70	10950	1.29E-05	0

Notes: LADE is calculated only for chemicals potentially carcinogenic via this exposure route.

TABLE 3-9
SURFACE WATER INGESTION
BASED ON SURFACE WATER MONITORING DATA
EXPOSURE POINT: WELLSVILLE RESIDENCES

CHEMICAL	CW (mg/l)	IR (l/day)	EF (days/year)	ED (years)	BW (Adult) (kg)	AT (days)	Chronic Daily Intake (mg/kg.day)	LADE (Carcinogens) (mg/kg.day)
Arsenic	7.01E-03	2	15	30	70	10950	8.23E-06	3.29E-06
Barium	9.59E-02	2	15	30	70	10950	1.13E-04	0
Benzene	4.92E-03	2	15	30	70	10950	5.78E-06	2.31E-06
Benzo(a)pyrene	5.00E-03	2	15	30	70	10950	5.87E-06	2.35E-06
Lead	4.11E-03	2	15	30	70	10950	4.82E-06	0
Methyl Chloride	5.00E-03	2	15	30	70	10950	5.87E-06	0
Nickel	4.09E-02	2	15	30	70	10950	4.80E-05	0
Nitrobenzene	5.64E-03	2	15	30	70	10950	6.62E-06	0
Trichloroethene	5.00E-03	2	15	30	70	10950	5.87E-06	2.35E-06
Xylene	5.00E-03	2	15	30	70	10950	5.87E-06	0
Zinc	1.44E-02	2	15	30	70	10950	1.69E-05	0

Notes: LADE is calculated only for chemicals potentially carcinogenic via this exposure route.

CS = monitoring data for surface soils; geometric mean values,
IR = 200 mg/day, (young children, suggested average, U.S. EPA 1989)
EF = 100 days/yr, (assumption),
ED = 6 years, (assumption),
BW = 16 kg (child, U.S. EPA, 1989), and
AT = 2,190 days (ED x 365 day/yr) for chronic non-carcinogenic effects
= 27,400 days (75 yrs x 365 days/yr) for LADE carcinogenic effects

Table 3-10 shows the calculation of intakes for surface soil ingestions at the refinery site. Table 3-11 shows the corresponding intakes of surface soils for children at the offsite tank farm.

The scenario to address the possibility of construction workers encounters subsurface soil during excavation activities assumes that adult workers weigh 70 kg, and are exposed for 15 days of one year. The short duration of this scenario prevents calculation of the CDI, so only SDI is calculated. Values used for the variables in the equation are:

CS = monitoring data subsurface soils; geometric mean values,
IR = 200 mg/day, (assumption),
ET = 8 hours/day, (assumption),
EF = 15 days/yr, (assumption),
ED = 1 year, (assumption),
BW = 70 kg (adult, U.S. EPA, 1989), and
AT = 15 days (EF only for subchronic exposure) for non-carcinogenic effects

Table 3-12 shows the calculations of intakes for subsurface soil ingestion.

3.4.4 Exposed Population

Limited populations are potentially exposed via the four potentially significant exposure scenarios. For the excavation worker scenario, it is expected that less than 30 workers will be exposed, depending on the size and extent of the excavation.

TABLE 3-10

SURFACE SOIL INGESTION VIA DIRECT CONTACT
EXPOSURE POINT: SINCLAIR REFINERY (CHILDREN)

CHEMICAL	CS (mg/kg)	IR (mg/day)	CF (kg/mg)	DF	EF (days/yr)	ED (years)	BW (child) (Kg)	AT (days)	Chronic Daily Intake (mg/kg.day)	LADE (Carcinogens) (mg/kg.day)
Arsenic	8.80E+00	200.0	1.00E-06	1	100	6	16	2190	3.01E-05	2.41E-06
Barium	5.65E+01	200.0	1.00E-06	1	100	6	16	2190	1.93E-04	0
Benzene	2.50E-03	200.0	1.00E-06	1	100	6	16	2190	8.56E-09	6.84E-10
Benzo[a]pyrene	1.89E-01	200.0	1.00E-06	1	100	6	16	2190	6.47E-07	5.17E-08
Lead	7.01E+01	200.0	1.00E-06	1	100	6	16	2190	2.40E-04	0
Methyl Chloride	9.47E-03	200.0	1.00E-06	1	100	6	16	2190	3.24E-08	0
Nickel	1.83E+01	200.0	1.00E-06	1	100	6	16	2190	6.27E-05	0
Nitrobenzene	1.65E-01	200.0	1.00E-06	1	100	6	16	2190	5.65E-07	0
Trichloroethene	2.50E-03	200.0	1.00E-06	1	100	6	16	2190	8.56E-09	6.84E-10
Xylene	2.50E-03	200.0	1.00E-06	1	100	6	16	2190	8.56E-09	0
Zinc	8.28E+01	200.0	1.00E-06	1	100	6	16	2190	2.84E-04	0

Notes: LADE is calculated only for chemicals potentially carcinogenic via this exposure route.

TABLE 3-11

INTAKES FROM SURFACE SOIL INGESTION VIA DIRECT CONTACT
EXPOSURE POINT: OFF SITE TANK FARM (CHILDREN)

CHEMICAL	CS (mg/kg)	IR (mg/day)	CF (kg/mg)	DF	EF (days/yr)	ED (years)	BW (child) (Kg)	AT (days)	Chronic Daily Intake (mg/kg.day)	LADE (Carcinogens) (mg/kg.day)
Arsenic	1.80E+01	200.0	1.00E-06	1	100	6	16	2190	6.16E-05	4.93E-06
Barium	3.37E+01	200.0	1.00E-06	1	100	6	16	2190	1.15E-04	0
Benzene	1.00E-03	200.0	1.00E-06	1	100	6	16	2190	3.42E-09	2.74E-10
Lead	1.12E+02	200.0	1.00E-06	1	100	6	16	2190	3.83E-04	0
Methyl Chloride	1.12E-02	200.0	1.00E-06	1	100	6	16	2190	3.83E-08	0
Nickel	8.18E+00	200.0	1.00E-06	1	100	6	16	2190	2.80E-05	0
Nitrobenzene	1.65E-01	200.0	1.00E-06	1	100	6	16	2190	5.65E-07	0
Trichloroethene	2.50E-03	200.0	1.00E-06	1	100	6	16	2190	8.56E-09	6.84E-10
Xylene	2.50E-03	200.0	1.00E-06	1	100	6	16	2190	8.56E-09	0
Zinc	6.86E+01	200.0	1.00E-06	1	100	6	16	2190	2.35E-04	0

Notes: LADE is calculated only for chemicals potentially carcinogenic via this exposure route.

TABLE 3-12

SUBSURFACE SOIL INGESTION VIA DIRECT CONTACT
EXPOSURE POINT: SINCLAIR REFINERY SITE (EXCAVATION WORKERS)

CHEMICAL	CS (mg/kg)	IR (mg/day)	CF (kg/mg)	DF	EF (days/yr)	ED (years)	BW (adult) (Kg)	AT (days)	Subchronic Daily Intake (mg/kg.day)
Arsenic	7.40E+00	200.0	1.00E-06	1	15	1	70	15	2.11E-05
Barium	4.40E+01	200.0	1.00E-06	1	15	1	70	15	1.26E-04
Benzene	4.12E-03	200.0	1.00E-06	1	15	1	70	15	1.18E-08
Benzo[a]pyrene	1.87E-01	200.0	1.00E-06	1	15	1	70	15	5.35E-07
Lead	1.67E+01	200.0	1.00E-06	1	15	1	70	15	4.78E-05
Methyl Chloride	1.22E-02	200.0	1.00E-06	1	15	1	70	15	3.47E-08
Nickel	1.74E+01	200.0	1.00E-06	1	15	1	70	15	4.97E-05
Nitrobenzene	1.64E-01	200.0	1.00E-06	1	15	1	70	15	4.69E-07
Trichloroethene	2.50E-03	200.0	1.00E-06	1	15	1	70	15	7.14E-09
Xylene	6.64E-03	200.0	1.00E-06	1	15	1	70	15	1.90E-08
Zinc	4.96E+01	200.0	1.00E-06	1	15	1	70	15	1.42E-04

Numbers of site occupants for the adult exposure scenario are tabulated below:

Entity	Number of People	Reference
Butler Larkin, Inc.	40	(Tilley, 1989)
Current Controls, Inc.	50*	(Joyce, 1989)
Mapes Industries, Inc.	9	(Ellenson, 1989)
National Fuel Company, Inc.	52	(Cox, 1989)
Otis Eastern Service, Inc.	14	(Joyce, 1989)
Release Coatings, Inc.	Unknown	
SUNY	685 (Students & faculty)	
TOTAL	850+	

* - Estimate

The total of 850 is regarded as a minimum since no information was obtained regarding Release Coatings, Inc. A reasonable estimate of the total number of adults potentially exposed onsite is 900.

Demographics for the residential area surrounding the site indicate that the community is stable, characterized by low mobility families. A community representative in Wellsville City Hall indicated that the 1980 census data are representative of current population figures. A qualitative assessment of the available information indicates that the number of children who frequent the site and offsite tank farm is likely to be small.

4.0 RISK EVALUATION

4.1 Human Health

The objective of this risk evaluation is to quantify information in the exposure and toxicity assessment (Section 3.0) in order to evaluate potential human health risks associated with the Sinclair Refinery site. Risk refers to the probability of injury, disease, or death resulting from exposure to the chemicals identified in this study.

Noncarcinogenic impacts of chemicals on human health are evaluated by comparing projected or estimated intakes to reference levels for the chemicals of concern. A reference level represents an acceptable exposure level at which there will be no observable adverse effect or the lowest observable adverse effect on human health. Reference doses (RfD) are intake levels with no expected adverse health effects. The RfD is used for chronic exposures, while the subchronic reference doses (RfDs) is used for subchronic exposures. A list of these reference doses appears in Table 4-1. Carcinogenic risk values are generally expressed in scientific notation; an individual lifetime risk of one in 10,000 is represented as 1×10^{-4} or 1E-04. The impact of carcinogenic chemicals is assessed by comparing calculated risks and target risks for known or suspected carcinogens. The extremes of the acceptable range for carcinogenic risk are 1E-04 to 1E-07 with a target level of 1E-06.

For the Sinclair Refinery site, potential exposures were identified via six general pathways. These include (1) inhalation of fugitive dust, (2) inhalation of volatile emissions from subsurface soil, (3) ingestion of surface water (predicted two different ways), (4) ingestion of surface soil, (5) ingestion of tank farm surface soil, and (6) ingestion of subsurface soil. These exposure routes were developed from four possible exposure scenarios. Risks quantified for each of these scenarios are: (1) adults on site and in Wellsville, (2) children onsite, (3) excavation workers onsite, and (4) children on the offsite Tank Farm and in Wellsville.

TABLE 4-1

CRITICAL TOXICITY VALUES

CHEMICAL	INHALATION RfD's (mg/kg.day)	RfD (mg/kg.day)	Carcinogenic Potency Factor 1/(mg/kg.day)	ORAL RfD's (mg/kg.day)	RfD (mg/kg.day)	Carcinogenic Potency Factor 1/(mg/kg.day)
Arsenic	0	0	5.00E+01 (a)	1.00E-02 (d)	1.00E-03 (c)	1.80E+00 (f)
Barium	1.00E-03 (b)	1.00E-04 (b)	0	5.00E-02 (b)	5.00E-02 (a)	0
Benzene	0	0	2.09E-02 (a)	0	0	2.09E-02 (a)
Benzo[a]pyrene	0	0	6.10E+00 (e)	0	0	1.15E+01 (e)
Lead	4.30E-03 (d)	4.30E-04 (e)	0	1.40E-02 (d)	1.40E-03 (e)	0
Methyl Chloride	0	0	0	0	0	0
Nickel	0	0	1.70E+00 (a)	2.00E-02 (a)	2.00E-02 (a)	0
Nitrobenzene	6.00E-03 (b)	6.00E-04 (b)	0	5.00E-03 (b)	5.00E-04 (b)	0
Trichloroethene	2.60E-01 (d)	2.60E-02 (g)	1.30E-02 (b)	1.00E-01 (d)	1.00E-02 (a)	1.10E-02 (b)
Xylene	7.00E-01 (b)	4.00E-01 (b)	0	4.00E+00 (b)	2.00E+00 (a)	0
Zinc	0	0	0	2.00E-01 (b)	2.00E-01 (b)	0

Notes: Zeros represent unavailable or unapplicable data

Sources:
(a) IRIS
(b) HEA Summary Tables
(c) Estimated based on MCL
(d) Estimated from chronic RfD
(e) HEA source (SPHEM)
(f) Estimated from unit risk in Risk Assessment Forum Report
(g) Based on conversion of oral RfD

The first scenario includes dust inhalation and surface water consumption. The intakes from these two exposure routes are combined to calculate the risks for the adults onsite and in Wellsville scenario. Because two different methods for determining intakes were used for the surface water exposure route, two risk quantifications were prepared, each using a different surface water intake calculation. Similar combining of intakes was performed for the remaining three scenarios. The children onsite scenario includes residential surface water and soil ingestion with the assumption they will consume the local public water for a lifetime. The excavation workers scenario includes subsurface soil ingestion and subsurface soil volatile inhalation, and the children on the offsite Tank Farm and in Wellsville scenario includes tank farm surface soil and surface water ingestion. Tables 4-2 through 4-5 present the summaries of intake combining for CDIs (SDIs for Table 4-4), and Tables 4-6 through 4-8 present the summaries for LADEs. Intakes in Table 4-2 through 4-8 each are divided into oral and inhalation pathways.

Noncarcinogenic Effects

Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg-day, are intake levels with no adverse health effects, including sensitive individuals. Estimated intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur. The Acceptable Intake or Subchronic Exposure (AIS) is the highest human intake of a chemical that is not expected to cause adverse effects when exposure is short term (i.e., for an interval that does not constitute a significant portion of the life span). The Acceptable Intake for Chronic Exposure (AIC) is the highest human intake of a chemical that is not expected to cause adverse effects when exposure is long term (i.e., for a lifetime).

TABLE 4-2

SUMMARY: CHRONIC HUMAN INTAKES
EXPOSURE POINT: SINCLAIR REFINERY (ADULTS)

CHEMICAL	Surface Water A CDI	Surface Water B CDI	Total Oral A CDI	Total Oral B CDI	Dust Inhalation CDI	Total Air CDI
Arsenic	1.83E-06	8.23E-06	1.83E-06	8.23E-06	1.14E-06	1.14E-06
Barium	2.13E-06	1.13E-04	2.13E-06	1.13E-04	7.33E-06	7.33E-06
Benzene	2.99E-07	5.78E-06	2.99E-07	5.78E-06	0	0
Benzo[a]pyrene	9.70E-09	5.87E-06	9.70E-09	5.87E-06	2.45E-08	2.45E-08
Lead	9.06E-08	4.82E-06	9.06E-08	4.82E-06	9.10E-06	9.10E-06
Methyl Chloride	9.70E-09	5.87E-06	9.70E-09	5.87E-06	0	0
Nickel	2.40E-07	4.80E-05	2.40E-07	4.80E-05	2.37E-06	2.37E-06
Nitrobenzene	1.84E-06	6.62E-06	1.84E-06	6.62E-06	2.15E-08	2.15E-08
Trichloroethene	5.82E-09	5.87E-06	5.82E-09	5.87E-06	0	0
Xylene	2.25E-07	5.87E-06	2.25E-07	5.87E-06	0	0
Zinc	1.29E-05	1.69E-05	1.29E-05	1.69E-05	1.07E-05	1.07E-05

Notes: 'A' refers to intakes using modeled data
'B' refers to intakes using monitored data
All values in mg/kg/day.
Zeros represent unavailable or unapplicable data

TABLE 4-3

SUMMARY: CHRONIC HUMAN INTAKES
EXPOSURE POINT: SINCLAIR REFINERY (CHILDREN)

CHEMICAL	Surface Water A CDI	Surface Water B CDI	Soil Ingestion CDI	Total Oral A CDI	Total Oral B CDI
Arsenic	1.83E-06	8.23E-06	3.01E-05	3.20E-05	3.84E-05
Barium	2.13E-06	1.13E-04	1.93E-04	1.96E-04	3.06E-04
Benzene	2.99E-07	5.78E-06	8.56E-09	3.08E-07	5.79E-06
Benzo[a]pyrene	9.70E-09	5.87E-06	6.47E-07	6.57E-07	6.52E-06
Lead	9.06E-08	4.82E-06	2.40E-04	2.40E-04	2.45E-04
Methyl Chloride	9.70E-09	5.87E-06	3.24E-08	4.21E-08	5.90E-06
Nickel	2.40E-07	4.80E-05	6.27E-05	6.29E-05	1.11E-04
Nitrobenzene	1.84E-06	6.62E-06	5.65E-07	2.41E-06	7.19E-06
Trichloroethene	5.82E-09	5.87E-06	8.56E-09	1.44E-08	5.88E-06
Xylene	2.25E-07	5.87E-06	8.56E-09	2.34E-07	5.88E-06
Zinc	1.29E-05	1.69E-05	2.84E-04	2.96E-04	3.00E-04

Notes: 'A' refers to intakes using modeled data
'B' refers to intakes using monitored data
All values in mg/kg/day.

TABLE 4-4

SUMMARY: SUBCHRONIC HUMAN INTAKES
EXPOSURE POINT: REFINERY (EXCAVATION WORKERS)

CHEMICAL	Subsurface Soil Ingest. SDI	Total Oral SDI	VOA Inhalation SDI	Total Air SDI
Arsenic	2.11E-05	2.11E-05	0	0
Barium	1.26E-04	1.26E-04	0	0
Benzene	1.18E-08	1.18E-08	2.67E-03	2.67E-03
Benzo(a)pyrene	5.35E-07	5.35E-07	0	0
Lead	4.78E-05	4.78E-05	0	0
Methyl Chloride	3.47E-08	3.47E-08	4.84E-03	4.84E-03
Nickel	4.97E-05	4.97E-05	0	0
Nitrobenzene	4.69E-07	4.69E-07	0	0
Trichloroethene	7.14E-09	7.14E-09	6.71E-04	6.71E-04
Xylene	1.90E-08	1.90E-08	6.73E-03	6.73E-03
Zinc	1.42E-04	1.42E-04	0	0

TABLE 4-5
SUMMARY:CHRONIC HUMAN INTAKES
EXPOSURE POINT: OFF SITE TANK FARM (CHILDREN)

CHEMICAL	Surface Water A CDI	Surface Water B CDI	Soil Ingestion CDI	Total Oral A CDI	Total Oral B CDI
Arsenic	1.83E-06	8.23E-06	6.16E-05	6.35E-05	6.99E-05
Barium	2.13E-06	1.13E-04	1.15E-04	1.18E-04	2.28E-04
Benzene	2.99E-07	5.78E-06	3.42E-09	3.03E-07	5.78E-06
Lead	9.06E-08	4.82E-06	3.83E-04	3.83E-04	3.87E-04
Methyl Chloride	9.70E-09	5.87E-06	3.83E-08	4.80E-08	5.91E-06
Nickel	2.40E-07	4.80E-05	2.80E-05	2.83E-05	7.60E-05
Nitrobenzene	1.84E-06	6.62E-06	5.65E-07	2.41E-06	7.19E-06
Trichloroethene	5.82E-09	5.87E-06	8.56E-09	1.44E-08	5.88E-06
Xylene	2.25E-07	5.87E-06	8.56E-09	2.34E-07	5.88E-06
Zinc	1.29E-05	1.69E-05	2.35E-04	2.48E-04	2.52E-04

Notes: 'A' refers to intakes using modeled data
'B' refers to intakes using monitored data
All values in mg/kg/day.
Zeros represent unavailable or unapplicable data

TABLE 4-6

SUMMARY: LADE'S (CARCINOGENS ONLY)
EXPOSURE POINT: ADULTS

CHEMICAL	Surface Water A	Surface Water B	Total Oral A	Total Oral B	Dust Inhalation	Total Inhalation
Arsenic	7.32E-07	3.29E-06	7.32E-07	3.29E-06	3.05E-07	3.05E-07
Barium	0	0	0	0	0	0
Benzene	1.20E-07	2.31E-06	1.20E-07	2.31E-06	0	0
Benzo[a]pyrene	3.88E-09	2.35E-06	3.88E-09	2.35E-06	6.52E-09	6.52E-09
Lead	0	0	0	0	0	0
Methyl Chloride	0	0	0	0	0	0
Nickel	0	0	0	0	6.31E-07	6.31E-07
Nitrobenzene	0	0	0	0	0	0
Trichloroethene	2.33E-09	2.35E-06	2.33E-09	2.35E-06	0	0
Xylene	0	0	0	0	0	0
Zinc	0	0	0	0	0	0

Notes: 'A' refers to intakes using modeled data
'B' refers to intakes using monitored data
All values in mg/kg/day.
Zeros represent unavailable or unapplicable data

TABLE 4-7

SUMMARY: LADE'S (CARCINOGENS ONLY)
EXPOSURE POINT: CHILDREN

CHEMICAL	Surface Water A	Surface Water B	Surface soil ingestion	Total Oral A	Total Oral B
Arsenic	7.32E-07	3.29E-06	2.41E-06	3.14E-06	5.70E-06
Barium	0	0	0	0	0
Benzene	1.20E-07	2.31E-06	6.84E-10	1.20E-07	2.31E-06
Benzo[a]pyrene	3.88E-09	2.35E-06	5.17E-08	5.56E-08	2.40E-06
Lead	0	0	0	0	0
Methyl Chloride	0	0	0	0	0
Nickel	0	0	0	0	0
Nitrobenzene	0	0	0	0	0
Trichloroethene	2.33E-09	2.35E-06	6.84E-10	3.01E-09	2.35E-06
Xylene	0	0	0	0	0
Zinc	0	0	0	0	0

Notes: 'A' refers to intakes using modeled data
'B' refers to intakes using monitored data
All values in mg/kg/day.
Zeros represent unavailable or unapplicable data

TABLE 4-8

SUMMARY: LADE'S (CARCINOGENS ONLY)
EXPOSURE POINT: OFF SITE TANK FARM (CHILDREN)

CHEMICAL	Surface Water A	Surface Water B	Surface soil ingestion	Total Oral A	Total Oral B
Arsenic	7.32E-07	3.29E-06	4.93E-06	5.66E-06	8.22E-06
Barium	0	0	0	0	0
Benzene	1.20E-07	2.31E-06	2.74E-10	1.20E-07	2.31E-06
Lead	0	0	0	0	0
Methyl Chloride	0	0	0	0	0
Nickel	0	0	0	0	0
Nitrobenzene	0	0	0	0	0
Trichloroethene	2.33E-09	2.35E-06	6.84E-10	3.01E-09	2.35E-06
Xylene	0	0	0	0	0
Zinc	0	0	0	0	0

Notes: 'A' refers to intakes using modeled data
'B' refers to intakes using monitored data
Zeros are shown for non-carcinogenic chemicals

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ) (or the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant's reference dose). By adding the HQs for all contaminants within a medium or across all media to which a given population may reasonably be exposed, the Hazard Index (HI) can be generated. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media.

Any potential health effects are identified by computing hazard indices derived from subchronic and chronic intake levels. The hazard index is a simple means of comparing intake levels (SDIs and CDIs) to acceptable intake levels: acceptable intake for subchronic exposure (RfDs) and acceptable intake for chronic exposure (RfD). The hazard index is computed as follows:

$$\text{Hazard Index} = \frac{DI_1}{AI_1} + \frac{DI_2}{AI_2} + \ldots + \frac{DI_n}{AI_n}$$

Where DI_n = subchronic or chronic daily intake (mg/kg/day)
Where AI_n = subchronic or chronic acceptable intake level (mg/kg/day)

The assumption that the combined effects of the chemicals will be additive may not be accurate. Actual effects may be multiplicative or may not be related at all. However, it is generally agreed that if the hazard index is less than one, deleterious health effects are unlikely. If the hazard index is greater than one, then the individual effects of each chemical should be considered to determine the liklihood of ill effects.

Versar evaluated the noncarcinogenic effects of exposure to the indicator chemicals via both the oral and the inhalation route. Hazard indices for total oral and total inhalation exposures for each of the exposure scenarios at the Sinclair Refinery site are presented in Tables 4-9 through 4-12. All hazard indices are less than one.

TABLE 4-9

CALCULATION OF CHRONIC HAZARD INDEX
EXPOSURE POINT: SINCLAIR REFINERY (ADULTS)

CHEMICAL	Inhalation			ORAL A			ORAL B		
	CDI	RfD	CDI:RfD	CDI	RfD	CDI:RfD	CDI	RfD	CDI:RfD
Arsenic	1.14E-06	0	0	1.83E-06	1.00E-03	1.83E-03	8.23E-06	1.00E-03	8.23E-03
Barium	7.33E-06	1.00E-04	7.33E-02	2.13E-06	5.00E-02	4.25E-05	1.13E-04	5.00E-02	2.25E-03
Benzene	0	0	0	2.99E-07	0	0	5.78E-06	0	0
Benzo[a]pyrene	2.45E-08	0	0	9.70E-09	0	0	5.87E-06	0	0
Lead	9.10E-06	4.30E-04	2.12E-02	9.06E-08	1.40E-03	6.47E-05	4.82E-06	1.40E-03	3.44E-03
Methyl Chloride	0	0	0	9.70E-09	0	0	5.87E-06	0	0
Nickel	2.37E-06	0	0	2.40E-07	2.00E-02	1.20E-05	4.80E-05	2.00E-02	2.40E-03
Nitrobenzene	2.15E-08	6.00E-04	3.59E-05	1.84E-06	5.00E-04	3.69E-03	6.62E-06	5.00E-04	1.32E-02
Trichloroethene	0	2.60E-02	0	5.82E-09	1.00E-02	5.82E-07	5.87E-06	1.00E-02	5.87E-04
Xylene	0	4.00E-01	0	2.25E-07	2.00E+00	1.13E-07	5.87E-06	2.00E+00	2.94E-06
Zinc	1.07E-05	0	0	1.29E-05	2.00E-01	6.46E-05	1.69E-05	2.00E-01	8.44E-05
	Hazard Index:		9.45E-02	Hazard Index:		5.70E-03	Hazard Index:		3.02E-02

Notes: 'A' refers to exposure calculations using modeled data
'B' refers to exposure calculations using monitored data
Zeros represent unavailable or unapplicable data

TABLE 4-10

CALCULATION OF CHRONIC HAZARD INDEX
EXPOSURE POINT: SINCLAIR REFINERY (CHILDREN)

CHEMICAL	ORAL A			ORAL B		
	CDI	RfD	CDI:RfD	CDI	RfD	CDI:RfD
Arsenic	3.20E-05	1.00E-03	3.20E-02	3.84E-05	1.00E-03	3.84E-02
Barium	1.96E-04	5.00E-02	3.91E-03	3.06E-04	5.00E-02	6.12E-03
Benzene	3.08E-07	0	0	5.79E-06	0	0
Benzo[a]pyrene	6.57E-07	0	0	6.52E-06	0	0
Lead	2.40E-04	1.40E-03	1.72E-01	2.45E-04	1.40E-03	1.75E-01
Methyl Chloride	4.21E-08	0	0	5.90E-06	0	0
Nickel	6.29E-05	2.00E-02	3.15E-03	1.11E-04	2.00E-02	5.55E-03
Nitrobenzene	2.41E-06	5.00E-04	4.82E-03	7.19E-06	5.00E-04	1.44E-02
Trichloroethene	1.44E-08	1.00E-02	1.44E-06	5.88E-06	1.00E-02	5.88E-04
Xylene	2.34E-07	2.00E+00	1.17E-07	5.88E-06	2.00E+00	2.94E-06
Zinc	2.96E-04	2.00E-01	1.48E-03	3.00E-04	2.00E-01	1.50E-03
	Hazard Index:		2.17E-01	Hazard Index:		2.41E-01

Notes: 'A' refers to exposure calculations using modeled data
'B' refers to exposure calculations using monitored data
Zeros represent unavailable or unapplicable data

TABLE 4-11

CALCULATION OF SUBCHRONIC HAZARD INDEX
EXPOSURE POINT: EXCAVATION WORKERS

CHEMICAL	Inhalation			ORAL		
	SDI	RfD's	SDI:RfD's	SDI	RfD's	SDI:RfD's
Arsenic	0	0	0	2.11E-05	1.00E-02	2.11E-03
Barium	0	1.00E-03	0	1.26E-04	5.00E-02	2.51E-03
Benzene	2.67E-03	0	0	1.18E-08	0	0
Benzo[a]pyrene	0	0	0	5.35E-07	0	0
Lead	0	4.30E-03	0	4.78E-05	1.40E-02	3.41E-03
Methyl Chloride	4.84E-03	0	0	3.47E-08	0	0
Nickel	0	0	0	4.97E-05	2.00E-02	2.49E-03
Nitrobenzene	0	6.00E-03	0	4.69E-07	5.00E-03	9.38E-05
Trichloroethene	6.71E-04	2.60E-01	2.58E-03	7.14E-09	1.00E-01	7.14E-08
Xylene	6.73E-03	7.00E-01	9.61E-03	1.90E-08	4.00E+00	4.74E-09
Zinc	0	0	0	1.42E-04	2.00E-01	7.08E-04
	Hazard Index:		1.22E-02	Hazard Index:		1.13E-02

Notes: 'A' refers to intakes using modeled data
'B' refers to intakes using monitored data
Zeros represent unavailable or unapplicable data

TABLE 4-12

CALCULATION OF CHRONIC HAZARD INDEX
EXPOSURE POINT: OFF SITE TANK FARM (CHILDREN)

CHEMICAL	ORAL A			ORAL B		
	CDI	RfD	CDI:RfD	CDI	RfD	CDI:RfD
Arsenic	6.35E-05	1.00E-03	6.35E-02	6.99E-05	1.00E-03	6.99E-02
Barium	1.18E-04	5.00E-02	2.35E-03	2.28E-04	5.00E-02	4.56E-03
Benzene	3.03E-07	0	0	5.78E-06	0	0
Lead	3.83E-04	1.40E-03	2.73E-01	3.87E-04	1.40E-03	2.77E-01
Methyl Chloride	4.80E-08	0	0	5.91E-06	0	0
Nickel	2.83E-05	2.00E-02	1.41E-03	7.60E-05	2.00E-02	3.80E-03
Nitrobenzene	2.41E-06	5.00E-04	4.82E-03	7.19E-06	5.00E-04	1.44E-02
Trichloroethene	1.44E-08	1.00E-02	1.44E-06	5.88E-06	1.00E-02	5.88E-04
Xylene	2.34E-07	2.00E+00	1.17E-07	5.88E-06	2.00E+00	2.94E-06
Zinc	2.48E-04	2.00E-01	1.24E-03	2.52E-04	2.00E-01	1.26E-03
	Hazard Index:		0.35	Hazard Index:		0.37

Notes: 'A' refers to intakes using modeled data
'B' refers to intakes using monitored data
All values in mg/kg/day.
Zeros represent unavailable or unapplicable data

Carcinogenic Effects

Cancer potency factors (CPFs) have been developed by EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. For potential carcinogens, risks are estimated by the probability of increased cancer incidence. A carcinogenic potency factor represents the upper 95 percent confidence limit of the probability of response per unit intake of the contaminant over a lifetime, and converts estimated intakes directly to incremental risk (U.S. EPA, 1986). CPFs, which are expressed in units of $(mg/kg\text{-}day)^{-1}$, are multiplied by the estimated intake of a potential lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the CPF. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Because all inputs into the exposure assessments are conservatively based, the resulting risks identified for the Sinclair Refinery Site represent upper-bound risk estimates, and may overestimate the actual risk from exposures to the indicator chemicals studied. Cancer potency factors are derived from the results of human epidemiological studies of chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied. Additional data would be required to derive a statistically valid estimate of error in the exposure and risk calculations.

Excess lifetime cancer risks are determined by multiplying the intake level with the cancer potency factor. These risks are probabilities that are generally expressed in scientific notation (e.g., 1×10^{-6} or 1E-6). As excess lifetime cancer risk of 1×10^{-6} indicates that, as a plausible upper bound, an individual has a one in one million chance of developing cancer as a result of site-related exposure to a carcinogen over a 75-year lifetime under the specific exposure conditions at a site. EPA's risk range for carcinogens is 10^{-4} to 10^{-7}. The carcinogenic risks for each of the exposure scenarios involving chronic exposure were calculated as:

Risk = LADE x CPF

Where LADE = Lifetime Average Daily Exposure (mg/kg/day)
CPF = Carcinogenic Potency Factor (mg/kg/day)

Of the eleven indicator chemicals for the Sinclair Refinery site, arsenic, benzene, benzo(a)pyrene, and trichloroethene are recognized as potential carcinogens via both the inhalation and oral pathways, and nickel is recognized as a carcinogen via the inhalation pathway only.

Tables 4-13 through 4-18 show the calculation of the total upper-bound carcinogenic risk for exposure to the indicator chemicals for adults and children. Adult risks range from a high of 4.93E-05 for the adult exposure route using monitored data to a low of 1.02E-05 from the offsite tank farm.

4.2 Evaluation of Potential Impacts on Environmental Receptors

As discussed in Section 3.3 of this report, the only potential environmental receptors identified are related to the organisms in the Genesee River, especially the fish population. In order to characterize the potential impact on these environmental receptors, the average and maximum surface water concentrations for each of the indicator chemicals were compared to the available Water Quality Criteria for Freshwater Aquatic Life (Table 4-19). The criteria for the protection of aquatic life specify pollutant concentrations which, if not exceeded, should protect most, but not necessarily all, aquatic life and its uses (Federal Register, Vol. 45, No. 231. Nov. 28, 1980). As illustrated, none of the maximum surface water concentrations exceeds the Aquatic Freshwater Levels for acute toxicity. Only the maximum surface water concentration of zinc exceeds the acute and chronic toxicity level while the mean concentration is below the Freshwater Chronic Toxicity Criteria.

The New York State Department of Environmental Conservation, Division of Regulatory Affairs, indicated that the closest wetlands area is less than 1 mile southeast of the site. This wetlands area, however, is upstream of the site along the Genesee River (Taft, K. 1989). Based on

TABLE 4-13

RISK ESTIMATES FOR CARCINOGENS USING MODELED DATA
EXPOSURE POINT: SINCLAIR REFINERY (ADULTS)

CHEMICAL	Exposure Route	LADE (mg/kg.day)	Carcinogenic Potency Factor 1/(mg/kg.day)	Route-Specific Risk	Total Chemical-specific Risk
Arsenic	Oral A	7.32E-07	1.80E+00	1.32E-06	1.66E-05
	Inhalation	3.05E-07	5.00E+01	1.53E-05	
Barium	Oral A	0	0	0	0
	Inhalation	0	0	0	
Benzene	Oral A	1.20E-07	2.09E-02	2.50E-09	2.50E-09
	Inhalation	0	2.09E-02	0	
Benzo[a]pyrene	Oral A	3.88E-09	1.15E+01	4.46E-08	8.43E-08
	Inhalation	6.52E-09	6.10E+00	3.98E-08	
Lead	Oral A	0	0	0	0
	Inhalation	0	0	0	
Methyl Chloride	Oral A	0	0	0	0
	Inhalation	0	0	0	
Nickel	Oral A	0	0	0	1.07E-06
	Inhalation	6.31E-07	1.70E+00	1.07E-06	
Nitrobenzene	Oral A	0	0	0	0
	Inhalation	0	0	0	
Trichloroethene	Oral A	2.33E-09	1.10E-02	2.56E-11	2.56E-11
	Inhalation	0	1.30E-02	0	
Xylene	Oral A	0	0	0	0
	Inhalation	0	0	0	
Zinc	Oral A	0	0	0	0
	Inhalation	0	0	0	
			Total Upper Bound Risk =		1.77E-05

Notes: 'A' refers to intakes using modeled data
Zeros represent unavailable or unapplicable data, i.e. zeros are shown for non-carcinogenic chemicals.

TABLE 4-14

RISK ESTIMATES FOR CARCINOGENS USING MONITORED DATA
EXPOSURE POINT: SINCLAIR REFINERY (ADULTS)

CHEMICAL	Exposure Route	LADE (mg/kg.day)	Carcinogenic Potency Factor 1/(mg/kg.day)	Route-Specific Risk	Total Chemical-specific Risk
Arsenic	Oral B	3.29E-06	1.80E+00	5.92E-06	2.12E-05
	Inhalation	3.05E-07	5.00E+01	1.53E-05	
Barium	Oral B	0	0	0	0
	Inhalation	0	0	0	
Benzene	Oral B	2.31E-06	2.09E-02	4.83E-08	4.83E-08
	Inhalation	0	2.09E-02	0	
Benzo[a]pyrene	Oral B	2.35E-06	1.15E+01	2.70E-05	2.70E-05
	Inhalation	6.52E-09	6.10E+00	3.98E-08	
Lead	Oral B	0	0	0	0
	Inhalation	0	0	0	
Methyl Chloride	Oral B	0	0	0	0
	Inhalation	0	0	0	
Nickel	Oral B	0	0	0	1.07E-06
	Inhalation	6.31E-07	1.70E+00	1.07E-06	
Nitrobenzene	Oral B	0	0	0	0
	Inhalation	0	0	0	
Trichloroethene	Oral B	2.35E-06	1.10E-02	2.58E-08	2.58E-08
	Inhalation	0	1.30E-02	0	
Xylene	Oral B	0	0	0	0
	Inhalation	0	0	0	
Zinc	Oral B	0	0	0	0
	Inhalation	0	0	0	
			Total Upper Bound Risk =		4.93E-05

Notes: 'B' refers to intakes using monitored data.
Zeros represent unavailable or unapplicable data, i.e. zeros are shown for non-carcinogenic chemicals.

TABLE 4-15

RISK ESTIMATES FOR CARCINOGENS USING MODELED DATA
EXPOSURE POINT: SINCLAIR REFINERY (CHILDREN)

CHEMICAL	Exposure Route	LADE (mg/kg.day)	Carcinogenic Potency Factor 1/(mg/kg.day)	Route-Specific Risk	Total Chemical-specific Risk
Arsenic	Oral A	3.14E-06	1.80E+00	5.65E-06	5.65E-06
	Inhalation	0	5.00E+01	0	
Barium	Oral A	0	0	0	0
	Inhalation	0	0	0	
Benzene	Oral A	1.20E-07	2.09E-02	2.52E-09	2.52E-09
	Inhalation	0	2.09E-02	0	
Benzo(a)pyrene	Oral A	5.56E-08	1.15E+01	6.40E-07	6.40E-07
	Inhalation	0	6.10E+00	0	
Lead	Oral A	0	0	0	0
	Inhalation	0	0	0	
Methyl Chloride	Oral A	0	0	0	0
	Inhalation	0	0	0	
Nickel	Oral A	0	0	0	0
	Inhalation	0	1.70E+00	0	
Nitrobenzene	Oral A	0	0	0	0
	Inhalation	0	0	0	
Trichloroethene	Oral A	3.01E-09	1.10E-02	3.31E-11	3.31E-11
	Inhalation	0	1.30E-02	0	
Xylene	Oral A	0	0	0	0
	Inhalation	0	0	0	
Zinc	Oral A	0	0	0	0
	Inhalation	0	0	0	
			Total Upper Bound Risk =		6.30E-06

Notes: 'A' refers to intakes using modeled data
Zeros represent unavailable or unapplicable data, i.e. zeros are shown for non-carcinogenic chemicals.

TABLE 4-16

RISK ESTIMATES FOR CARCINOGENS USING MONITORED DATA
EXPOSURE POINT: SINCLAIR REFINERY (CHILDREN)

CHEMICAL	Exposure Route	LADE (mg/kg.day)	Carcinogenic Potency Factor 1/(mg/kg.day)	Route-Specific Risk	Total Chemical-specific Risk
Arsenic	Oral B	5.70E-06	1.80E+00	1.03E-05	1.03E-05
	Inhalation		5.00E+01	0	
Barium	Oral B	0	0	0	0
	Inhalation		0	0	
Benzene	Oral B	2.31E-06	2.09E-02	4.83E-08	4.83E-08
	Inhalation		2.09E-02	0	
Benzo[a]pyrene	Oral B	2.40E-06	1.15E+01	2.76E-05	2.76E-05
	Inhalation		6.10E+00	0	
Lead	Oral B	0	0	0	0
	Inhalation		0	0	
Methyl Chloride	Oral B	0	0	0	0
	Inhalation		0	0	
Nickel	Oral B	0	0	0	0
	Inhalation		1.70E+00	0	
Nitrobenzene	Oral B	0	0	0	0
	Inhalation		0	0	
Trichloroethene	Oral B	2.35E-06	1.10E-02	2.58E-08	2.58E-08
	Inhalation		1.30E-02	0	
Xylene	Oral B	0	0	0	0
	Inhalation		0	0	
Zinc	Oral B	0	0	0	0
	Inhalation		0	0	
			Total Upper Bound Risk =		3.79E-05

Notes: 'B' refers to intakes using monitored data.
Zeros represent unavailable or unapplicable data, i.e. zeros are shown for non-carcinogenic chemicals.

TABLE 4-17

RISK ESTIMATES FOR CARCINOGENS USING MODELED DATA
EXPOSURE POINT: OFF SITE TANK FARM (CHILDREN)

CHEMICAL	Exposure Route	LADE (mg/kg.day)	Carcinogenic Potency Factor 1/(mg/kg.day)	Route-Specific Risk	Total Chemical-specific Risk
Arsenic	Oral A	5.66E-06	1.80E+00	1.02E-05	1.02E-05
Barium	Oral A	0	0	0	0
Benzene	Oral A	1.20E-07	2.09E-02	2.51E-09	2.51E-09
Lead	Oral A	0	0	0	0
Methyl Chloride	Oral A	0	0	0	0
Nickel	Oral A	0	0	0	0
Nitrobenzene	Oral A	0	0	0	0
Trichloroethene	Oral A	3.01E-09	1.10E-02	3.31E-11	3.31E-11
Xylene	Oral A	0	0	0	0
Zinc	Oral A	0	0	0	0
			Total Upper Bound Risk =		1.02E-05

Notes: 'A' refers to intakes using modeled data
Zeros represent unavailable or unapplicable data, i.e. zeros a
shown for non-carcinogenic chemicals.

TABLE 4-18

RISK ESTIMATES FOR CARCINOGENS USING MONITORING DATA
EXPOSURE POINT: OFF SITE TANK FARM (CHILDREN)

CHEMICAL	Exposure Route	LADE (mg/kg.day)	Carcinogenic Potency Factor 1/(mg/kg.day)	Route-Specific Risk	Total Chemical-Risk
Arsenic	Oral B	8.22E-06	1.80E+00	1.48E-05	1.48E-05
Barium	Oral B	0	0	0	0
Benzene	Oral B	2.31E-06	2.09E-02	4.83E-08	4.83E-08
Lead	Oral B	0	0	0	0
Methyl Chloride	Oral B	0	0	0	0
Nickel	Oral B	0	0	0	0
Nitrobenzene	Oral B	0	0	0	0
Trichloroethene	Oral B	2.35E-06	1.10E-02	2.58E-08	2.58E-08
Xylene	Oral B	0	0	0	0
Zinc	Oral B	0	0	0	0

Total Upper Bound Risk = 1.49E-05

Notes: 'B' refers to intakes using monitored data
Zeros represent unavailable or unapplicable data, i.e.
shown for non-carcinogenic chemicals.

TABLE 4-19

COMPARISON OF SURFACE WATER CONCENTRATIONS WITH WATER QUALITY CRITERIA FOR THE PROTECTION OF AQUATIC FRESHWATER LIFE

Contaminant	Average Surface Water Concentration (ug/l)	Maximum Surface Water Concentration (ug/l)	Freshwater Aquatic Life Acute Toxicity (1) (ug/l)	Freshwater Aquatic Life Chronic Toxicity (1) (ug/l)
Trichloroethene	3.35	5940	45000	NA
Benzene	3.45	1450	5300	NA
Arsenic	6.39	89	NA	NA
Zinc	19.17	330	130	110

(1) CERCLA, 1988
NA - Not Available

the potentiometic surface map of the water table found in the Remedial Investigation Report prepared by Ebasco, the ground-water flow in the upper aquifer is towards the river in a north to northeast direction. Therefore, the wetlands area southeast of the site is not expected to be adversely impacted by either contaminated surface water runoff or ground water. Another wetlands area, indicated by the NYDEC is approximately 3 miles northwest and downstream of the site. Based on a comparison of Water Quality Criteria for the protection of aquatic life in freshwater systems, discussed above, the relatively low contaminant levels currently found in the surface water are likely to be even further reduced once they reach the downstream wetlands area.

The Genesee River, in the Town of Wellsville, was provided with a concrete bottom and spill-way system as part of the regional flood control program. This type of bottom surface precludes the growth of aquatic vascular plants along the site. As a result, the number of species at the top of the aquatic food chain, indigenous to the river near the site, would be expected to be small. In addition, the fishing patterns of the area, as referenced in Section 3.3, is likely to be much smaller in comparison in other areas of the river.

The New York State Department of Environmental Conservation did not identify, from currently available information, any potential impacts on endangered, threatened, or special concern wildlife species (Evans, J. 1989). In conclusion, the environmental impacts resulting from chemical releases from the Sinclair Refinery Site are expected to be negligible.

4.3 Assessment of Method Uncertainties

There are a number of uncertainties associated with the carcinogenic risk estimate discussed above. These uncertainties are introduced because of (1) the need to extrapolate below the dose range of experimental tests using animals, (2) the variability of the receptor population, (3) assumed equivalency of dose-response relationship between animals and humans, and

(4) differences in exposure routes in test animals versus routes expected onsite. In addition to contaminant concentration, route, and duration of exposure, there are many other factors that may influence the likelihood of developing cancer. These include differences between individual nutritional and health status, age and sex, and inherited characteristics that may affect susceptibility (USDHHS, 1985). Risk calculation also assumes that intake levels will be small, without synergistic or antagonistic chemical effects, and that individuals will be exposed to each of the indicator chemicals and elicit a carcinogenic response.

5.0 SUMMARY/CONCLUSION

Contaminant screening was performed on analytical results from the soil, surface water, and ground-water samples collected by SMC Martin and Ebasco and compiled in Ebasco's 1989 Draft Remedial Investigation Report. The contaminant screening process identified eleven chemicals of potential concern: 4 volatile organic compounds, 2 semivolatile organic compounds, and 5 metals. The indicator chemicals used in this Endangerment Assessment were: methyl chloride, trichloroethene, benzene, xylene, nitrobenzene, benzo(a)pyrene, arsenic, barium, lead, nickel, and zinc. These compounds or elements were selected based on their toxicological properties, potentially critical exposure routes, and higher concentrations present in comparison to other contaminants.

Environmental fate and transport mechanisms were evaluated for each of the indicator chemicals based on an assessment of the site's environmental setting and chemical and physical properties of each contaminant. Predominant transport mechanisms identified included: (1) leachate percolation through soils to ground water and subsequent migration to the Genesee River, (2) runoff of surface soils to the river during storm events, and (3) dispersion of fugitive dust particles by vehicular traffic on the site.

Potentially exposed populations include: temporary site excavation workers, children trespassing onto the refinery site and offsite tank farm, local residents, students and faculty members of the onsite SUNY campus, and employees of current onsite businesses.

Four exposure scenarios were evaluated: (1) inhalation of volatile organic compounds (VOCs) by excavation workers exposed to subsurface soils, (2) inhalation of fugitive dust emissions of metals and semivolatile contaminants by onsite occupants, (3) inadvertent ingestion of soil contaminants by both excavation works and trespassing children, and (4) ingestion of dissolved contaminants in surface water by local residents.

Total body burden rates were computed based on all exposure routes using an average body mass of 70 kilograms (adults) or 16 kilograms (child) and an average 75-year lifetime (for chronic and carcinogenic exposures). The evaluation of excavation worker subchronic exposure through VOC inhalation and inadvertent ingestion of subsurface soils assumed individuals could be exposed for 15 days in 1 year. For the fugitive dust exposure evaluation, it was assumed that site occupants would be exposed for 8 hours per day, 5 days per week, and 50 weeks per year for 20 years. It was assumed that trespassing children would be exposed to the surface soils for 100 days per year for 6 years and to surface water for 15 days per year for 30 years. The evaluation of residential ingesting of surface water, through the secondary water intake system downstream of the site, assumed exposure for 15 days per year for 30 years.

The calculations presented in Tables 4-9 thru 4-12, indicate that the greatest noncarcinogenic risk from the site is associated with the inhalation of barium and lead dust particles by adults that work and attend vocational school on the refinery site. The chronic hazard index for the inhalation route is 9.45E-02. The total exposure point chronic hazard index for adults onsite, based on inhalation of fugitive dust particles and ingestion of water, was determined to be 1.25E-01. The next highest noncarcinogenic risk is for children trespassing on the offsite tank farm. The chronic hazard index for this route was determined to be 3.7E-01, primarily as a result of ingesting of inorganic metals in the surface soil. The chronic hazard index for children trespassing on the refinery portion of the site was calculated to be 2.41E-01. The total exposure point subchronic hazard index for excavation workers is 1.17E-01.

A summary of the carcinogenic risks associated with the site are displayed on Tables 4-13 thru 4-18. The greatest carcinogenic risk identified is associated with the inhalation of arsenic by adults that work and attend the vocational school on the refinery site. The carcinogenic risk for the inhalation route was calculated to be 1.53E-05. The total upper bound risk for these adults, based on inhalation of fugitive dust particles and ingestion of water is 4.93E-05. The next highest carcinogenic risk is 3.79E-05 for children that trespass on the refinery area. Again, the risk to children is mainly associated with the ingestion arsenic and benzo(a)pyrene. Children that trespass on the offsite tank farm have a total upper bound risk of 1.49E-05.

Since the noncarcinogenic hazard index for each exposure point does not exceed unity, adverse noncarcinogenic effects are not expected. The highest total upper bound carcinogenic risk is 4.93E-05. It is not in the scope of this report to determine suitable background levels for the Sinclair Refinery site, or establish remediation cleanup levels.

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APPENDIX A
COMPOUNDS AND ELEMENTS DETECTED AT THE SINCLAIR REFINERY SITE

DATA CODES AND QUALIFIERS
SINCLAIR REFINERY

TYPE1 SO - Subsurface Soil
GW - Groundwater
SS - Surface Soil
SW - Surfacewater
SD - Sediment

LOCATION RF - Refinery
LF - Landfill
TF - Tank Farm
BG - Background
WE - Wellsville Water Treatmnet Plant Outfall
WT - Waste (Manhole, Oil Separator, Blockhouse

TYPE2 AB - Augur Boring
MW - Monitoring Well
HF - High Flow (River water)
LF - Low Flow (River water)
DS - Drainage Swale
OF - Outfall (Refinery)
SP - Seep (Refinery and landfill)
MH - Manhole sample
CL - Clay layer (Soil or water)
UA - Upper aquifer (Background soil)
DA - Deep aquifer (Background soil)
SF - Surface sediment (0-6") or soil (0-0.5')
DP - Deep sediment (6"-2') or soil (8-10')
MD - Mid-depth soil or sediment (2-4')
CS - Composite sample (Surface soil)
PT - Single point sample (Surface soil)
RS - River Sediment
PL - Poll sample (Refinery surfacewater)
OS - Oil Separator
TP - Test pit
NR - Non-river background sample
GR - Genessee River background sample

QUALIFIERS E - Estimated (Serial dilution)
D - Dilution
X - Compound present, but not within control limits
T - Compound present, but not within control limits
N - Evidence of presence
NJ - Estimated
U - Undetected
N - Above Instrument Detection Limit but below Contract Required Detection Limit
* - Laboratory duplicate not within control limits

SAMPLE #s D - Duplicate analysis
A - Average value of a duplicate pair
F - Filtered
C - Centrifuged

DC - Decanted

GROUN   VOLAT. --
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	VINYL CHLORIDE	METHYL CHLORIDE	ACETONE	CARBON DISULFIDE	1,1-DICHLOROETHENE	1,1-DICHLOROETHANE	TRANS-1,2-DICHLOROETHENE	CHLOROFORM	1,2-DICHLOROETHANE
SMC-MW-07-02	GW	RF	UA	5 U	5 U	5 U	3 U	3 U	3 U	3 U	3 U	3 U
SR-GW32-02	GW	RF	UA	5 U	5 U	5 U	3 U	3 U	3 U	3 U	3 U	3 U
SR-GW31-02	GW	RF	UA	5 U	5 U	31 UJ	3 U	3 U	3 U	3 U	3 U	3 U
SR-GW53-02SVMS	GW	RF	UAC	5 U	5 U	340 UJ	3 U	3 U	31 J	3 U	3 U	3 U
SR-GW28-02	GW	RF	UA	5 U	5 U	5 U	3 U	3 U	3 U	3 U	3 U	3 U
SR-GW10-02	GW	RF	UA	94	5 U	5 U	3 U	3 U	3 U	3 U	3 U	3 U
SR-GW07-02	GW	RF	UA	5 U	5 U	16 T	3 U	3 U	3 U	3 U	3 U	3 U
SR-GW09-02	GW	RF	UA	5 U	5 U	20 UJ	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MW-01-02	GW	RF	UA	5 U	5 U	5 U	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MW-01-01	GW	RF	UA	5 U	5 U	5 U	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MW-54GW	GW	RF	UA	5 U	9 C	800 C	3 U	3 U	3 U	3 U	3 U	3 U
SR-GW10-02SVMS	GW	RF	UAC	98	5 U	5 U	3 U	3 U	28 J	3 U	3 U	3 U
SMC-MW-52GW	GW	RF	UA	5 U	5 C	150 C	3 U	3 U	3 U	3 U	3 U	3 U
SR-GW09-02SVMS	GW	RF	UAC	5 U	5 U	10 UJ	2 J	3 U	3 U	3 U	3 U	3 U
SMC-MW-50GW	GW	RF	UA	5 U	39 C	180 C	3 U	3 U	3 U	3 U	3 U	3 U
SR-GW07-02SVMS	GW	RF	UAC	5 U	2 J	8 J	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MWD-49GW	GW	RF	DA	5 U	11 C	67 C	3 U	3 U	3 U	3 U	3 U	3 U
SR-GW11-02	GW	RF	UA	5 U	5 U	23 UJ	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MW-32GW	GW	RF	UA	5 U	40 C	160 C	3 U	3 U	3 U	3 U	3 U	3 U
SR-GW25-02	GW	RF	UA	5 U	5 U	230 J	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MW-30GW	GW	RF	UA	5 U	18 C	240 C	6	3 U	3 U	3 U	3 U	3 U
SMC-MW-28GW	GW	RF	UA	5 U	8 C	21 C	3 U	3 U	3 U	3 U	3 U	3 U
SR-GW27-02A	GW	RF	UA	5 U	5 U	5 U	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MW-25GW	GW	RF	UA	5 U	18 C	230 C	3 U	3 U	5	3 U	2 E	3 U
SMC-MWC-41GW	GW	RF	CL	5 U	5 C	2200 C	3 U	3 U	3 U	3 U	3 U	3 U
SR-GW33-02DL	GW	RF	UAD	5 U	1 J	39	1 J	3 U	3 U	3 U	3 U	3 U
SMC-MWC-39GW	GW	RF	CL	5 U	5 C	48 C	3 U	3 U	3 U	3 U	3 U	3 U
SR-GW32-02SVMS	GW	RF	UAC	5 U	5 U	5 U	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MWC-37GW	GW	RF	CL	460	31 C	120 C	3 U	30	74	6400	3 U	3 U
SR-GW33-02	GW	RF	UA	5 U	5 UJ	39 UJ	5 UJ	3 U	3 U	3 U	3 U	3 U
SMC-MWP-02GW	GW	RF	UA	5 U	260 C	170 C	3 U	3 U	3 U	3 U	3 U	3 U
SR-GW34-02	GW	RF	UA	5 U	5 U	260 D	1 J	3 U	3 U	3 U	3 U	3 U
SMC-MWP-56GW	GW	RF	UA	5 U	10 C	14 C	3 U	3 U	3 U	3 U	3 U	3 U
SR-GW35-02	GW	RF	UA	5 U	1 J	8500 D	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MW-35GW	GW	RF	UA	5 U	48 C	350 C	3 U	3 U	3 U	3 U	3 U	3 U
SR-GW36-02	GW	RF	UA	5 U	5 U	5 U	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MW-33GW	GW	RF	DA	5 U	202 C	300 C	3 U	3 U	3 U	3 U	3 U	3 U
SR-GW50-02	GW	RF	UA	5 U	5 U	15 U	3 U	3 U	12	3 U	3 U	3 U
SR-GW01-02	GW	RF	UA	5 U	5 U	80 UJ	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MW-11-02	GW	RF	UA	5 U	5 U	5 U	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MW-55GW	GW	RF	UA	5 U	31 EC	120 C	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MW-11-01	GW	RF	UA	5 U	5 U	5 U	3 U	3 U	47 U	3 U	3 U	2 U
SMC-MW-51GW	GW	RF	UA	5 U	19 EC	110 C	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MW-10-02	GW	RF	UA	160	5 U	5 U	3 U	1 U	20	260	3 U	3 U
SMC-MWD-47GW	GW	RF	DA	5 U	11 C	89 C	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MW-10-01	GW	RF	UA	330	5 U	5 U	3 U	11	67	2600	3 U	1 U
SMC-MW-29GW	GW	RF	UA	5 U	4 EC	29 C	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MW-09-02	GW	RF	UA	5 U	5 U	5 U	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MWD-48GW	GW	RF	DA	5 U	7 C	107 C	3 U	3 U	3 U	2 E	1 E	3 U
SMC-MW-09-01	GW	RF	UA	5 U	5 U	5 U	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MWC-38GW	GW	RF	CL	5 U	18 C	190 C	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MW-08-02	GW	RF	UA	5 U	5 U	5 U	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MW-57GW	GW	RF	UA	5 U	130 EC	240 EC	3 U	3 U	3 U	2000	3 U	3 U
SMC-MW-08-01	GW	RF	UA	5 U	5 U	5 U	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MW-34GW	GW	RF	UA	5 U	13 C	28 C	3 U	3 U	3 U	3 U	3 U	3 U
SR-GW66-01A	GW	RF	DA	5 U	5 U	7 JB	3 U	3 U	3 U	3 U	3 U	3 U
SR-GW57-02	GW	RF	UA	5 U	5 U	5 U	3 U	3 U	690	3 U	3 U	8700
SMC-MW-07-01	GW	RF	UA	5 U	5 U	5 U	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MW-49GW	GW	RF	UA	5 U	68 C	320 C	3 U	3 U	3 U	3 U	3 U	3 U
SR-GW51-02	GW	RF	UA	5 U	5 U	22 J	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MW-27GW	GW	RF	UA	5 U	31 EC	72 C	3 U	3 U	3 U	3 U	3 U	3 U
SR-GW52-02	GW	RF	UA	5 U	5 U	250 J	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MWD-46GW	GW	RF	UA	5 U	5 U	5 U	3 U	3 U	3 U	3 U	3 U	3 U
SR-GW53-02	GW	RF	UA	5 U	5 U	64 UJ	3 U	3 U	24	3 U	3 U	3 U
SMC-MW-31GW	GW	RF	UA	5 U	180 C	248 C	3 U	3 U	3 U	3 U	3 E	3 U
SR-GW54-02	GW	RF	UA	5 U	5 U	16	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MW-36GW	GW	RF	UA	5 U	34 C	6030 C	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MWC-40GW	GW	RF	CL	5 U	12 C	410 C	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MW-53GW	GW	RF	UA	5 U	28 EC	96 C	3 U	3 U	3 U	3 U	3 U	3 U
SR-GW55-02	GW	RF	UA	5 U	5 U	5 U	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MWDB-03GW	GW	TF	DA	5 U	14 C	150 C	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MWDB-01GW	GW	TF	DA	5 U	36 C	38 C	3 U	3 U	3 U	3 U	3 U	3 U
SMC-MWDB-02GW	GW	TF	DA	5 U	22 C	240 C	3 U	3 U	3 U	3 U		3 U

GROU ? VOL/

SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	1,1,1-TRICHLOROETHANE	VINYL ACETATE	TRICHLOROETHENE	1,1,2-TRICHLOROETHANE
SMC-MW-07-02	GW	RF	UA	3 U	5 U	3 U	3 U
SR-GW32-02	GW	RF	UA	3 U	5 U	3 U	3 U
SR-GW31-02	GW	RF	UA	3 U	5 U	3 U	3 U
SR-GW53-02SVMS	GW	RF	UAC	3 U	5 U	3 U	3 U
SR-GW28-02	GW	RF	UA	3 U	5 U	3 U	3 U
SR-GW10-02	GW	RF	UA	35 J	5 U	3 U	3 U
SR-GW07-02	GW	RF	UA	3 U	5 U	3 U	3 U
SR-GW09-02	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MW-01-02	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MW-01-01	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MW-54GW	GW	RF	UA	3 U	5 U	3 U	3 U
SR-GW10-02SVMS	GW	RF	UAC	38 J	5 U	3 U	3 U
SMC-MW-52GW	GW	RF	UA	3 U	5 U	3 U	3 U
SR-GW09-02SVMS	GW	RF	UAC	3 U	5 U	3 U	3 U
SMC-MW-50GW	GW	RF	UA	3 U	5 U	3 U	3 U
SR-GW07-02SVMS	GW	RF	UAC	3 U	5 U	3 U	3 U
SMC-MWD-49GW	GW	RF	DA	3 U	5 U	3 U	3 U
SR-GW11-02	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MW-32GW	GW	RF	UA	3 U	5 U	3 U	3 U
SR-GW25-02	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MW-30GW	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MW-28GW	GW	RF	UA	3 U	5 U	3 U	3 U
SR-GW27-02A	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MW-25GW	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MWC-41GW	GW	RF	CL	3 U	5 U	3 U	3 U
SR-GW33-02DL	GW	RF	UAD	3 U	5 U	3 U	3 U
SMC-MWC-39GW	GW	RF	CL	3 U	5 U	3 U	3 U
SR-GW32-02SVMS	GW	RF	UAC	3 U	5 U	3 U	3 U
SMC-MWC-37GW	GW	RF	CL	280	5 U	3 U	3 U
SR-GW33-02	GW	RF	UA	3 U	5 U	3 U	81 J
SMC-MWP-02GW	GW	RF	UA	3 U	5 U	3 U	3 U
SR-GW34-02	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MWP-56GW	GW	RF	UA	3 U	5 U	3 U	3 U
SR-GW35-02	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MW-35GW	GW	RF	UA	3 U	5 U	3 U	3 U
SR-GW36-02	GW	RF	UA	3 U	19 T	3 U	3 U
SMC-MW-33GW	GW	RF	UA	3 U	5 U	3 U	3 U
SR-GW50-02	GW	RF	UA	3 U	5 U	3 U	3 U
SR-GW01-02	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MW-11-02	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MW-55GW	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MW-11-01	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MW-51GW	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MW-10-02	GW	RF	UA	27	5 U	1 U	3 U
SMC-MWD-47GW	GW	RF	DA	3 U	5 U	3 U	3 U
SMC-MW-10-01	GW	RF	UA	200	5 U	310	3 U
SMC-MW-29GW	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MW-09-02	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MWD-48GW	GW	RF	DA	3 U	5 U	3 U	3 U
SMC-MW-09-01	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MWC-38GW	GW	RF	CL	3 U	5 U	3 U	3 U
SMC-MW-08-02	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MW-57GW	GW	RF	UA	240 E	5 U	660	3 U
SMC-MW-08-01	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MW-34GW	GW	RF	UA	3 U	5 U	3 U	3 U
SR-GW66-01A	GW	RF	DA	3 U	5 U	3 U	3 U
SR-GW57-02	GW	RF	UA	1800	5 U	3 U	3 U
SMC-MW-07-01	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MW-49GW	GW	RF	UA	3 U	5 U	3 U	3 U
SR-GW51-02	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MW-27GW	GW	RF	UA	3 U	5 U	3 U	3 U
SR-GW52-02	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MWD-46GW	GW	RF	UA	3 U	5 U	3 U	3 U
SR-GW53-02	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MW-31GW	GW	RF	UA	1 E	5 U	3 U	3 U
SR-GW54-02	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MW-36GW	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MWC-40GW	GW	RF	CL	3 U	5 U	3 U	3 U
SMC-MW-53GW	GW	RF	UA	3 U	5 U	3 U	3 U
SR-GW55-02	GW	RF	UA	3 U	5 U	3 U	3 U
SMC-MWDB-03GW	GW	TF	DA	3 U	5 U	3 U	3 U
SMC-MWDB-01GW	GW	TF	DA	3 U	5 U	3 U	3 U
SMC-MWDB-02GW	GW	TF	DA	3 U	5 U	3 U	3 U

[redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted]

BENZENE	cis-1,3-DICHLOROPROPENE	4-METHYL-2-PENTANONE	2-HEXANONE	1,1,2,2-TETRACHLOROETHANE
28	3 U	5 U	5 U	3 U
3 U	3 U	5 U	5 U	3 U
3 U	3 U	5 U	5 U	3 U
3 U	3 U	5 U	5 U	3 U
3 U	3 U	5 U	5 U	3 U
620	3 U	5 U	5 U	3 U
7 T	3 U	5 U	5 U	3 U
100	3 U	5 U	5 U	3 U
3 U	3 U	5 U	5 U	3 U
5 U	3 U	5 U	5 U	3 U
5 U	3 U	28	5 U	3 U
660	3 U	5 U	5 U	3 U
140	7	33	5 U	3 U
99	3 U	5 U	5 U	3 U
180	3 U	5 U	5 U	3 U
0 J	3 U	5 U	5 U	3 U
5 U	3 U	5 U	5 U	3 U
51	3 U	5 U	5 U	3 U
8 E	3 U	5 U	5 U	3 U
250	3 U	5 U	5 U	3 U
5 U	3 U	5 U	5 U	3 U
5 U	3 U	5 U	5 U	3 U
5 U	3 U	5 U	5 U	3 U
106	3 U	5 U	5 U	3 U
12	3 U	5 U	5 U	3 U
81	3 U	5 U	5 U	3 U
5 U	3 U	5 U	5 U	3 U
5 U	3 U	5 U	5 U	3 U
650	3 U	5 U	5 U	3 U
5 U	3 U	5 U	5 U	3 U
270	3 U	5 U	5 U	3 U
11	3 U	5 U	5 U	3 U
15	3 U	70	5 U	3 U
200	3 U	5 U	5 U	3 U
130	3 U	5 U	5 U	3 U
4 J	3 U	14 T	5 U	7 T
330	3 U	5 U	5 U	3 U
160	3 U	5 U	5 U	3 U
5 U	3 U	5 U	5 U	3 U
51	3 U	5 U	5 U	3 U
81	3 U	5 U	5 U	3 U
140	3 U	5 U	5 U	13
15 E	3 U	5 U	5 U	3 U
760	3 U	5 U	5 U	3 U
5 U	3 U	5 U	5 U	3 U
700	3 U	5 U	5 U	21
5 U	3 U	5 U	5 U	3 U
130	3 U	5 U	5 U	3 U
6 E	3 U	5 U	5 U	3 U
5 U	3 U	5 U	5 U	3 U
18	3 U	5 U	5 U	3 U
5 U	3 U	5 U	5 U	3 U
530	3 U	5 U	5 U	3 U
54	3 U	5 U	5 U	3 U
5 U	3 U	10 E	5 U	3 U
5 U	3 U	5 U	5 U	3 U
830	3 U	5 U	860	3 U
100	3 U	5 U	5 U	3 U
420	3 U	2700	5 U	3 U
95	3 U	5 U	5 U	3 U
48	3 U	5 U	5 U	3 U
1200	3 U	5 U	5 U	3 U
5 U	3 U	5 U	20 E	3 U
98 J	3 U	5 U	5 U	3 U
5 E	3 U	92	5 U	3 U
5 U	3 U	5 U	5 U	3 U
5 U	3 U	5 U	290	3 U
4 E	3 U	5 U	5 U	3 U
110	3 U	3300	5 U	3 U
11 T	3 U	5 U	5 U	3 U
5 U	3 U	5 U	5 U	3 U
5 U	3 U	5 U		3 U
5 U	3 U	6 U		3 U

GROUNDWATER VOLATILES
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	TOLUENE	CHLOROBENZENE	ETHYLBENZENE	STYRENE	TOTAL XYLENES
SMC-MW-07-02	GW	RF	UA	1 U	3 U	3 U	3 U	3 U
SR-GW32-02	GW	RF	UA	1 U	3 U	3 U	3 U	3 U
SR-GW31-02	GW	RF	UA	1 U	3 U	13	3 U	42
SR-GW53-02SYMS	GW	RF	UAC	1 U	3 U	1100	3 U	1700 J
SR-GW28-02	GW	RF	UA	1 U	3 U	46	3 U	220
SR-GW10-02	GW	RF	UA	84	3 U	83	3 U	440
SR-GW07-02	GW	RF	UA	1 U	3 U	3 U	3 U	1 JT
SR-GW09-02	GW	RF	UA	16	3 U	9 J	3 U	160 J
SMC-MW-01-02	GW	RF	UA	1 U	3 U	3 U	3 U	3 U
SMC-MW-01-01	GW	RF	UA	1 U	3 U	3 U	3 U	3 U
SMC-MW-54GW	GW	RF	UA	1 U	3 U	26	3 U	52
SR-GW10-02SYMS	GW	RF	UAC	110	3 U	110	3 U	590
SMC-MW-52GW	GW	RF	UA	7	3 U	8	3 U	170
SR-GW09-02SYMS	GW	RF	UAC	16	3 U	8	3 U	100 J
SMC-MW-50GW	GW	RF	UA	1 U	3 U	160	3 U	270
SR-GW07-02SYMS	GW	RF	UAC	1 J	3 U	3 U	3 U	8 J
SMC-MWD-49GW	GW	RF	DA	1 U	3 U	3 U	3 U	3 U
SR-GW11-02	GW	RF	UA	1 U	3 U	30	3 U	50
SMC-MW-32GW	GW	RF	UA	1 U	3 U	44	3 U	170
SR-GW25-02	GW	RF	UA	47	3 U	85	3 U	510
SMC-MW-30GW	GW	RF	UA	1 U	3 U	3 U	3 U	3 U
SMC-MW-28GW	GW	RF	UA	1 U	3 U	7	3 U	34
SR-GW27-02A	GW	RF	UA	22	3 U	3 U	3 U	9
SMC-MW-25GW	GW	RF	UA	10	3 U	37	3 U	200
SMC-MWC-41GW	GW	RF	CL	1 U	3 U	3 U	3 U	7
SR-GW33-02DL	GW	RF	UAD	3 J	3 U	1 J	3 U	81
SMC-MWC-39GW	GW	RF	CL	1 U	3 U	3 U	3 U	20
SR-GW32-02SYMS	GW	RF	UAC	1 U	3 U	3 U	3 U	3 U
SMC-MWC-37GW	GW	RF	CL	240	3 U	140	3 U	3 U
SR-GW33-02	GW	RF	UA	3 J	3 U	1 J	3 U	81 J
SMC-MWP-02GW	GW	RF	UA	23 E	3 U	46	3 U	240
SR-GW34-02	GW	RF	UA	1 JT	3 U	8 J	3 U	2 J
SMC-MWP-56GW	GW	RF	UA	2 E	3 U	35	3 U	23
SR-GW35-02	GW	RF	UA	49	3 U	6	3 U	320 D
SMC-MW-35GW	GW	RF	UA	10	3 U	3 U	3 U	170
SR-GW36-02	GW	RF	UA	3 J	1 J	3 U	3 U	3 U
SMC-MW-33GW	GW	RF	UA	1 U	3 U	3 U	3 U	150
SR-GW50-02	GW	RF	UA	23	3 U	170	3 U	120
SR-GW01-02	GW	RF	UA	1 U	3 U	3 U	3 U	3 U
SMC-MW-11-02	GW	RF	UA	19	3 U	24	3 U	3 U
SMC-MW-55GW	GW	RF	UA	1 U	3 U	3 U	3 U	3 U
SMC-MW-11-01	GW	RF	UA	19	7	4 U	3 U	3 U
SMC-MW-51GW	GW	RF	UA	1 U	3 U	3 U	3 U	3 U
SMC-MW-10-02	GW	RF	UA	32	11	3 U	3 U	3 U
SMC-MWD-47GW	GW	RF	DA	50	3 U	30	3 U	1000
SMC-MW-10-01	GW	RF	UA	81	11	44	3 U	3 U
SMC-MW-29GW	GW	RF	UA	1 U	3 U	3 U	3 U	3 U
MC-MW-09-02	GW	RF	UA	7	3 U	4 U	3 U	3 U
MC-MWD-48GW	GW	RF	DA	1 U	3 U	3 U	3 U	3 U
MC-MW-09-01	GW	RF	UA	1 U	3 U	3 U	3 U	3 U
MC-MWC-38GW	GW	RF	CL	8	8	3 U	3 U	90
MC-MW-08-02	GW	RF	UA	1 U	3 U	3 U	3 U	3 U
MC-MW-57GW	GW	RF	UA	530	3 U	110 E	3 U	3 U
MC-MW-08-01	GW	RF	UA	11	3 U	70	3 U	3 U
MC-MW-34GW	GW	RF	UA	1 U	3 U	3 U	3 U	3 U
R-GW56-01A	GW	RF	DA	4	3 U	3 U	3 U	10
R-GW57-02	GW	RF	UA	390 J	3 U	3 U	3 U	1500
MC-MW-07-01	GW	RF	UA	8	3 U	3 U	3 U	3 U
C-MW-49GW	GW	RF	UA	1 U	3 U	3 U	3 U	3 U
R-GW51-02	GW	RF	UA	1 U	3 U	8 J	3 U	19
C-MW-27GW	GW	RF	UA	1 U	3 U	3 U	3 U	3 U
R-GW52-02	GW	RF	UA	1 U	3 U	3 U	3 U	440
C-MWD-46GW	GW	RF	UA	1 U	3 U	3 U	3 U	3 U
R-GW53-02	GW	RF	UA	17	3 U	50 J	3 U	74 J
C-MW-31GW	GW	RF	UA	1 U	3 U	3 U	3 U	3 U
-GW54-02	GW	RF	UA	1 U	3 U	51	3 U	84
C-MW-36GW	GW	RF	UA	28	3 U	3 U	3 U	3 U
C-MWC-40GW	GW	RF	CL	2 E	3 U	9 E	3 U	81
C-MW-53GW	GW	RF	DA	1 U	3 U	830	3 U	1100
-GW55-02	GW	RF	UA	5 JT	3 U	11 T	37 T	3 U
C-MWDB-03GW	GW	TF	DA	1 U	3 U	3 U	3 U	3 U
C-MWDB-01GW	GW	TF	DA	1 U	3 U	3 U	3 U	3 U
C-MWDB-02GW	GW	TF	DA	1 U	3 U	3 U	3 U	3 U

GROUNDWATER SEMI-VOLATILES
SINCLAIR REFINERY-

SAMPLEID	TYPE1	LOC	TYPE2	PHENOL	NITROBENZENE	ISOPHORONE	2,4-DIMETHYLPHENOL	BENZOIC ACID	NAPHTHALENE	4-CHLOROANILINE	2-METHYNAPHTHALENE	4-NITROPHENOL	DIETHYLPHTHALATE	FLUORENE
SMC-MW-09-02	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U
SMC-MW-34GW	GW	RF	UA	5 U	5 U	9 E	5 U	1 E	5 U	5 U	25	25 U	5 U	5 U
SMC-MW-33GW	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	3 E	5 U	15	25 U	5 U	5 U
SMC-MW-55GW	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	53	25 U	5 U	5 U
SR-GW01-02	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U
SMC-MW-53GW	GW	RF	UA	5 U	5 U	24	5 U	25 U	170	120	250	25 U	5 U	23
SR-GW07-02	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	9 J	25 U	5 U	5 U
SMC-MW-51GW	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	22	25 U	5 U	5 U
SR-GW09-02	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U
SMC-MW-49GW	GW	RF	UA	5 U	5 U	34	5 U	25 U	5 U	5 U	67	25 U	5 U	5 U
SR-GW10-02	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	29	25 U	5 U	5 U
SMC-MWD-47GW	GW	RF	DA	5 U	5 U	5 U	5 U	25 U	28	21	33	25 U	5 U	5 U
SR-GW11-02	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	14 UB	5 U
SMC-MW-31GW	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U
SR-GW27-02	GW	RF	UA	5 U	8100 D	5 U	5 U	25 U	5 U	5 U	12	30 J	5 U	5 U
SMC-MW-29GW	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	7 E	25 U	5 U	5 U
SR-GW27-02A	GW	RF	UA	5 U	8200 D	5 U	5 U	25 U	5 U	5 U	9	20 J	5 U	5 U
SMC-MW-27GW	GW	RF	UA	5 U	1700	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U
SMC-MWD-40GW	GW	RF	DA	5 U	5 U	5 U	5 U	25 U	3 E	5 U	11	25 U	5 U	5 U
SMC-MWC-40GW	GW	RF	CL	5 U	5 U	5 U	5 U	25 U	5 E	5 U	25	25 U	5 U	5 U
SR-GW31-02	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U
SMC-MWC-38GW	GW	RF	CL	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U
SR-GW32-02	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U
SMC-MWD-48GW	GW	RF	DA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U
SR-GW33-02	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U
SMC-MWP-37GW	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 E	5 U	10	25 U	5 U	5 U
SR-GW35-02	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	27	25 U	5 U	5 U
SMC-MW-36GW	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U
SR-GW50-02	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	130	25 U	5 U	5 U
SMC-MW-01-01	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U
SR-GW53-02	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	230	5 U	270	25 U	5 U	21
SMC-MW-52GW	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	13	5 U	33	25 U	5 U	5 U
SR-GW54-02	GW	RF	UA	5 U	5 U	5 U	R	R	32 R	5 U	100	25 U	5 U	5 U
SMC-MWD-49GW	GW	RF	DA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U
SR-GW55-02	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	89	R	5 U	5 U
SMC-MW-30GW	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U
SMC-MW-11-02	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U
SMC-MW-25GW	GW	RF	UA	25	5 U	5 U	5 U	25 U	5 E	5 U	39	25 U	5 U	5 U
SMC-MW-11-01	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	1 U
SMC-MWC-39GW	GW	RF	CL	23	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U
SMC-MW-10-02	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U
SMC-MWP-02GW	GW	RF	UA	43	5 U	5 U	5 U	2 E	5 U	5 U	5 U	25 U	5 U	5 U
SMC-MW-10-01	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U
SMC-MW-35GW	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	10	25 U	5 U	5 U
SMC-MW-09-01	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U
SMC-MW-50GW	GW	RF	UA	5 U	5 S	41	5 U	6 E	5 U	5 U	340	25 U	5 U	30
SMC-MW-08-02	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U
SMC-MW-28GW	GW	RF	UA	5 U	5 U	5 U	5 U	1 E	5 U	5 U	88	25 U	5 U	5 U
SMC-MW-08-01	GW	RF	UA	5 U	5 U	5 U	32	25 U	150	5 U	5 U	25 U	5 U	3
SMC-MWC-37GW	GW	RF	CL	5 U	5 U	5 U	5 U	25 U	5 U	5 U	21	25 U	5 U	5 U
SMC-MW-07-02	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U
SMC-MW-54GW	GW	RF	UA	5 U	11	5 E	5 U	1 E	20	5 U	59	25 U	5 U	7 E
SMC-MW-07-01	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	2	5 U	5 U	25 U	5 U	1 U
SMC-MWC-41GW	GW	RF	CL	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U
SMC-MW-32GW	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	90	25 U	5 U	5 U
SMC-MWP-56GW	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	41	25 U	5 U	5 U
SMC-MW-01-02	GW	RF	UA	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U
SMC-MWDB-01GW	GW	TF	MW	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U
SMC-MWDB-03GW	GW	TF	MW	5 U	5 U	5 U	5 U	25 U	5 U	5 U	5 U	25 U	5 U	5 U

GROUNDWATER SEMI-VOLATILES
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	N-NITROSODIPHENYLAMINE	PHENANTHRENE	DI-n-BUTYLPHTHALATE	PYRENE	BIS(2-ETHYLHEXYL)PHTHALATE	DI-n-OCTYLPHTHALATE	BENZO(a)PYRENE
SMC-MW-09-02	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MW-34GW	GW	RF	UA	5 U	5 U	5 U	5 U	21 C	5 U	5 U
SMC-MW-33GW	GW	RF	UA	5 U	5 U	3 EC	5 U	39 C	5 U	10
SMC-MW-55GW	GW	RF	UA	5 U	5 U	5 U	5 U	240 C	5 U	5 U
SR-GW01-02	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MW-53GW	GW	RF	UA	5 U	64	5 U	10	690 C	41	5 U
SR-GW07-02	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MW-51GW	GW	RF	UA	5 U	5 U	3 EC	5 U	42 C	5 U	13
SR-GW09-02	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MW-49GW	GW	RF	UA	82	41	5 U	5 U	66 C	5 U	5 U
SR-GW10-02	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MWD-47GW	GW	RF	DA	5 U	5 U	3 EC	5 U	51 C	5 U	5 U
SR-GW11-02	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MW-31GW	GW	RF	UA	5 U	5 U	5 U	5 U	160 C	5 U	5 U
SR-GW27-02	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MW-29GW	GW	RF	UA	5 U	5 U	10 C	5 U	19 C	5 U	12
SR-GW27-02A	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MW-27GW	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MWD-40GW	GW	RF	DA	5 U	5 U	5 U	5 U	71 C	3 E	10
SMC-MWC-40GW	GW	RF	CL	5 U	5 U	6 EC	5 U	59 C	6 E	12
SR-GW31-02	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MWC-38GW	GW	RF	CL	5 U	5 U	35 C	5 U	200 C	5 U	5 U
SR-GW32-02	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MWD-46GW	GW	RF	DA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SR-GW33-02	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MWP-57GW	GW	RF	UA	5 U	5 U	7 EC	5 U	78 C	14	12
SR-GW35-02	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MW-36GW	GW	RF	DA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SR-GW50-02	GW	RF	UA	5 U	10	5 U	5 U	7 U	5 U	5 U
SMC-MW-01-01	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SR-GW53-02	GW	RF	UA	5 U	53	5 U	10	16 U	5 U	5 U
SMC-MW-52GW	GW	RF	DA	5 U	5 U	12 C	5 U	22 C	5 U	5 U
SR-GW54-02	GW	RF	UA	5 U	25	5 U	5 U	5 U	5 U	5 U
SMC-MWD-49GW	GW	RF	DA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SR-GW55-02	GW	RF	UA	5 U	5 U	5 U	5 U	7 U	5 U	5 U
SMC-MW-30GW	GW	RF	UA	5 U	5 U	3 EC	5 U	20 C	5 U	13
SMC-MW-11-02	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MW-25GW	GW	RF	UA	5 U	5 U	15 C	5 U	20 C	5 U	11
SMC-MW-11-01	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MWC-39GW	GW	RF	CL	5 U	5 U	3 EC	5 U	57 C	5 E	13
SMC-MW-10-02	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MWP-02GW	GW	RF	UA	5 U	5 U	2 EC	5 U	14 C	5 U	10
SMC-MW-10-01	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MW-35GW	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MW-09-01	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MW-50GW	GW	RF	UA	108	90	5 U	24	110 C	5 U	5 U
SMC-MW-08-02	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MW-28GW	GW	RF	UA	5 U	5 U	6 C	5 U	5 U	5 U	5 U
SMC-MW-08-01	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MWC-37GW	GW	RF	CL	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MW-07-02	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MW-54GW	GW	RF	UA	10	15	5 EC	7 E	22 C	6 E	13
SMC-MW-07-01	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MWC-41GW	GW	RF	CL	5 U	5 U	5 U	5 U	14 C	5 U	5 U
SMC-MW-32GW	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MWP-56GW	GW	RF	UA	5 U	5 U	3 EC	5 U	16 C	5 U	12
SMC-MW-01-02	GW	RF	UA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SMC-MWDB-01GW	GW	TT	MW	5 U	5 U	5 EC	5 U	160 C	16	5 U
SMC-MWDB-03GW	GW	TT	MW	5 U	5 U	5 U	5 U	30 C	5 U	5 U

GROUNDWATER INORGANICS
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	AL	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	NI	K	AG	NA	TL	V	ZN
SR-GW01-02	GW	RF	UA	23200	5 U	580	3 N	3 U	105000	73 J	22 N	143	234000	91	22200	2020	104 J	8230	5 U	85900	5 U	45 N	7440
SR-GW07-02	GW	RF	UA	39300	155	695	2 N	3 U	74400	66	42 N	123	183000	70 S	30600 J	9420	104	7980	10 N	10000 J	5 U	48 N	6860
SR-GW09-02	GW	RF	UA	14000	30	823	4 N	3 U	83000	37 J	12 N	98	128000	65	19000	3880	90 J	6380	5 U	80600	5 U	27 N	2650
SR-GW10-02	GW	RF	UA	753	248	1290	3 U	3 U	92200	74 J	9 N	264	112000	26	9770	4460	73 J	2850 N	5 U	14000	5 U	8 N	1880 J
SR-GW11-02	GW	RF	UA	15100	884	1260	3 U	3 U	84900	182 J	29 N	473	119000	77	16300	31900	189 J	8290	5 U	12500	10 UJ	27 N	4030
SR-GW27-02A	GW	RF	UA	9900	648	1260	3 N	3 U	64800	298 J	36 N	958	64750	42	17250	4900	382 J	5310	5 U	50150	5 U	18 N	1490
SR-GW28-02	GW	RF	UA	24200	170 S	538	4 N	3 U	28500	30 J	19 N	58	61200	151	10200	1700	45 J	6310	5 U	2285 N	5 U	32 N	9040
SR-GW31-02	GW	RF	UA	7100	217 S	829	3 U	3 U	26400	17 J	6 N	21 N	46000	62	7140	8520	25 NJ	3950 N	5 U	5340	5 U	25 U	1310
SR-GW32-02	GW	RF	UA	34500 J	79 J	1100 J	2 NJ	3 U	103000 J	100 J	38 NJ	70 J	110000 J	72 J	33800 J	11000 J	106 J	7550 J	9 NJ	12300 J	5 U	44 NJ	21500
SR-GW33-02	GW	RF	UA	3960	385	981	3 U	6	72000	151	18 N	499	73900	122	20400 J	7350	201	8370	5 N	70000 J	5 U	5 N	4680
SR-GW35-02	GW	RF	UA	20300	89	911	3 U	3 U	96300	33	15 N	44	67500	47	20800 J	2270	41	6430	4 N	30600 J	5 U	23 N	4080 J
SR-GW50-02	GW	RF	UA	100 U	53	472	3 U	3 U	27200	5 U	25 U	13 U	42500	3 U	6770	6170	20 U	3180 N	5 U	6740	5 U	5 N	273 J
SR-GW53-02	GW	RF	UA	113000	277	2360	8	3 U	28500	198 J	89	235	280000	249	29100	8640	235 J	12900	5 U	8010	5 U	149	21200 J
SR-GW54-02	GW	RF	UA	16600	29	1110	3 N	3 U	16500	70 J	17 N	67	83300	73	6050	12900	82 J	3800 N	5 U	5850	5 U	25 N	3900
SR-GW55-02	GW	RF	UA	27000 J	55 J	934 J	3 U	3 U	39000 J	71 J	26 NJ	62 J	80600 J	34 J	15800 J	10400 J	77 J	8730 J	10 NJ	10100 J	5 U	31 NJ	3270

SOIL VOLATILES
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	CHLOROETHANE	METHYL CHLORIDE	ACETONE	CARBON DISULFIDE	TRANS-1,2-DICHLOROETHENE
SR-RS15-01	SO	GR	SF	5 U	5 U	5 U	3 U	3 U
SMC-RS-13	SO	GR	SF	5 U	2150 C	8 EC	3 U	3 U
SMC-RS-12	SO	GR	SF	5 U	21 C	70 C	3 U	7
SMC-RS-04	SO	GR	DP	5 U	5 U	5 U	3 U	3 U
SMC-RS-09	SO	GR	SF	5 U	70 C	770 C	3 U	3 U
SMC-RS-05	SO	UR	SF	5 U	5 U	5 U	3 U	3 U
SR-RS17-01	SO	GR	SF	5 U	5 U	5 U	3 U	3 U
SMC-RS-08	SO	GR	DP	5 U	5 U	5 U	3 U	3 U
SMC-RS-06	SO	GR	DP	5 U	5 U	5 U	3 U	3 U
SMC-RS-03	SO	GR	SF	5 U	5 U	5 U	3 U	3 U
SR-RS16-01A	SO	GR	SF	5 U	5 U	5 U	3 U	3 U
SMC-RS-14	SO	GR	SF	5 U	1250 EC	65 C	3 U	3 U
SMC-RS-07	SO	GR	SF	5 U	5 U	5 U	3 U	3 U
SMC-RS-11	SO	NF	DS	5 U	41 C	210 C	60	3 U
SMC-SP-29	SO	NF	PL	5 U	5 U	5 U	3 U	3 U
SMC-SP-31	SO	NF	PL	5 U	5 U	5 U	3 U	3 U
SMC-SP-32	SO	NF	MF	5 U	5 U	5 U	3 U	3 U
SMC-SP-27	SO	NF	SP	5 U	5 U	5 U	3 U	3 U
SMC-SP-33	SO	NF	MF	5 U	5 U	5 U	3 U	3 U
SR-AB07-01	SO	NF	DS	5 U	5 U	5 U	3 U	3 U
SMC-SP-34	SO	NF	OF	5 U	5 U	5 U	3 U	3 U
SR-AB06-01A	SO	NF	DS	5 U	5 U	5 U	3 U	3 U
SMC-SP-35	SO	NF	OF	5 U	5 U	5 U	3 U	3 U
SMC-SP-25	SO	NF	SP	5 U	5 U	5 U	3 U	3 U
SMC-SP-36	SO	NF	MF	5 U	5 U	5 U	3 U	3 U
SR-AB08-01	SO	NF	DS	5 U	5 U	36 U	3 U	3 U
SMC-RS-10	SO	NF	DS	5 U	6 C	60 C	3 U	3 U
SMC-SS-20	SO	NF	DS	5 U	4964 EC	78 C	3 U	3 U
SR-AB101-01	SO	NF	DP	5 U	5 U	5 U	3 U	3 U
SMC-MW-34	SO	NF	MW	5 U	43 EC	240 EC	3 U	3 U
SMC-MW-35	SO	NF	MW	5 U	110 EC	280 EC	8 E	3 U
SMC-MW-27	SO	NF	MW	5 U	54 EC	7800 EC	9 E	3 U
SMC-MW-36	SO	NF	MW	5 U	2000 EC	5100 EC	190 E	3 U
SMC-MW-25	SO	NF	MW	5 U	1200 EC	4100 EC	180 E	3 U
SMC-MWC-37	SO	NF	CL	5 U	7 C	140 C	3 U	3 U
SMC-AB-37	SO	NF	AB	5 U	36 C	140 C	3 U	3 U
SMC-MWC-38	SO	NF	CL	5 U	5 U	66 C	3 U	3 U
SMC-MW-55	SO	NF	MW	5 U	15 C	39 C	5	3 U
SMC-MWC-40	SO	NF	CL	5 U	6 C	97 C	3 U	3 U
SMC-MW-100	SO	NF	MW	5 U	5 U	5 U	3 U	3 U
SMC-MWC-41	SO	NF	CL	5 U	5 U	100 C	3 U	3 U
SMC-MW-08	SO	NF	MW	5 U	5 U	5 U	3 U	3 U
SMC-AB-41	SO	NF	CL	5 U	7 EC	2400 C	3 U	3 U
SMC-MW-01	SO	NF	MW	5 U	5 U	5 U	3 U	3 U
SMC-AB-42	SO	NF	CL	5 U	12 C	170 C	3 U	3 U
SMC-AB-31	SO	NF	AB	5 U	5 U	5 U	3 U	3 U
SMC-MW-11	SO	NF	MW	5 U	5 U	5 U	3 U	3 U
SMC-MW-09	SO	NF	MW	5 U	5 U	5 U	3 U	3 U
SMC-AB-28	SO	NF	AB	5 U	5 U	5 U	3 U	3 U
SMC-MW-07	SO	NF	MW	5 U	120	5 U	3 U	3 U
SMC-AB-20	SO	NF	AB	5 U	5 U	5 U	3 U	3 U
SMC-AB-32	SO	NF	AB	5 U	5 U	5 U	3 U	3 U
SMC-AB-24	SO	NF	AB	5 U	5 U	5 U	3 U	3 U
SMC-AB-30	SO	NF	AB	5 U	5 U	5 U	3 U	3 U
SMC-AB-22	SO	NF	AB	5 U	5 U	5 U	3 U	3 U
SMC-AB-29	SO	NF	AB	5 U	5 U	5 U	3 U	3 U
SMC-AB-20	SO	NF	AB	5 U	5 U	5 U	3 U	3 U
SMC-MW-51	SO	NF	MW	5 U	6 EC	1200	6 E	3 U
SMC-AB-18	SO	NF	AB	5 U	5 U	5 U	3 U	3 U

CHLOROFORM	1,2-DICHLOROETHANE	2-BUTANONE	1,1,1-TRICHLOROETHANE	VINYL ACETATE
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	3 E
3 U	3 U	32	1 E	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	72	3 U	5 E
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	210	3 U	5 U
3 U	3 U	5 U	1 E	5 U
3 U	3 U	74	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	40	3 U	5 U
21	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	10 E	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	130	3 U	5 U
3 U	3 U	5 U	3 U	5 U

SOIL VOLATILES
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	CHLOROETHANE	METHYL CHLORIDE	ACETONE	CARBON DISULFIDE	TRANS-1,2-DICHLOROETHENE	CHLORO
SMC-MW-50	SO	WF	MW	5 U	13 C	370 EC	8	3 U	8
SMC-AB-39	SO	WF	AB	5 U	8 C	38 C	3 U	3 U	3
SMC-MW-49	SO	WF	MW	5 U	18 C	1100 EC	7	3 U	3
SMC-AB-15	SO	WF	AB	5 U	5 U	5 U	3 U	3 U	3
SMC-MW-52	SO	WF	MW	5 U	80 C	7500 EC	48	3 U	3
SMC-AB-13	SO	WF	AB	5 U	5 U	5 U	3 U	3 U	3
SMC-MW-53	SO	WF	MW	5 U	14 E	9200 EC	4 E	3 U	1
SMC-MW-30	SO	WF	MW	5 U	220 C	22000 EC	7 E	3 U	3
SMC-MWD-47	SO	WF	DA	5 U	22 C	4500 C	3 U	3 U	3
SMC-MW-32	SO	WF	MW	5 U	140 EC	5700 EC	7 E	3 U	3
SR-TP02-04	SO	WF	TP	5 U	5 U	420 U	3 U	3 U	3
SMC-AB-40	SO	WF	AB	5 U	63 EC	2200 EC	3 U	3 U	3
SR-TP01-04	SO	WF	TP	5 U	5 U	120	3 U	3 U	3 U
SMC-AB-38	SO	WF	AB	5 U	15 C	91 C	3 U	2 E	3
SR-AB68-02	SO	WF	MD	5 U	5 U	5 U	3 U	3 U	3
SMC-MWD-46	SO	WF	MW	5 U	56 C	15 C	3 U	3 U	3
SR-AB67-02	SO	WF	MD	5 U	5 U	5 U	3 U	3 U	3
SMC-AB-25	SO	WF	AB	5 U	5 U	5 U	3 U	3 U	3
SR-AB66-02	SO	WF	MD	5 U	5 U	5 U	3 U	3 U	3
SMC-AB-21	SO	WF	AB	5 U	5 U	5 U	3 U	3 U	3
SR-AB68-03	SO	WF	DP	5 U	5 U	18	3 U	3 U	3
SMC-AB-17	SO	WF	AB	5 U	5 U	5 U	3 U	3 U	3
SR-AB67-03	SO	WF	DP	5 U	5 U	5 U	3 U	3 U	3
SMC-AB-14	SO	WF	AB	5 U	5 U	5 U	3 U	3 U	25
SR-AB66-03	SO	WF	DP	5 U	5 U	7 U	3 U	3 U	3
SMC-MW-31	SO	WF	MW	5 U	10 EC	800 EC	9 E	3 U	3
SR-AB102-01	SO	WF	DP	5 U	5 U	5 U	3 U	3 U	3
SMC-MW-26	SO	WF	MW	5 U	5 EC	70000 EC	5 E	3 U	3
SMC-MW-54	SO	WF	MW	5 U	11 C	130 C	4 E	3 U	3
SMC-AB-27	SO	WF	AB	5 U	5 U	5 U	3 U	3 U	3
SMC-MWP-56	SO	WF	MW	5 U	26 C	550 C	3 U	3 U	3
SMC-AB-19	SO	WF	AB	5 U	5 U	5 U	3 U	3 U	3
SMC-MWP-02	SO	WF	MW	5 U	41 C	27 C	3 U	3 U	3
SMC-MW-29	SO	WF	MW	5 U	4 EC	7300 EC	8 E	3 U	3
SMC-MW-28	SO	WF	MW	5 U	1100 EC	3000 EC	190 E	3 U	3
SMC-AB-35	SO	WF	AB	5 U	36 C	4500 C	34	3 U	3
SMC-MWC-39	SO	WF	MW	5 U	5 U	51 C	3 U	3 U	3
SMC-AB-16	SO	WF	AB	5 U	5 U	5 U	3 U	3 U	3
SMC-AB-23	SO	WF	AB	5 U	5 U	5 U	3 U	3 U	3
SMC-MW-33	SO	WF	MW	5 U	32 C	970 C	34	3 U	3
SMC-MWD-48	SO	WF	MW	5 U	24 C	930 C	3 U	3 U	3
SMC-MWDB-01	SO	TF	MW	5 U	10 C	13 C	3 U	3 U	3
SMC-AB-44	SO	TF	AB	5 U	19 C	540 C	3 U	3 U	3
SMC-AB-43	SO	TF	AB	5 U	21 C	1200 C	3 U	3 U	3
SMC-MWDB-03	SO	TF	MW	5 U	7 C	5 EC	3 U	3 U	3
SMC-AB-45	SO	TF	AB	5 U	29 C	930 C	3 U	3 U	3
SMC-MWDB-02	SO	TF	MW	5 U	17 C	380 C	3 U	3 U	3
SMC-MH-05	SO	WT	MH	29 E	18 EC	22 EC	3 U	3 U	3
SMC-MH-04	SO	WT	MH	5 U	1560 C	51560 C	3 U	2970	3
SMC-MH-06	SO	WT	MH	5 U	4300 C	12000 C	3 U	3 U	3
SMC-SS-16	SS	WF	CP	5 U	5 U	5 U	3 U	3 U	3
SR-TP02-01	SS	WF	TP	5 U	5 U	5 U	3 U	3 U	3
SMC-SS-08	SS	WF	CP	5 U	5 U	5 U	3 U	3 U	3
SR-TP34-02	SS	WF	TP	5 U	5 U	5 U	3 U	3 U	3
SMC-SS-10	SS	WF	CP	5 U	5 U	5 U	3 U	3 U	3

[redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted]

FORM	1,2-DICHLOROETHANE	2-BUTANONE	1,1,1-TRICHLOROETHANE	VINYL ACETATE
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	5 E	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	27	0 E	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	1 E	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	17	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	2 E	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	53	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	2 E	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	90 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	6940	3 U	5 U
	3 U	30000	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	24 E
	3 U	5 U	3 U	2735 U
	3 U	5 U	3 U	6100
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U
	3 U	5 U	3 U	5 U

SOIL VOLATILES
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	CHLOROETHANE	METHYL CHLORIDE	ACETONE	CARBON DISULFIDE	TRANS-1,2-DICHLOROETHENE	CHL
SR-TP34-04	SS	RF	TP	5 U	5 U	5 U	3 U	3 U	
SMC-SS-12	SS	RF	CP	5 U	100	5 U	3 U	3 U	
SR-TP33-01	SS	RF	TP	5 U	5 U	5 U	3 U	3 U	
SMC-SS-14	SS	RF	CP	5 U	5 U	5 U	3 U	3 U	
SMC-SS-07	SS	RF	CP	5 U	5 U	5 U	3 U	3 U	
SMC-SS-13	SS	RF	CP	5 U	78	5 U	3 U	3 U	
SR-TP35-04A	SS	RF	TP	5 U	5 U	5 U	3 U	3 U	
SMC-SS-15	SS	RF	CP	5 U	5 U	5 U	3 U	3 U	
SMC-SS-09	SS	RF	CP	5 U	5 U	5 U	3 U	3 U	
SMC-SS-21	SS	RF	DS	5 U	18 C	73 C	35	3 U	
SMC-SS-11	SS	RF	CP	5 U	5 U	5 U	3 U	3 U	
SMC-SS-08	SS	RF	CP	5 U	5 U	5 U	3 U	3 U	
SR-TP36-01	SS	RF	TP	5 U	5 U	5 U	3 U	3 U	
SMC-SS-04	SS	RF	CP	5 U	5 U	5 U	3 U	3 U	
SR-TP30-04	SS	RF	TP	5 U	5 U	5 U	3 U	3 U	
SMC-SS-25	SS	RF	DS	5 U	4100 EC	20 C	3 U	3 U	
SR-TP37-02	SS	RF	TP	5 U	5 U	5 U	3 U	3 U	
SR-TP01-01	SS	RF	TP	5 U	5 U	20 U	3 U	3 U	
SR-TP37-04	SS	RF	TP	5 U	5 U	5 U	3 U	3 U	
SMC-SS-05	SS	RF	CP	5 U	5 U	5 U	3 U	3 U	
SMC-SS-23	SS	RF	DS	5 U	85 C	9 C	3 E	3 U	
SMC-SS-24	SS	RF	DS	5 U	10 C	18 C	3 U	3 U	
SMC-SS-03	SS	RF	CP	5 U	5 U	5 U	3 U	3 U	
SMC-SS-22	SS	RF	DS	5 U	19 C	22 C	3 U	3 U	
SMC-S-04	SS	TF	PT	5 U	12 C	159 C	3 U	3 U	
SMC-S-03	SS	TF	PT	5 U	13 C	15 C	3 U	3 U	
SMC-S-00	SS	TF	PT	5 U	14 C	5 U	3 U	3 U	
SMC-S-01	SS	TF	PT	5 U	10 C	15 C	3 U	3 U	
SMC-S-02	SS	TF	PT	5 U	15 C	10 C	1 E	3 U	
SMC-S-05	SS	TF	PT	5 U	7 C	4 EC	3 U	3 U	
SMC-SBW-01	SS	WT	PT	5 U	10 C	9 EC	3 U	3 U	

ROFORM	1,2-DICHLOROETHANE	2-BUTANONE	1,1,1-TRICHLOROETHANE	VINYL ACETATE
3 U	3 U	5 U	3 U	5 U
3 U	3 U	27 E	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	10	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U	5 U	3 U	5 U
3 U	3 U		3 U	5 U
3 U	3 U		3 U	5 U
3 U	3 U		3 U	5 U
3 U	3 U		3 U	5 U
3 U	3 U		3 U	5 U
3 U	3 U		3 U	5 U
3 U	3 U		3 U	5 U
3 U	3 U		3 U	5 U
3 U	3 U		3 U	5 U
3 U	3 U		3 U	5 U
3 U	3 U		3 U	5 U
3 U	3 U		3 U	5 U
3 U	3 U		3 U	5 U
3 U	3 U		3 U	5 U
3 U	3 U		3 U	5 U
3 U	3 U		3 U	5 U
3 U	3 U		3 U	5 U

E	4-METHYL-2-PENTANONE	2-HEXANONE	TETRACHLOROETHENE	1,1,2,2-TETRACHLOROETHANE	TOLUENE
U	5 U	5 U	3 U	3 U	1 U
E	5 U	5 U	3 U	3 U	1 U
	5 U	0	3 U	3 U	0
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
	5 U	5 U	3 U	95	5 E
U	5 U	5 U	3 U	3 U	1 U
	5 U	81	3 U	51	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	250	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	960
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
	5 U	5 U	3 U	3 U	1 U
	5 U	5 U	3 U	3 U	1 U
E	5 U	5 U	3 U	3 U	5 E
U	5 U	5 U	3 U	3 U	1 U
E	140	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
E	5 U	5 U	3 U	3 U	1 U
E	5 U	920 E	3 U	3 U	1 U
E	5 U	5 U	3 U	3 U	020 E
U	5 U	5 U	3 U	3 U	1 U
U	3100 E	910 E	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	22 E	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
E	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U
E	5 U	5 U	3 U	3 U	1 U
U	5 U	5 U	3 U	3 U	1 U

SOIL VOLATILES
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	1,2-DICHLOROPROPANE	TRANS-1,3-DICHLOROPROPENE	TRICHLOROETHENE	BENZE
SR-RS15-01	SO	GR	SF	3 U	3 U	3 U	3
SMC-RS-13	SO	GR	SF	3 U	3 U	3 U	8
SMC-RS-12	SO	GR	SF	3 U	3 U	3 U	11
SMC-RS-04	SO	GR	DP	3 U	3 U	3 U	3
SMC-RS-09	SO	GR	SF	3 U	3 U	3 U	3
SMC-RS-05	SO	GR	SF	3 U	3 U	3 U	3
SR-RS17-01	SO	GR	SF	3 U	3 U	3 U	3
SMC-RS-08	SO	GR	DP	3 U	3 U	3 U	3
SMC-RS-06	SO	GR	DP	3 U	3 U	3 U	3
SMC-RS-03	SO	GR	SF	3 U	3 U	3 U	3
SR-RS18-01A	SO	GR	SF	3 U	3 U	3 U	3
SMC-RS-14	SO	GR	SF	3 U	4 E	3 U	10
SMC-RS-07	SO	GR	SF	3 U	3 U	3 U	3
SMC-RS-11	SO	RF	DS	3 U	3 U	3 U	120
SMC-SP-29	SO	RF	PL	3 U	3 U	3 U	3
SMC-SP-31	SO	RF	PL	3 U	3 U	3 U	3
SMC-SP-32	SO	RF	OF	3 U	3 U	3 U	3
SMC-SP-27	SO	RF	SP	3 U	3 U	3 U	3
SMC-SP-33	SO	RF	OF	3 U	3 U	3 U	3
SR-AB67-01	SO	RF	DS	3 U	3 U	3 U	3
SMC-SP-34	SO	RF	OF	3 U	3 U	3 U	3
SR-AB66-01A	SO	RF	DS	3 U	3 U	3 U	3
SMC-SP-35	SO	RF	OF	3 U	3 U	3 U	3
SMC-SP-25	SO	RF	SP	3 U	3 U	3 U	3
SMC-SP-36	SO	RF	OF	3 U	3 U	3 U	3
SR-AB68-01	SO	RF	DS	3 U	3 U	3 U	36
SMC-RS-10	SO	RF	DS	3 U	3 U	3 U	5
SMC-SS-20	SO	RF	DS	3 U	3 U	3 U	43
SR-AB101-01	SO	RF	DP	3 U	3 U	3 U	3
SMC-MW-34	SO	RF	MW	3 U	3 U	3 U	5
SMC-MW-35	SO	RF	MW	3 U	3 U	3 U	3
SMC-MW-27	SO	RF	MW	3 U	3 U	3 U	14
SMC-MW-36	SO	RF	MW	3 U	3 U	3 U	470
SMC-MW-25	SO	RF	MW	3 U	3 U	3 U	260
SMC-MWC-37	SO	RF	CL	3 U	3 U	3 U	3
SMC-AB-37	SO	RF	AB	3 U	3 U	3 U	3
SMC-MWC-38	SO	RF	CL	3 U	3 U	3 U	3
SMC-MW-55	SO	RF	MW	1 E	1 E	3 U	3
SMC-MWC-40	SO	RF	CL	3 U	3 U	3 U	3
SMC-MW-100	SO	RF	MW	3 U	3 U	3 U	3
SMC-MWC-41	SO	RF	CL	3 U	3 U	3 U	3
SMC-MW-08	SO	RF	MW	3 U	3 U	3 U	3
SMC-AB-41	SO	RF	CL	3 U	3 U	3 U	3
SMC-MW-01	SO	RF	MW	3 U	3 U	3 U	3
SMC-AB-42	SO	RF	CL	3 U	3 U	3 U	2
SMC-AB-31	SO	RF	AB	3 U	3 U	3 U	3
SMC-MW-11	SO	RF	MW	3 U	3 U	3 U	3
SMC-MW-09	SO	RF	MW	3 U	3 U	3 U	3
SMC-AB-28	SO	RF	AB	3 U	3 U	3 U	3
SMC-MW-07	SO	RF	MW	3 U	3 U	3 U	3
SMC-AB-26	SO	RF	AB	3 U	3 U	3 U	3
SMC-AB-32	SO	RF	AB	3 U	3 U	3 U	3
SMC-AB-24	SO	RF	AB	3 U	3 U	3 U	3
SMC-AB-30	SO	RF	AB	3 U	3 U	3 U	3
SMC-AB-22	SO	RF	AB	3 U	3 U	3 U	3
SMC-AB-29	SO	RF	AB	3 U	3 U	3 U	3
SMC-AB-20	SO	RF	AB	3 U	3 U	3 U	3
SMC-MW-51	SO	RF	MW	3 U	3 U	3 U	1
SMC-AB-18	SO	RF	AB	3 U	3 U	3 U	3

SOIL VOLATILES
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	1,2-DICHLOROPROPANE	TRANS-1,3-DICHLOROPROPENE	TRICHLOROETHENE
SMC-MW-50	SO	WF	MW	3 U	3 U	3 U
SMC-AB-39	SO	WF	AB	3 U	3 U	3 U
SMC-MW-49	SO	WF	MW	3 U	3 U	3 U
SMC-AB-15	SO	WF	AB	3 U	3 U	3 U
SMC-MW-52	SO	WF	MW	3 U	3 U	3 U
SMC-AB-13	SO	WF	AB	3 U	3 U	3 U
SMC-MW-53	SO	WF	MW	3 U	3 U	3 U
SMC-MW-30	SO	WF	MW	3 U	3 U	3 U
SMC-MWD-47	SO	WF	DA	3 U	3 U	3 U
SMC-MW-32	SO	WF	MW	3 U	3 U	3 U
SR-TP02-04	SO	WF	TP	3 U	3 U	3 U
SMC-AB-40	SO	WF	AB	3 U	3 U	3 U
SR-TP01-04	SO	WF	TP	3 U	3 U	3 U
SMC-AB-38	SO	WF	AB	3 U	3 U	3 U
SR-AB68-02	SO	WF	MD	3 U	3 U	3 U
SMC-MWD-46	SO	WF	MW	3 U	3 U	3 U
SR-AB67-02	SO	WF	MD	3 U	3 U	3 U
SMC-AB-25	SO	WF	AB	3 U	3 U	3 U
SR-AB66-02	SO	WF	MD	3 U	3 U	3 U
SMC-AB-21	SO	WF	AB	3 U	3 U	3 U
SR-AB68-03	SO	WF	DP	3 U	3 U	3 U
SMC-AB-17	SO	WF	AB	3 U	3 U	3 U
SR-AB67-03	SO	WF	DP	3 U	3 U	3 U
SMC-AB-14	SO	WF	AB	3 U	3 U	3 U
SR-AB66-03	SO	WF	DP	3 U	3 U	3 U
SMC-MW-31	SO	WF	MW	3 U	3 U	3 U
SR-AB102-01	SO	WF	DP	3 U	3 U	3 U
SMC-MW-26	SO	WF	MW	3 U	3 U	3 U
SMC-MW-54	SO	WF	MW	3 U	3 U	3 U
SMC-AB-27	SO	WF	AB	3 U	3 U	3 U
SMC-MWP-56	SO	WF	MW	3 U	3 U	3 U
SMC-AB-19	SO	WF	AB	3 U	3 U	3 U
SMC-MWP-02	SO	WF	MW	3 U	3 U	3 U
SMC-MW-29	SO	WF	MW	3 U	3 U	3 U
SMC-MW-28	SO	WF	MW	3 U	3 U	3 U
SMC-AB-35	SO	WF	AB	3 U	3 U	3 U
SMC-MWC-39	SO	WF	MW	3 U	3 U	3 U
SMC-AB-16	SO	WF	AB	3 U	3 U	3 U
SMC-AB-23	SO	WF	AB	3 U	3 U	3 U
SMC-MW-33	SO	WF	MW	3 U	3 U	3 U
SMC-MWD-48	SO	WF	MW	3 U	3 U	3 U
SMC-MWDB-01	SO	TF	MW	3 U	3 U	3 U
SMC-AB-44	SO	TF	AB	3 U	3 U	3 U
SMC-AB-43	SO	TF	AB	3 U	3 U	3 U
SMC-MWDB-03	SO	TF	MW	3 U	3 U	3 U
SMC-AB-45	SO	TF	AB	3 U	3 U	3 U
SMC-MWDB-02	SO	TF	MW	3 U	3 U	3 U
SMC-MW-05	SO	WT	MW	10 E	3 U	3 U
SMC-MW-04	SO	WT	MW	3 U	3 U	5940
SMC-MW-06	SO	WT	MW	3 U	3 U	3 U
SMC-SS-16	SS	WF	CP	3 U	3 U	3 U
SR-TP02-01	SS	WF	TP	3 U	3 U	3 U
SMC-SS-08	SS	WF	CP	3 U	3 U	3 U
SR-TP34-02	SS	WF	TP	3 U	3 U	3 U
SMC-SS-10	SS	WF	CP	3 U	3 U	3 U

BENZENE	4-METHYL-2-PENTANONE	2-HEXANONE	TETRACHLOROETHENE	1,1,2,2-TETRACHLOROETHANE	TOLUENE
5 E	5 U	5 U	3 U	56	1 U
3 U	5 U	5 U	3 U	3 U	1 U
46	5 U	1900 E	3 U	630 E	1 U
3 U	5 U	5 U	3 U	2100	1 U
1450	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
4 U	360 E	67	3 U	49	1 U
4 U	5 U	14 E	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
4 E	5 U	5 U	3 U	3 U	4 E
3 U	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	8
3 U	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
2 E	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
1 E	5 U	5 U	3 U	3 U	2 E
3 U	5 U	5 U	3 U	3 U	1 U
24 E	5 U	5 U	3 U	3 U	1 U
1 E	5 U	5 U	3 U	330 E	1 U
3 U	5 U	5 U	3 U	3 U	1 U
3 U	720	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
3 U	370	5 U	3 U	3 U	1 U
41	1300	440	3 U	70	1067 U
100	5 U	5 U	3 U	3 U	910
11	1200 E	230	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
100	1700 E	320	3 U	3 U	1 U
4 E	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	4 E
6 E	5 U	5 U	3 U	3 U	1 U
695 U	5 U	5 U	3 U	3 U	1 U
1000	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U
3 U	5 U	5 U	3 U	3 U	1 U

SOIL VOLATILES
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	1,2-DICHLOROPROPANE	TRANS-1,3-DICHLOROPROPENE	TRICHLOROETHENE	BENZENE	4-METHYL-2-PENTA
SR-TP34-04	SS	WF	TP	3 U	3 U	3 U	3 U	5 U
SMC-SS-12	SS	WF	CP	3 U	3 U	3 U	3 U	5 U
SR-TP35-01	SS	WF	TP	3 U	3 U	3 U	3 U	5 U
SMC-SS-14	SS	WF	CP	3 U	3 U	3 U	3 U	5 U
SMC-SS-07	SS	WF	CP	3 U	3 U	3 U	3 U	5 U
SMC-SS-13	SS	RF	CP	3 U	3 U	3 U	3 U	5 U
SR-TP35-04A	SS	RF	TP	3 U	3 U	3 U	3 U	5 U
SMC-SS-15	SS	WF	CP	3 U	3 U	3 U	3 U	5 U
SMC-SS-09	SS	WF	CP	3 U	3 U	3 U	3 U	5 U
SMC-SS-21	SS	WF	DS	3 U	3 U	3 U	2 E	5 U
SMC-SS-11	SS	WF	CP	3 U	3 U	3 U	3 U	5 U
SMC-SS-08	SS	WF	CP	3 U	3 U	3 U	3 U	5 U
SR-TP36-01	SS	WF	TP	3 U	3 U	3 U	3 U	5 U
SMC-SS-06	SS	WF	CP	3 U	3 U	3 U	3 U	5 U
SR-TP36-04	SS	WF	TP	3 U	3 U	3 U	3 U	5 U
SMC-SS-25	SS	RF	DS	3 U	3 U	3 U	3 E	5 U
SR-TP37-02	SS	WF	TP	3 U	3 U	3 U	3 U	5 U
SR-TP01-01	SS	WF	TP	3 U	3 U	3 U	3 U	5 U
SR-TP37-04	SS	WF	TP	3 U	3 U	3 U	3 U	5 U
SMC-SS-05	SS	WF	CP	3 U	3 U	3 U	3 U	5 U
SMC-SS-23	SS	WF	DS	3 U	3 U	3 U	2 E	5 U
SMC-SS-24	SS	WF	DS	3 U	3 U	3 U	3 E	5 U
SMC-SS-03	SS	WF	CP	3 U	3 U	3 U	3 U	5 U
SMC-SS-22	SS	WF	DS	3 U	3 U	3 U	3 U	5 U
SMC-S-04	SS	TF	PT	3 U	3 U	3 U	1 E	5 U
SMC-S-03	SS	TF	PT	3 U	3 U	3 U	1 E	5 U
SMC-S-06	SS	TF	PT	3 U	3 U	3 U	1 E	5 U
SMC-S-01	SS	TF	PT	3 U	3 U	3 U	1 E	5 U
SMC-S-02	SS	TF	PT	3 U	3 U	3 U	1 E	5 U
SMC-S-05	SS	TF	PT	3 U	3 U	3 U	1 E	5 U
SMC-SOW-01	SS	WT	PT	3 U	3 U	3 U	1 E	5 U

NONE	2-HEXANONE	TETRACHLOROETHENE	1,1,2,2-TETRACHLOROETHANE	TOLUENE
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U
	5 U	3 U	3 U	1 U

SOIL VOLATILES
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	CHLOROBENZENE	ETHYLBENZENE	STYRENE	TOTAL XYLENES
SR-RS15-01	SO	GR	SF	3 U	3 U	3 U	3 U
SMC-RS-13	SO	GR	SF	3 U	3 U	3 U	3 U
SMC-RS-12	SO	GR	SF	3 U	7	3 U	3 E
SMC-RS-04	SO	GR	DP	3 U	3 U	3 U	3 U
SMC-RS-09	SO	GR	SF	3 U	3 U	3 U	3 U
SMC-RS-05	SO	GR	SF	3 U	3 U	3 U	3 U
SR-RS17-01	SO	GR	SF	3 U	3 U	3 U	3 U
SMC-RS-08	SO	GR	DP	3 U	3 U	3 U	3 U
SMC-RS-06	SO	GR	DP	3 U	3 U	3 U	3 U
SMC-RS-03	SO	GR	SF	3 U	3 U	3 U	3 U
SR-RS16-01A	SO	GR	SF	3 U	3 U	3 U	3 U
SMC-RS-14	SO	GR	SF	50	3 U	3 U	71
SMC-RS-07	SO	GR	SF	3 U	3 U	3 U	3 U
SMC-RS-11	SO	RF	DS	31	3 U	3 U	3 U
SMC-SP-29	SO	RF	PL	3 U	3 U	3 U	3 U
SMC-SP-31	SO	RF	PL	3 U	3 U	3 U	3 U
SMC-SP-32	SO	RF	OF	3 U	75	3 U	3 U
SMC-SP-27	SO	RF	SP	3 U	3 U	3 U	3 U
SMC-SP-33	SO	RF	OF	3 U	3 U	3 U	3 U
SR-AB67-01	SO	RF	DS	3 U	3 U	3 U	3 U
SMC-SP-34	SO	RF	OF	3 U	50	3 U	3 U
SR-AB66-01A	SO	RF	DS	3 U	3 U	3 U	3 U
SMC-SP-35	SO	RF	OF	3 U	3 U	3 U	3 U
SMC-SP-25	SO	RF	SP	3 U	3 U	3 U	3 U
SMC-SP-30	SO	RF	OF	3 U	3 U	3 U	3 U
SR-AB68-01	SO	RF	DS	3 U	3 U	3 U	3 U
SMC-RS-10	SO	RF	DS	3 U	3 U	3 U	3 U
SMC-SS-26	SO	RF	DS	3 U	3 U	3 U	3 U
SR-AB101-01	SO	RF	DP	3 U	3 U	3 U	3 U
SMC-MW-34	SO	RF	MW	3 U	3 U	3 U	85
SMC-MW-35	SO	RF	MW	3 U	3 U	3 U	72
SMC-MW-27	SO	RF	MW	3 U	3 U	3 U	330
SMC-MW-36	SO	RF	MW	3 U	3600	3 U	26000
SMC-MW-25	SO	RF	MW	3 U	3 U	3 U	3 U
SMC-MWC-37	SO	RF	CL	3 U	3 U	3 U	3 U
SMC-AB-37	SO	RF	AB	3 U	260 E	3 U	5100 E
SMC-MWC-38	SO	RF	CL	3 U	3 U	3 U	3 U
SMC-MW-55	SO	RF	MW	3 U	3 U	3 U	8 E
SMC-MWC-40	SO	RF	CL	3 U	3 U	3 U	3 U
SMC-MW-100	SO	RF	MW	3 U	3 U	3 U	3 U
SMC-MWC-41	SO	RF	CL	3 U	3 U	3 U	3 U
SMC-MW-08	SO	RF	MW	3 U	25 U	3 U	3 U
SMC-AB-41	SO	RF	CL	3 U	3 U	3 U	3 U
SMC-MW-01	SO	RF	MW	3 U	3 U	3 U	3 U
SMC-AB-42	SO	RF	CL	3 U	3 U	3 U	3 U
SMC-AB-31	SO	RF	AB	3 U	3 U	3 U	3 U
SMC-MW-11	SO	RF	MW	3 U	3 U	3 U	3 U
SMC-MW-09	SO	RF	MW	3 U	25 U	3 U	3 U
SMC-AB-28	SO	RF	AB	3 U	3 U	3 U	3 U
SMC-MW-07	SO	RF	MW	3 U	3 U	3 U	3 U
SMC-AB-26	SO	RF	AB	3 U	3 U	3 U	3 U
SMC-AB-32	SO	RF	AB	3 U	3 U	3 U	3 U
SMC-AB-24	SO	RF	AB	3 U	3 U	3 U	3 U
SMC-AB-30	SO	RF	AB	3 U	3 U	3 U	3 U
SMC-AB-22	SO	RF	AB	3 U	3 U	3 U	3 U
SMC-AB-29	SO	RF	AB	3 U	3 U	3 U	3 U
SMC-AB-20	SO	RF	AB	3 U	3 U	3 U	3 U
SMC-MW-81	SO	RF	MW	10 E	3 U	2 E	310
SMC-AB-10	SO	RF	AB	3 U	3 U	3 U	3 U

SOIL VOLATILES
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	CHLOROBENZENE	ETHYLBENZENE	STYRENE	TOTAL XYLENES
SMC-MW-50	SO	RF	MW	130	100	3 U	200 E
SMC-AB-39	SO	RF	AB	3 U	3 U	3 U	3 U
SMC-MW-49	SO	RF	MW	3 U	3 U	3 U	3 U
SMC-AB-15	SO	RF	AB	3 U	3 U	3 U	3 U
SMC-MW-52	SO	RF	MW	3 U	1200	2 E	3 U
SMC-AB-13	SO	RF	AB	3 U	3 U	3 U	3 U
SMC-MW-53	SO	RF	MW	3 U	3 U	3 U	2500 E
SMC-MW-30	SO	RF	MW	3 U	3 U	3 U	3 U
SMC-MWD-47	SO	RF	DA	3 U	3 U	3 U	10
SMC-MW-32	SO	RF	MW	3 U	3 U	3 U	3 U
SR-TP02-04	SO	RF	TP	3 U	3 U	3 U	3 U
SMC-AB-40	SO	RF	AB	3 U	3 U	3 U	3 U
SR-TP01-04	SO	RF	TP	3 U	3 U	3 U	3 U
SMC-AB-30	SO	RF	AB	3 U	3 U	3 U	3 U
SR-AB68-02	SO	RF	MD	3 U	3 U	3 U	3 U
SMC-MWD-46	SO	RF	MW	3 U	3 U	3 U	3 U
SR-AB67-02	SO	RF	MD	3 U	3 U	3 U	3 U
SMC-AB-25	SO	RF	AB	3 U	3 U	3 U	3 U
SR-AB66-02	SO	RF	MD	3 U	3 U	3 U	3 U
SMC-AB-21	SO	RF	AB	3 U	3 U	3 U	3 U
SR-AB68-03	SO	RF	DP	3 U	3 U	3 U	3 U
SMC-AB-17	SO	RF	AB	3 U	3 U	3 U	3 U
SR-AB67-03	SO	RF	DP	3 U	3 U	3 U	3 U
SMC-AB-14	SO	RF	AB	3 U	3 U	3 U	3 U
SR-AB66-03	SO	RF	DP	3 U	3 U	3 U	3 U
SMC-MW-31	SO	RF	MW	3 U	3 U	3 U	1 E
SR-AB102-01	SO	RF	DP	3 U	3 U	3 U	3 U
SMC-MW-26	SO	RF	MW	370	1100	3 U	6100 E
SMC-MW-54	SO	RF	MW	3 U	3 U	3 U	300 E
SMC-AB-27	SO	RF	AB	3 U	3 U	3 U	3 U
SMC-MWP-56	SO	RF	MW	3 U	45	3 U	69
SMC-AB-19	SO	RF	AB	3 U	3 U	3 U	3 U
SMC-MWP-02	SO	RF	MW	3 U	46	3 U	204
SMC-MW-29	SO	RF	MW	300	3 U	3 U	3 U
SMC-MW-28	SO	RF	MW	3 U	3 U	3 U	3 U
SMC-AB-35	SO	RF	AB	320	65 U	3 U	130
SMC-MWC-39	SO	RF	MW	3 U	3 U	3 U	3 U
SMC-AB-16	SO	RF	AB	3 U	3 U	3 U	3 U
SMC-AB-23	SO	RF	AB	3 U	3 U	3 U	3 U
SMC-MW-33	SO	RF	MW	210	240	3 U	3 U
SMC-MWD-48	SO	RF	MW	3 U	3 U	3 U	53
SMC-MWDB-01	SO	TF	MW	3 U	3 U	3 U	3 U
SMC-AB-44	SO	TF	AB	3 U	3 U	3 U	3 U
SMC-AB-43	SO	TF	AB	3 U	3 U	3 U	3 U
SMC-MWDB-03	SO	TF	MW	3 U	3 U	3 U	3 U
SMC-AB-45	SO	TF	AB	3 U	3 U	3 U	3 U
SMC-MWDB-02	SO	TF	MW	3 U	3 U	3 U	3 U
SMC-MH-05	SO	WT	MH	10 E	24	3 U	8 E
SMC-MH-04	SO	WT	MH	3200	3 U	3 U	8440
SMC-MH-06	SO	WT	MH	2500	3 U	3 U	1300
SMC-SS-16	SS	RF	CP	3 U	3 U	3 U	3 U
SR-TP02-01	SS	RF	TP	3 U	3 U	3 U	3 U
SMC-SS-08	SS	RF	CP	3 U	3 U	3 U	3 U
SR-TP34-02	SS	RF	TP	3 U	3 U	3 U	3 U
SMC-SS-18	SS	RF	CP	3 U	3 U	3 U	3 U

SOIL VOLATILES
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	CHLOROBENZENE	ETHYLBENZENE	STYRENE	TOTAL XYLENES
SR-TP34-04	SS	RF	TP	3 U	3 U	3 U	3 U
SMC-SS-12	SS	RF	CP	3 U	3 U	3 U	3 U
SR-TP35-01	SS	RF	TP	3 U	3 U	3 U	3 U
SMC-SS-14	SS	RF	CP	3 U	3 U	3 U	3 U
SMC-SS-07	SS	RF	CP	3 U	3 U	3 U	3 U
SMC-SS-13	SS	RF	CP	3 U	3 U	3 U	3 U
SR-TP35-04A	SS	RF	TP	3 U	3 U	3 U	3 U
SMC-SS-18	SS	RF	CP	3 U	3 U	3 U	3 U
SMC-SS-09	SS	RF	CP	3 U	3 U	3 U	3 U
SMC-SS-21	SS	RF	DS	3 U	3 U	3 U	3 U
SMC-SS-11	SS	RF	CP	3 U	3 U	3 U	3 U
SMC-SS-08	SS	RF	CP	3 U	3 U	3 U	3 U
SR-TP36-01	SS	RF	TP	3 U	3 U	3 U	3 U
SMC-SS-04	SS	RF	CP	3 U	3 U	3 U	3 U
SR-TP36-04	SS	RF	TP	3 U	3 U	3 U	3 U
SMC-SS-20	SS	RF	DS	3 U	3 U	3 U	3 U
SR-TP37-02	SS	RF	TP	3 U	3 U	3 U	3 U
SR-TP01-01	SS	RF	TP	3 U	3 U	3 U	3 U
SR-TP37-04	SS	RF	TP	3 U	3 U	3 U	3 U
SMC-SS-05	SS	RF	CP	3 U	3 U	3 U	3 U
SMC-SS-23	SS	RF	DS	3 U	3 U	3 U	3 U
SMC-SS-24	SS	RF	DS	3 U	3 U	3 U	3 U
SMC-SS-03	SS	RF	CP	3 U	3 U	3 U	3 U
SMC-SS-22	SS	RF	DS	3 U	3 U	3 U	3 U
SMC-S-04	SS	TF	PT	3 U	3 U	3 U	3 U
SMC-S-03	SS	TF	PT	3 U	3 U	3 U	3 U
SMC-S-06	SS	TF	PT	3 U	3 U	3 U	3 U
SMC-S-01	SS	TF	PT	3 U	3 U	3 U	3 U
SMC-S-02	SS	TF	PT	3 U	3 U	3 U	3 U
SMC-S-05	SS	TF	PT	3 U	3 U	3 U	3 U
SMC-SBW-01	SS	WT	PT	3 U	3 U	3 U	3 U

SOIL SEMI-VOLATILES
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	PHENOL	1,3-DICHLOROBENZENE	2-METHYLPHENOL	4-METHYLPHENOL	NITROBENZENE	2,4-DIMETHYLPHENOL	1,2,4-TRICHLOROBENZENE	NAPHTHALENE	2-METNAPHTHALENE	2,4,5-TRICHLOROPHENOL
SMC-RS-14	SD	GR	SF	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	74 E	800 U
SMC-RS-05	SD	GR	SF	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-RS-06	SD	GR	DP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-RS-08	SD	GR	DP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SR-RS15-01	SD	GR	SF	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-RS-12	SD	GR	SF	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	110	800 U
SMC-RS-04	SD	GR	DP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-RS-13	SD	GR	SF	210 E	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SR-RS17-01	SD	GR	SF	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-RS-07	SD	GR	SF	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SR-RS16-01A	SD	GR	SF	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-RS-09	SD	GR	SF	165 U	165 U	165 U	165 U	165 U	165 U	165 U	29	165 U	800 U
SMC-RS-03	SD	GR	SF	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-SP-36	SD	RF	OF	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-RS-11	SD	RF	DS	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-SP-34	SD	RF	OF	165 U	1 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SR-AB66-01A	SD	RF	DS	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-SP-33	SD	RF	OF	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SR-AB67-01	SD	RF	DS	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-SP-32	SD	RF	OF	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-SP-35	SD	RF	OF	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-SP-31	SD	RF	PL	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-RS-10	SD	RF	DS	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-SP-29	SD	RF	PL	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-SP-27	SD	RF	SP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-SS-26	SD	RF	DS	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SR-AB68-01	SD	RF	DS	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	4600	800 U
SMC-SP-25	SD	RF	SP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-MW-08	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-AB-16	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-MW-27	SO	RF	MW	165 U	165 U	165 U	165 U	240 E	165 U	165 U	40 E	220	800 U
SMC-AB-15	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	500 U	165 U	800 U
SMC-AB-38	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	250 E	800 U
SMC-AB-14	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-AB-35	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	130 E	1300	800 U
SMC-AB-13	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-AB-40	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-MW-50	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	120 E	4400	800 U
SMC-MWC-39	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-MW-49	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	190	165 U	165 U	2200	800 U
SMC-MWD-46	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-MWD-48	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	820 E	800 U
SMC-MWP-02	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-MW-11	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-MW-25	SO	RF	MW	38 E	165 U	165 U	6 E	165 U	165 U	165 U	165 U	33 E	800 U
SMC-MW-09	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-MW-29	SO	RF	MW	100 E	165 U	165 U	165 U	165 U	165 U	165 U	2400	165 U	800 U
SMC-MW-54	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	49 E	290 E	800 U
SMC-MW-30	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	28 E	800 U
SMC-MW-01	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-MWD-47	SO	RF	DA	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-AB-31	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	1 U	165 U	800 U
SMC-MW-07	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	1000	165 U	800 U
SR-AB68-02	SO	RF	MD	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-AB-32	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-AB-28	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-MW-53	SO	RF	MW	165 U	160 E	165 U	165 U	165 U	165 U	250 E	960 E	17000	490 E
SMC-AB-26	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-AB-30	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-AB-24	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SR-AB66-03	SO	RF	DP	2 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-AB-22	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SR-AB67-03	SO	RF	DP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SMC-AB-20	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SR-AB68-03	SO	RF	DP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SR-AB101-01	SO	RF	DP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
SR-AB66-02	SO	RF	MD	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U
MC-MW-51	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	360 E	660	800 U

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SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	DIMETHYL PHTHALATE	ACENAPHTHALENE	DIBENZOFURAN	DIETHYLPHTHALATE
SMC-RS-14	SO	GR	SF	165 U	165 U	165 U	530 E
SMC-RS-05	SO	GR	SF	165 U	165 U	165 U	165 U
SMC-RS-06	SO	GR	DP	165 U	165 U	165 U	165 U
SMC-RS-08	SO	GR	DP	165 U	165 U	165 U	165 U
SR-RS15-01	SO	GR	SF	165 U	165 U	165 U	165 U
SMC-RS-12	SO	GR	SF	165 U	165 U	165 U	550 E
SMC-RS-04	SO	GR	DP	165 U	165 U	165 U	165 U
SMC-RS-13	SO	GR	SF	460 E	165 U	165 U	165 U
SR-RS17-01	SO	GR	SF	165 U	165 U	165 U	165 U
SMC-RS-07	SO	GR	SF	165 U	165 U	165 U	165 U
SR-RS18-01A	SO	GR	SF	165 U	165 U	165 U	165 U
SMC-RS-09	SO	GR	SF	165 U	165 U	165 U	165 U
SMC-RS-03	SO	GR	SF	165 U	165 U	165 U	165 U
SMC-SP-36	SO	RF	OF	165 U	165 U	165 U	165 U
SMC-RS-11	SO	RF	DS	165 U	165 U	165 U	260 E
SMC-SP-34	SO	RF	OF	165 U	165 U	165 U	165 U
SR-AB66-01A	SO	RF	DS	165 U	165 U	165 U	165 U
SMC-SP-33	SO	RF	OF	165 U	165 U	165 U	165 U
SR-AB67-01	SO	RF	DS	165 U	165 U	165 U	165 U
SMC-SP-32	SO	RF	OF	165 U	165 U	165 U	165 U
SMC-SP-35	SO	RF	OF	165 U	165 U	165 U	165 U
SMC-SP-31	SO	RF	PL	165 U	165 U	165 U	165 U
SMC-RS-10	SO	RF	DS	165 U	165 U	165 U	1000
SMC-SP-29	SO	RF	PL	165 U	165 U	165 U	165 U
SMC-SP-27	SO	RF	SP	165 U	165 U	165 U	165 U
SMC-SS-26	SO	RF	DS	165 U	165 U	165 U	225 E
SR-AB68-01	SO	RF	DS	165 U	165 U	165 U	165 U
SMC-SP-25	SO	RF	SP	165 U	165 U	165 U	165 U
SMC-MW-08	SO	RF	MW	165 U	165 U	165 U	165 U
SMC-AB-18	SO	RF	AB	165 U	165 U	165 U	165 U
SMC-MW-27	SO	RF	MW	165 U	165 U	165 U	42 E
SMC-AB-15	SO	RF	AB	165 U	165 U	165 U	165 U
SMC-AB-38	SO	RF	AB	165 U	165 U	165 U	165 U
SMC-AB-14	SO	RF	AB	165 U	165 U	165 U	165 U
SMC-AB-35	SO	RF	AB	165 U	165 U	165 U	250 E
SMC-AB-13	SO	RF	AB	165 U	165 U	165 U	165 U
SMC-AB-40	SO	RF	AB	165 U	165 U	165 U	165 U
SMC-MW-50	SO	RF	MW	165 U	165 U	165 U	165 U
SMC-MWC-39	SO	RF	MW	165 U	165 U	165 U	165 U
SMC-MW-49	SO	RF	MW	165 U	165 U	165 U	165 U
SMC-MWD-46	SO	RF	MW	165 U	165 U	165 U	165 U
SMC-MWD-48	SO	RF	MW	165 U	165 U	165 U	165 U
SMC-MWP-02	SO	RF	MW	165 U	165 U	165 U	165 U
SMC-MW-11	SO	RF	MW	165 U	165 U	165 U	165 U
SMC-MW-25	SO	RF	MW	165 U	165 U	165 U	36 E
SMC-MW-09	SO	RF	MW	165 U	165 U	165 U	165 U
SMC-MW-29	SO	RF	MW	165 U	165 U	100 E	165 U
SMC-MW-54	SO	RF	MW	33 E	16 E	165 U	87 E
SMC-MW-30	SO	RF	MW	165 U	165 U	165 U	43 E
SMC-MW-01	SO	RF	MW	165 U	165 U	165 U	165 U
SMC-MWD-47	SO	RF	DA	165 U	165 U	165 U	165 U
SMC-AB-31	SO	RF	AB	165 U	165 U	165 U	165 U
SMC-MW-07	SO	RF	MW	165 U	165 U	165 U	165 U
SR-AB68-02	SO	RF	MD	165 U	165 U	165 U	165 U
SMC-AB-32	SO	RF	AB	165 U	165 U	165 U	165 U
SMC-AB-28	SO	RF	AB	165 U	165 U	165 U	165 U
SMC-MW-53	SO	RF	MW	370 E	350 E	590 E	1000 E
SMC-AB-26	SO	RF	AB	165 U	165 U	165 U	165 U
SMC-AB-30	SO	RF	AB	165 U	165 U	165 U	165 U
SMC-AB-24	SO	RF	AB	165 U	165 U	165 U	165 U
SR-AB66-03	SO	RF	DP	165 U	165 U	165 U	165 U
SMC-AB-22	SO	RF	AB	165 U	165 U	165 U	165 U
SR-AB67-03	SO	RF	DP	165 U	165 U	165 U	165 U
SMC-AB-20	SO	RF	AB	165 U	165 U	165 U	165 U
SR-AB68-03	SO	RF	DP	165 U	165 U	165 U	165 U
SR-AB101-01	SO	RF	DP	165 U	165 U	165 U	165 U
SR-AB66-02	SO	RF	MD	165 U	165 U	165 U	165 U
SMC-MW-51	SO	RF	MW	165 U	165 U	165 U	90 E

FLUORENE	N-NITROSODIPHENYLAMINE	HEXACHLOROBENZENE	PHENANTHRENE	ANTHRACENE	DI-n-BUTYLPHTHALATE	FLUORANTHENE
165 U	165 U	165 U	165 U	165 U	4900 C	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	53 E	165 U	1970 C	130 E
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	4600 C	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	52 E	165 U	5300 C	130 E
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	250 E	63 E	5000 C	1200
165 U	165 U	165 U	1 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	1 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	5300 C	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
52 E	165 U	165 U	630 E	78 E	4600 C	1100
165 U	165 U	165 U	1600 J	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	500 U	165 U	165 U	1000
165 U	165 U	165 U	1 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	3400 EC	40 E
500 U	165 U	165 U	500 U	165 U	165 U	1600
165 U	250 E	165 U	102 E	165 U	420 EC	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
71 E	165 U	165 U	150 E	165 U	2600 C	165 U
1 U	165 U	165 U	1 U	165 U	165 U	1 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
760 E	165 U	165 U	2300	380 E	6300 C	140 E
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	580 E	165 U	1300 E	165 U	4600 C	165 U
165 U	165 U	165 U	165 U	165 U	350 EC	165 U
165 U	165 U	165 U	165 U	165 U	340 EC	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	220 EC	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
660 E	930 E	165 U	2200	270 E	165 U	120 E
67 E	165 U	165 U	120 E	24 E	6800 C	86 E
165 U	165 U	165 U	5 E	165 U	190 EC	165 U
165 U	165 U	165 U	1200	165 U	165 U	1600
165 U	165 U	165 U	165 U	165 U	2200 C	165 U
1 U	165 U	165 U	1 U	165 U	165 U	165 U
165 U	165 U	165 U	1500	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
2500 E	165 U	390 E	6100	1500 E	3600 C	300 E
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	2 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	3000 C	165 U

FLUORENE	N-NITROSODIPHENYLAMINE	HEXACHLOROBENZENE	PHENANTHRENE	ANTHRACENE	DI-n-BUTYLPHTHALATE	FLUORANTHENE
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	1 U	165 U	165 U	1 U
165 U	165 U	165 U	165 U	165 U	120 EC	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	166 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	2900 C	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	2600 C	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	3400 C	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	2800 C	165 U
165 U	165 U	165 U	165 U	165 U	165 U	1 U
630 E	165 U	165 U	1900	165 U	480 EC	120 E
110 E	133 E	165 U	270 E	165 U	3300 C	165 U
120 E	165 U	165 U	240 E	165 U	630 EC	165 U
45 E	165 U	165 U	165 U	165 U	1800 C	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	5400 C	165 U
31 E	165 U	165 U	130 E	165 U	390 EC	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
200 E	165 U	165 U	165 U	165 U	6200 C	165 U
165 U	165 U	165 U	1 U	165 U	165 U	1 U
165 U	165 U	165 U	165 U	165 U	840 C	165 U
66 E	165 U	165 U	280 E	130 E	2800 C	540 E
165 U	165 U	165 U	22000 J	165 U	165 U	33000
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	510	165 U	165 U	165 U
165 U	165 U	165 U	1 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	1700 C	165 U
165 U	165 U	165 U	165 U	165 U	2300 C	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	1400 C	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	1100	165 U	165 U	420
1160 U	165 U	165 U	1755 U	165 U	410 U	165 U
165 U	165 U	165 U	165 U	165 U	860 C	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	170 E	29 E	3500 C	280 E
165 U	165 U	165 U	1 U	165 U	165 U	1 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	110 E	165 U	3000 C	220 E
165 U	165 U	165 U	500 U	500 U	165 U	2500
165 U	165 U	165 U	370 J	165 U	880	320 J
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	2400 C	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
500 U	165 U	165 U	1000	165 U	165 U	1700
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
1 U	165 U	165 U	1 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	1 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	165 U	165 U	165 U	165 U
165 U	165 U	165 U	305 J	165 U	165 U	165 U

SOIL SEMI-VOLATILES
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	DIMETHYL PHTHALATE	ACENAPHTHALENE	DIBENZOFURAN	DIETHYLPHTHALATE
SR-AB67-02	SO	RF	MD	165 U	165 U	165 U	165 U
SMC-AB-17	SO	RF	AB	165 U	165 U	165 U	165 U
SMC-AB-42	SO	RF	CL	165 U	165 U	165 U	165 U
SMC-AB-37	SO	RF	AB	165 U	165 U	165 U	165 U
SMC-AB-41	SO	RF	CL	165 U	155 U	165 U	165 U
SMC-AB-39	SO	RF	AB	165 U	165 U	165 U	165 U
SMC-MMC-41	SO	RF	CL	165 U	165 U	165 U	165 U
SMC-MM-100	SO	RF	MM	165 U	165 U	165 U	165 U
SMC-MMC-40	SO	RF	CL	165 U	165 U	165 U	165 U
SMC-AB-29	SO	RF	AB	165 U	165 U	165 U	165 U
SMC-MMC-38	SO	RF	CL	165 U	165 U	165 U	165 U
SMC-AB-25	SO	RF	AB	165 U	165 U	165 U	165 U
SMC-MMC-37	SO	RF	CL	165 U	165 U	165 U	165 U
SMC-AB-21	SO	RF	AB	165 U	165 U	165 U	165 U
SMC-MM-36	SO	RF	MM	33 E	165 U	67 E	59 E
SMC-MM-52	SO	RF	MM	165 U	165 U	170 E	430 E
SMC-MM-35	SO	RF	MM	165 U	165 U	41 E	64 E
SMC-MM-26	SO	RF	MM	166 U	165 U	51 E	100 E
SMC-MM-34	SO	RF	MM	165 U	165 U	165 U	165 U
SMC-MM-31	SO	RF	MM	165 U	165 U	165 U	270 E
SMC-MM-28	SO	RF	MM	165 U	165 U	165 U	165 U
SMC-AB-27	SO	RF	AB	165 U	165 U	165 U	165 U
SMC-MM-33	SO	RF	MM	165 U	165 U	165 U	190 E
SMC-AB-19	SO	RF	AB	165 U	165 U	165 U	165 U
SMC-MM-32	SO	RF	MM	165 U	165 U	165 U	165 U
SMC-MM-55	SO	RF	MM	165 U	165 U	165 U	91 E
SR-TP02-04	SO	RF	TP	165 U	165 U	165 U	165 U
SMC-AB-23	SO	RF	AB	165 U	165 U	165 U	165 U
SMC-MMP-56	SO	RF	MM	165 U	165 U	165 U	165 U
SMC-AB-18	SO	RF	AB	165 U	165 U	165 U	165 U
SR-TP01-04	SO	RF	TP	165 U	165 U	165 U	165 U
SMC-AB-45	SO	TF	AB	165 U	165 U	165 U	165 U
SMC-AB-43	SO	TF	AB	165 U	165 U	165 U	165 U
SMC-MMDB-01	SO	TF	MM	165 U	165 U	165 U	165 U
SMC-MMDB-03	SO	TF	MM	165 U	165 U	165 U	165 U
SMC-MMDB-02	SO	TF	MM	165 U	165 U	165 U	165 U
SMC-AB-44	SO	TF	AB	165 U	165 U	165 U	165 U
SMC-MH-06	SO	WT	MH	165 U	165 U	165 U	165 U
SMC-MH-04	SO	WT	MH	165 U	165 U	670 U	165 U
SMC-MH-05	SO	WT	MH	165 U	165 U	165 U	165 U
SR-TP34-02	SS	RF	TP	165 U	165 U	165 U	200 U
SMC-SS-25	SS	RF	DS	165 U	165 U	165 U	150 E
SMC-SS-07	SS	RF	CP	165 U	165 U	165 U	165 U
SR-TP02-01	SS	RF	TP	165 U	165 U	165 U	6500 U
SMC-SS-09	SS	RF	CP	165 U	165 U	165 U	165 U
SMC-SS-23	SS	RF	DS	165 U	165 U	165 U	160 E
MC-SS-11	SS	RF	CP	165 U	165 U	165 U	165 U
R-TP34-04	SS	RF	TP	165 U	165 U	165 U	165 U
SMC-SS-13	SS	RF	CP	165 U	165 U	165 U	165 U
SR-TP35-01	SS	RF	TP	165 U	165 U	165 U	165 U
SMC-SS-15	SS	RF	CP	165 U	165 U	165 U	165 U
SMC-SS-24	SS	RF	DS	155 U	165 U	165 U	140 E
R-TP37-04	SS	RF	TP	165 U	165 U	165 U	165 U
MC-SS-08	SS	RF	CP	165 U	165 U	165 U	165 U
SMC-SS-10	SS	RF	CP	165 U	165 U	165 U	165 U
R-TP36-04	SS	RF	TP	165 U	165 U	165 U	165 U
MC-SS-12	SS	RF	CP	165 U	165 U	165 U	165 U
MC-SS-05	SS	RF	CP	165 U	165 U	165 U	165 U
MC-SS-14	SS	RF	CP	165 U	165 U	165 U	165 U
MC-SS-03	SS	RF	CP	165 U	155 U	165 U	165 U
MC-SS-16	SS	RF	CP	165 U	165 U	165 U	165 U
R-TP35-04A	SS	RF	TP	165 U	165 U	165 U	165 U
R-TP37-02	SS	RF	TP				

IL SEMI-VOLATILES
INCLAIR REFINERY

MPLEID	TYPE1	LOC	TYPE2	DIMETHYL PHTHALATE	ACENAPHTHALENE	DIBENZOFURAN	DIETHYLPHTHALATE	FLUORENE	N-NITROSODIPHENYLAMINE	HEXACHLOROBENZENE	PHENANTHRENE	ANTHRACENE	DI-n-BUTYLPHTHALATE	FLUORANTHENE
I-AB07-02	SO	RF	MD	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
C-AB-17	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	1 U	165 U	165 U	1 U
C-AB-42	SO	RF	CL	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	120 EC	165 U
C-AB-37	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
C-AB-41	SO	RF	CL	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
C-AB-39	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
C-MWC-41	SO	RF	CL	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	2900 C	165 U
C-MW-100	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
C-MWC-40	SO	RF	CL	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	2600 C	165 U
C-AB-29	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
C-MWC-38	SO	RF	CL	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	3400 C	165 U
C-AB-25	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
C-MWC-37	SO	RF	CL	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	2800 C	165 U
C-AB-21	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	1 U
C-MW-36	SO	RF	MW	33 E	165 U	67 E	99 E	630 E	165 U	165 U	1900	165 U	480 EC	120 E
C-MW-52	SO	RF	MW	165 U	165 U	170 E	430 E	110 E	133 E	165 U	270 E	165 U	3300 C	165 U
C-MW-35	SO	RF	MW	165 U	165 U	41 E	64 E	120 E	165 U	165 U	240 E	165 U	630 EC	165 U
C-MW-20	SO	RF	MW	165 U	165 U	81 E	100 E	45 E	165 U	165 U	165 U	165 U	1000 C	165 U
C-MW-34	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
C-MW-31	SO	RF	MW	165 U	165 U	165 U	270 E	165 U	165 U	165 U	165 U	165 U	5400 C	165 U
MW-28	SO	RF	MW	165 U	165 U	165 U	165 U	31 E	165 U	165 U	130 E	165 U	390 EC	165 U
AB-27	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
MW-33	SO	RF	MW	165 U	165 U	165 U	190 E	200 E	165 U	165 U	165 U	165 U	6200 C	165 U
AB-19	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	1 U	165 U	165 U	1 U
MW-32	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	840 C	165 U
MW-55	SO	RF	MW	165 U	165 U	165 U	91 E	66 E	165 U	165 U	280 E	130 E	2800 C	540 E
IP02-04	SO	RF	TP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	22000 J	165 U	165 U	33000
AB-23	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
MWP-50	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	510	165 U	165 U	165 U
AB-10	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	1 U	165 U	165 U	165 U
IP01-04	SO	RF	TP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
AB-45	SO	TF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	1700 C	165 U
AB-43	SO	TF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	2300 C	165 U
HMDB-01	SO	TF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
HMDB-03	SO	TF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
HMDB-02	SO	TF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	1400 C	165 U
AB-44	SO	TF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
MH-06	SO	WT	MH	165 U	165 U	165 U	165 U	165 U	165 U	165 U	1100	165 U	165 U	420
MH-04	SO	WT	MH	165 U	165 U	670 U	165 U	1160 U	165 U	165 U	1755 U	165 U	410 U	165 U
MH-05	SO	WT	MH	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	860 C	165 U
IP34-02	SS	RF	TP	165 U	165 U	165 U	200 U	160 U	165 U	165 U	165 U	165 U	165 U	165 U
SS-25	SS	RF	DS	165 U	165 U	165 U	150 E	165 U	165 U	165 U	170 E	29 E	3500 C	200 E
SS-07	SS	RF	CP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	1 U	165 U	165 U	1 U
IP02-01	SS	RF	TP	165 U	165 U	165 U	6500 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SS-09	SS	RF	CP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SS-23	SS	RF	DS	165 U	165 U	165 U	100 E	165 U	165 U	165 U	110 E	165 U	3000 C	220 E
SS-11	SS	RF	CP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	800 U	500 U	165 U	2500
IP34-04	SS	RF	TP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	370 J	165 U	800	320 J
SS-13	SS	RF	CP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
P35-01	SS	RF	TP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SS-15	SS	RF	CP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SS-24	SS	RF	DS	165 U	165 U	165 U	140 E	165 U	165 U	165 U	165 U	165 U	2400 C	165 U
P37-04	SS	RF	TP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SS-08	SS	RF	CP	165 U	165 U	165 U	165 U	500 U	165 U	165 U	1000	165 U	165 U	1700
SS-10	SS	RF	CP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
P36-04	SS	RF	TP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SS-12	SS	RF	CP	165 U	165 U	165 U	165 U	1 U	165 U	165 U	1 U	165 U	165 U	165 U
SS-05	SS	RF	CP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	1 U
SS-14	SS	RF	CP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SS-03	SS	RF	CP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SS-16	SS	RF	CP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
P35-04A	SS	RF	TP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	305 J	165 U	165 U	165 U
P37-02	SS	RF	TP											

SOIL SEMI-VOLATILES
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SAMPLEID	TYPE1	LOC	TYPE2	PYRENE	BUTYLBENZYLPHTHALATE	BENZO[a]ANTHRACENE	BIS[2-ETHYLHEXYL]PHTHALATE	CHRYSENE	DI-n-OCTYLPHTHALATE	BENZO[b]FLOURANTHENE	BENZO[k]FLOURANTHENE	BENZO[a]PYRENE
SMC-RS-14	SD	GR	SF	165 U	54 E	165 U	360 EC	165 U	165 U	165 U	390 E	165 U
SMC-RS-05	SD	GR	SF	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-RS-06	SD	GR	DP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-RS-08	SD	GR	DP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SR-RS15-01	SD	GR	SF	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-RS-12	SD	GR	SF	88 E	78 E	165 U	850 C	47 E	81 E	165 U	440 E	165 U
SMC-RS-04	SD	GR	DP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-RS-13	SD	GR	SF	165 U	165 U	165 U	310 EC	165 U	165 U	165 U	360 E	165 U
SR-RS17-01	SD	GR	SF	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-RS-07	SD	GR	SF	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SR-RS16-01A	SD	GR	SF	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-RS-09	SD	GR	SF	60 E	165 U	165 U	5600 C	165 U	165 U	165 U	790	165 U
SMC-RS-03	SD	GR	SF	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-SP-36	SD	RF	OF	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-RS-11	SD	RF	DS	990	165 U	330 E	440 EC	520 E	165 U	165 U	590 E	860
SMC-SP-34	SD	RF	OF	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SR-AB66-01A	SD	RF	DS	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-SP-33	SD	RF	OF	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SR-AB67-01	SD	RF	DS	165 U	165 U	165 U	295 U	165 U	165 U	165 U	165 U	165 U
SMC-SP-32	SD	RF	OF	1 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-SP-35	SD	RF	OF	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-SP-31	SD	RF	PL	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-RS-10	SD	RF	DS	165 U	165 U	165 U	210 EC	165 U	165 U	165 U	510 E	165 U
SMC-SP-29	SD	RF	PL	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-SP-27	SD	RF	SP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-SS-26	SD	RF	DS	920	165 U	280 E	1100 C	400 E	165 U	165 U	470 E	450 E
SR-AB68-01	SD	RF	DS	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-SP-25	SD	RF	SP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-MW-08	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-AB-16	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-MW-27	SO	RF	MW	165 U	165 U	14 E	165 U	165 U	7 E	165 U	165 U	26 E
SMC-AB-15	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-AB-38	SO	RF	AB	165 U	165 U	165 U	2100 C	165 U	220 E	165 U	165 U	165 U
SMC-AB-14	SO	RF	AB	1 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-AB-35	SO	RF	AB	165 U	150 E	165 U	8600 C	165 U	47 E	165 U	165 U	165 U
SMC-AB-13	SO	RF	AB	1 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-AB-40	SO	RF	AB	165 U	165 U	165 U	1000 C	165 U	165 U	165 U	165 U	165 U
SMC-MW-50	SO	RF	MW	580 E	1700	165 U	21000 C	165 U	165 U	165 U	165 U	165 U
SMC-MWC-39	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-MW-49	SO	RF	MW	165 U	165 U	165 U	27000 C	310	165 U	165 U	165 U	165 U
SMC-MWD-46	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-MWD-48	SO	RF	MW	165 U	165 U	165 U	760 C	165 U	165 U	165 U	165 U	165 U
SMC-MWP-02	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-MW-11	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-MW-25	SO	RF	MW	165 U	165 U	165 U	23000 EC	165 U	7 E	165 U	165 U	490 E
SMC-MW-09	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-MW-29	SO	RF	MW	430 E	165 U	165 U	17000 C	165 U	165 U	165 U	165 U	165 U
SMC-MW-54	SO	RF	MW	81 E	1900	165 U	10000 C	165 U	208 E	165 U	165 U	165 U
SMC-MW-30	SO	RF	MW	165 U	165 U	165 U	14000 EC	165 U	165 U	165 U	165 U	165 U
SMC-MW-01	SO	RF	MW	2600	165 U	1700	165 U	165 U	165 U	165 U	165 U	165 U
SMC-MWD-47	SO	RF	DA	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-AB-31	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-MW-07	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SR-AB68-02	SO	RF	MD	165 U	165 U	165 U	670	165 U	165 U	165 U	165 U	165 U
SMC-AB-32	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-AB-28	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-MW-53	SO	RF	MW	1500 E	1100 E	570 E	19000 C	800 E	400 E	165 U	1600 E	165 U
SMC-AB-26	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-AB-30	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-AB-24	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SR-AB66-03	SO	RF	DP	165 U	165 U	165 U	220 U	165 U	165 U	165 U	165 U	165 U
SMC-AB-22	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SR-AB67-03	SO	RF	DP	165 U	165 U	165 U	195 U	165 U	165 U	165 U	165 U	165 U
SMC-AB-20	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SR-AB68-03	SO	RF	DP	165 U	165 U	165 U	480	165 U	165 U	165 U	165 U	165 U
SR-AB101-01	SO	RF	DP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SR-AB66-02	SO	RF	MD	165 U	165 U	165 U	190 U	165 U	165 U	165 U	165 U	165 U
SMC-MW-51	SO	RF	MW	165 U	165 U	165 U	3000 C	165 U	165 U	165 U	165 U	520 E

SOIL SEMI-VOLATILES
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	PYRENE	BUTYLBENZYLPHTHALATE	BENZO[a]ANTHRACENE	BIS[2-ETHYLHEXYL]PHTHALATE	CHRYSENE	DI-n-OCTYLPHTHALATE	BENZO[b]FLOURANTHENE	BENZO[k]FLOURANTHENE	BENZO[a]PYRENE
SR-AB67-02	SO	RF	MD	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-AB-17	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-AB-42	SO	RF	CL	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-AB-37	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-AB-41	SO	RF	CL	165 U	165 U	165 U	2100 C	165 U	290 E	165 U	165 U	165 U
SMC-AB-39	SO	RF	AB	165 U	165 U	165 U	530 EC	165 U	165 U	165 U	165 U	165 U
SMC-MWC-41	SO	RF	CL	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-MW-100	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-MWC-40	SO	RF	CL	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-AB-29	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-MWC-38	SO	RF	CL	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-AB-25	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-MWC-37	SO	RF	CL	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-AB-21	SO	RF	AB	1 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-MW-36	SO	RF	MW	290 E	200 E	48 E	13000 EC	165 U	12 E	165 U	165 U	240 E
SMC-MW-52	SO	RF	MW	165 U	165 U	165 U	135000 EC	165 U	45 E	165 U	165 U	1000
SMC-MW-35	SO	RF	MW	60 E	26 E	41 E	11000 C	150 E	165 U	165 U	165 U	100 E
SMC-MW-26	SO	RF	MW	165 U	165 U	165 U	8500 C	165 U	165 U	165 U	165 U	165 U
SMC-MW-34	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-MW-31	SO	RF	MW	165 U	165 U	165 U	18000 EC	165 U	165 U	165 U	165 U	165 U
SMC-MW-28	SO	RF	MW	165 U	46 E	165 U	13000 EC	165 U	10 E	165 U	165 U	530 E
SMC-AB-27	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-MW-33	SO	RF	MW	270 E	165 U	165 U	11000 C	620 E	165 U	165 U	165 U	180
SMC-AB-19	SO	RF	AB	1 U	165 U	165 U	165 U	185 U	165 U	165 U	165 U	165 U
SMC-MW-32	SO	RF	MW	165 U	165 U	165 U	14000 EC	165 U	165 U	165 U	165 U	165 U
SMC-MW-55	SO	RF	MW	560 E	165 U	200 E	165 U	140 E	42 E	160 E	165 U	165 U
SR-TP02-04	SO	RF	TP	30000	165 U	17000 J	165 U	25000	165 U	16000 J	22000	19000 J
SMC-AB-23	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-MWP-56	SO	RF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-AB-18	SO	RF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SR-TP01-04	SO	RF	TP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	440
SMC-AB-45	SO	TF	AB	165 U	165 U	165 U	470 EC	165 U	165 U	165 U	165 U	165 U
SMC-AB-43	SO	TF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-MWDB-01	SO	TF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-MWDB-03	SO	TF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-MWDB-02	SO	TF	MW	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-AB-44	SO	TF	AB	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-MH-06	SO	WT	MH	1700	165 U	165 U	5600 C	165 U	1600	165 U	2100	165 U
SMC-MH-04	SO	WT	MH	1085 U	640 U	165 U	3006 U	165 U	165 U	165 U	4915 U	165 U
SMC-MH-05	SO	WT	MH	165 U	165 U	165 U	137 EC	165 U	165 U	165 U	2100	165 U
SR-TP34-02	SS	RF	TP	165 U	165 U	165 U	285 U	165 U	165 U	165 U	165 U	250 J
SMC-SS-25	SS	RF	DS	350 E	120 E	120 E	17000 EC	170 E	40 E	150 E	440 E	290 E
SMC-SS-07	SS	RF	CP	1 U	165 U	1 U	165 U	165 U	165 U	165 U	165 U	165 U
SR-TP02-01	SS	RF	TP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-SS-09	SS	RF	CP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-SS-23	SS	RF	DS	250 E	91 E	79 E	390 EC	165 U	165 U	165 U	165 U	165 U
SMC-SS-11	SS	RF	CP	2800	165 U	7500	165 U	165 U	165 U	5000	165 U	3600
SR-TP34-04	SS	RF	TP	460	165 U	165 U	900 U	480	165 U	420	380 J	290 J
SMC-SS-13	SS	RF	CP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SR-TP35-01	SS	RF	TP	165 U	165 U	165 U	200 U	165 U	165 U	165 U	165 U	165 U
SMC-SS-15	SS	RF	CP	165 U	165 U	1700	165 U	165 U	165 U	2000	165 U	2000
SMC-SS-24	SS	RF	DS	165 U	165 U	165 U	150 EC	165 U	165 U	165 U	514 E	165 U
SR-TP37-04	SS	RF	TP	165 U	165 U	165 U	185 U	165 U	165 U	165 U	165 U	165 U
SMC-SS-08	SS	RF	CP	1300	165 U	1500	165 U	165 U	165 U	165 U	165 U	165 U
SMC-SS-10	SS	RF	CP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SR-TP36-04	SS	RF	TP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-SS-12	SS	RF	CP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-SS-05	SS	RF	CP	1 U	165 U	1 U	165 U	165 U	165 U	1 U	165 U	1 U
SMC-SS-14	SS	RF	CP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-SS-03	SS	RF	CP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SMC-SS-16	SS	RF	CP	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SR-TP35-04A	SS	RF	TP	345 J	165 U	165 U	165 U	165 U	165 U	165 U	165 U	165 U
SR-TP37-02	SS	RF	TP									

SOIL SEMI-VOLATILES
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	INDENO[1,2,3-CD]PYRENE	BENZO[G,H,I]PERYLENE
SMC-RS-14	SD	GR	SF	165 U	165 U
SMC-RS-05	SD	GR	SF	165 U	165 U
SMC-RS-06	SD	GR	DP	165 U	165 U
SMC-RS-08	SD	GR	DP	165 U	165 U
SR-RS15-01	SD	GR	SF	165 U	165 U
SMC-RS-12	SD	GR	SF	165 U	165 U
SMC-RS-04	SD	GR	DP	165 U	165 U
SMC-RS-13	SO	GR	SF	165 U	165 U
SR-RS17-01	SD	GR	SF	165 U	165 U
SMC-RS-07	SD	GR	SF	165 U	165 U
SR-RS16-01A	SO	GR	SF	165 U	165 U
SMC-RS-09	SD	GR	SF	165 U	165 U
SMC-RS-03	SD	GR	SF	165 U	165 U
SMC-SP-36	SO	RF	OF	165 U	165 U
SMC-RS-11	SO	RF	DS	165 U	165 U
SMC-SP-34	SO	RF	OF	165 U	165 U
SR-AB68-01A	SD	RF	DS	165 U	165 U
SMC-SP-33	SO	RF	OF	165 U	165 U
SR-AB67-01	SD	RF	DS	165 U	165 U
SMC-SP-32	SD	RF	OF	165 U	165 U
SMC-SP-35	SD	RF	OF	165 U	165 U
SMC-SP-31	SD	RF	PL	165 U	165 U
SMC-RS-10	SD	RF	DS	165 U	165 U
SMC-SP-29	SO	RF	PL	165 U	165 U
SMC-SP-27	SO	RF	SP	165 U	165 U
SMC-SS-26	SO	RF	DS	165 U	165 U
SR-AB68-01	SD	RF	DS	165 U	165 U
SMC-SP-25	SD	RF	SP	165 U	165 U
SMC-MW-08	SO	RF	MW	165 U	165 U
SMC-AB-18	SO	RF	AB	165 U	165 U
SMC-MW-27	SO	RF	MW	165 U	165 U
SMC-AB-15	SO	RF	AB	165 U	165 U
SMC-AB-38	SO	RF	AB	165 U	165 U
SMC-AB-14	SO	RF	AB	165 U	165 U
SMC-AB-35	SO	RF	AB	165 U	165 U
SMC-AB-13	SO	RF	AB	165 U	165 U
SMC-AB-40	SO	RF	AB	165 U	165 U
SMC-MW-50	SO	RF	MW	165 U	165 U
SMC-MWC-39	SO	RF	MW	165 U	165 U
SMC-MW-49	SO	RF	MW	165 U	165 U
SMC-MWD-46	SO	RF	MW	165 U	165 U
SMC-MWD-40	SO	RF	MW	165 U	165 U
SMC-MWP-02	SO	RF	MW	165 U	165 U
SMC-MW-11	SO	RF	MW	165 U	165 U
SMC-MW-25	SO	RF	MW	165 U	165 U
SMC-MW-09	SO	RF	MW	165 U	165 U
SMC-MW-29	SO	RF	MW	165 U	165 U
SMC-MW-54	SO	RF	MW	165 U	165 U
SMC-MW-30	SO	RF	MW	165 U	165 U
SMC-MW-01	SO	RF	MW	165 U	165 U
SMC-MWD-47	SO	RF	DA	165 U	165 U
SMC-AB-31	SO	RF	AB	165 U	165 U
SMC-MW-07	SO	RF	MW	165 U	165 U
SR-AB68-02	SO	RF	MD	165 U	165 U
SMC-AB-32	SO	RF	AB	165 U	165 U
SMC-AB-28	SO	RF	AB	165 U	165 U
SMC-MW-53	SO	RF	MW	165 U	165 U
SMC-AB-26	SO	RF	AB	165 U	165 U
SMC-AB-30	SO	RF	AB	165 U	165 U
SMC-AB-24	SO	RF	AB	165 U	165 U
SR-AB66-03	SO	RF	DP	165 U	165 U
SMC-AB-22	SO	RF	AB	165 U	165 U
SR-AB67-03	SO	RF	DP	165 U	165 U
SMC-AB-20	SO	RF	AB	165 U	165 U
SR-AB68-03	SO	RF	DP	165 U	165 U
SR-AB101-01	SO	RF	DP	165 U	165 U
SR-AB66-02	SO	RF	MD	165 U	165 U
SMC-MW-51	SO	RF	MW	165 U	165 U

SOIL SEMI-VOLATILES
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	INDENO[1,2,3-CD]PYRENE	BENZO[G,H,I]PERYLENE
SR-AB67-02	SO	RF	MD	165 U	165 U
SMC-AB-17	SO	RF	AB	165 U	165 U
SMC-AB-42	SO	RF	CL	165 U	165 U
SMC-AB-37	SO	RF	AB	165 U	165 U
SMC-AB-41	SO	RF	CL	165 U	165 U
SMC-AB-39	SO	RF	AB	165 U	165 U
SMC-MWC-41	SO	RF	CL	165 U	165 U
SMC-MW-100	SO	RF	MW	165 U	165 U
SMC-MWC-40	SO	RF	CL	165 U	165 U
SMC-AB-29	SO	RF	AB	165 U	165 U
SMC-MWC-38	SO	RF	CL	165 U	165 U
SMC-AB-25	SO	RF	AB	165 U	165 U
SMC-MWC-37	SO	RF	CL	165 U	165 U
SMC-AB-21	SO	RF	AB	165 U	165 U
SMC-MW-36	SO	RF	MW	165 U	165 U
SMC-MW-52	SO	RF	MW	165 U	165 U
SMC-MW-35	SO	RF	MW	165 U	165 U
SMC-MW-26	SO	RF	MW	165 U	165 U
SMC-MW-34	SO	RF	MW	165 U	165 U
SMC-MW-31	SO	RF	MW	165 U	165 U
SMC-MW-28	SO	RF	MW	165 U	165 U
SMC-AB-27	SO	RF	AB	165 U	165 U
SMC-MW-33	SO	RF	MW	165 U	165 U
SMC-AB-19	SO	RF	AB	165 U	165 U
SMC-MW-32	SO	RF	MW	165 U	165 U
SMC-MW-55	SO	RF	MW	165 U	165 U
SR-TP02-04	SO	RF	TP	13000 J	12000 J
SMC-AB-23	SO	RF	AB	165 U	165 U
SMC-MWP-56	SO	RF	MW	165 U	165 U
SMC-AB-18	SO	RF	AB	165 U	165 U
SR-TP01-04	SO	RF	TP	165 U	165 U
SMC-AB-45	SO	TF	AB	165 U	165 U
SMC-AB-43	SO	TF	AB	165 U	165 U
SMC-MWDB-01	SO	TF	MW	165 U	165 U
SMC-MWDB-03	SO	TF	MW	165 U	165 U
SMC-MWDB-02	SO	TF	MW	165 U	165 U
SMC-AB-44	SO	TF	AB	165 U	165 U
SMC-MH-06	SO	WT	MH	165 U	165 U
SMC-MH-04	SO	WT	MH	165 U	165 U
SMC-MH-05	SO	WT	MH	165 U	165 U
SR-TP34-02	SS	RF	TP	165 U	165 U
SMC-SS-25	SS	RF	DS	165 U	165 U
SMC-SS-07	SS	RF	CP	165 U	165 U
SR-TP02-01	SS	RF	TP	165 U	165 U
SMC-SS-09	SS	RF	CP	165 U	165 U
SMC-SS-23	SS	RF	DS	165 U	165 U
HC-SS-11	SS	RF	CP	165 U	165 U
R-TP34-04	SS	RF	TP	165 U	165 U
HC-SS-13	SS	RF	CP	165 U	165 U
R-TP35-01	SS	RF	TP	165 U	165 U
HC-SS-15	SS	RF	CP	165 U	165 U
HC-SS-24	SS	RF	DS	165 U	165 U
R-TP37-04	SS	RF	TP	165 U	165 U
HC-SS-08	SS	RF	CP	165 U	165 U
HC-SS-10	SS	RF	CP	165 U	165 U
R-TP36-04	SS	RF	TP	165 U	165 U
HC-SS-12	SS	RF	CP	165 U	165 U
HC-SS-05	SS	RF	CP	165 U	165 U
HC-SS-14	SS	RF	CP	165 U	165 U
HC-SS-03	SS	RF	CP	165 U	165 U
HC-SS-16	SS	RF	CP	165 U	165 U
R-TP35-04A	SS	RF	TP	165 U	165 U
R-TP37-02	SS	RF	TP		

[redacted]

SO[illegible] [illegible]GANIC[illegible]
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	TL	VN	ZN
SMC-RS-09	SD	GR	SF	20 U	6 U	2	20 U	1 U	1 U	500 U	13	5 U	11	10 U	11	500 U	2 U	0 U	19	500 U	1 U	0	1 U	5 U	43
SR-RS15-01	SD	GR	SF	5590	6 U	7	73	0 M	1 U	711 M	5	8 M	9	15200	7 J	1510	304	0 U	13	354 M	1 U	1 U	1 U	6 M	37 E
SMC-RS-14	SD	GR	SF	20 U	6 U	6	20 U	1 U	1 U	500 U	1 U	5 U	5	10 U	7	500 U	2 U	0 U	61	500 U	1 U	1 U	1 U	5 U	7
SMC-RS-03	SD	GR	SF	20 U	6 U	17	20 U	1 U	1	500 U	17	5 U	17	10 U	25	500 U	2 U	0	3	500 U	1 U	12	1 U	5 U	64
SMC-RS-04	SD	GR	DP	20 U	6 U	7	20 U	1 U	1 U	500 U	8	5 U	10	10 U	10	500 U	2 U	0	2	500 U	1 U	1	1 U	5 U	34
SMC-RS-06	SD	GR	DP	20 U	6 U	7	20 U	1 U	1 U	500 U	7	5 U	8	10 U	11	500 U	2 U	0 U	1	500 U	1 U	10	1 U	5 U	26
SMC-RS-08	SD	GR	DP	20 U	1 U	28	20 U	1 U	1 U	500 U	22	5 U	43	10 U	43	500 U	2 U	0 U	5	500 U	1 U	1 U	1 U	5 U	116
SR-RS16-01A	SD	GR	SF	5260	6 U	6	124	0 M	1 U	845 M	6	7 M	6	17350	6 J	1595	597	0 U	13	376 M	1 U	1 U	1 U	8 M	40 E
SMC-RS-13	SD	GR	SF	20 U	6 U	4	20 U	1 U	1 U	500 U	1 U	5 U	7	10 U	2	500 U	2 U	0 U	17	500 U	1 U	0	1 U	5 U	26
SMC-RS-07	SD	GR	SF	20 U	6 U	7	20 U	1 U	1 U	500 U	6	5 U	6	10 U	9	500 U	2 U	0 U	1	500 U	1 U	2	1 U	5 U	21
SMC-RS-05	SD	GR	SF	20 U	6 U	6	20 U	1 U	1 U	500 U	5	5 U	160	10 U	9	500 U	2 U	0 U	1	500 U	1 U	1 U	1 U	5 U	25
SMC-RS-12	SD	GR	SF	20 U	6 U	98	20 U	1 U	1 U	500 U	1 U	5 U	13	10 U	1 U	500 U	2 U	0 U	357	500 U	1 U	1	1 U	5 U	1030
SR-RS17-01	SD	GR	SF	3550	6 U	6	45 M	1 U	1 U	965 M	5	5 M	12	9100	7 J	1320	185	0 U	9 M	278 M	1 U	1 U	1 U	4 M	25 E
SMC-SS-26	SD	RF	DS	20 U	6 U	1	20 U	1 U	1 U	500 U	12	5 U	59	10 U	55	500 U	2 U	0 U	4 U	14	1 U	0 U	1 U	5 U	59
SMC-SP-36	SD	RF	OF	20 U	6 U	16 U	20 U	1 U	1 U	500 U	96	5 U	15	10 U	666	500 U	2 U	0	38	500 U	1 U	1 U	1 U	5 U	714
SMC-SP-32	SD	RF	OF	20 U	6 U	24	20 U	1 U	1 U	500 U	9	5 U	35	10 U	37	500 U	2 U	0	24	500 U	1 U	1 U	1 U	5 U	161
SMC-SP-34	SD	RF	OF	20 U	6 U	17	20 U	1 U	1 U	500 U	19	5 U	19	10 U	100	500 U	2 U	0	31	500 U	1 U	1 U	1 U	5 U	94
SMC-SP-31	SD	RF	PL	20 U	6 U	9	20 U	1 U	1 U	500 U	12	5 U	147	10 U	880	500 U	2 U	0	22	500 U	1 U	1 U	1 U	5 U	60
SMC-RS-10	SD	RF	DS	20 U	6 U	1 U	20 U	1 U	22	500 U	1 U	5 U	6	10 U	802	500 U	2 U	0 U	272	500 U	1 U	0	1 U	5 U	159
SMC-SP-29	SD	RF	PL	20 U	1 U	271	20 U	1 U	3	500 U	1 U	5 U	32	10 U	18	500 U	2 U	0	1 U	500 U	1 U	1 U	1 U	5 U	119
SMC-SP-35	SD	RF	OF	20 U	6 U	18	20 U	1 U	1 U	500 U	14	5 U	37	10 U	160	500 U	2 U	0 U	33	500 U	1 U	1 U	1 U	5 U	112
SMC-SP-27	SD	RF	SP	20 U	2 U	37	20 U	2 U	2 U	500 U	33	5 U	71	10 U	116	500 U	2 U	0 U	74	500 U	2 U	2 U	2 U	5 U	165
SMC-SP-33	SD	RF	OF	20 U	6 U	52	20 U	2 U	2 U	500 U	27	5 U	7 M	10 U	263	500 U	2 U	2	46	500 U	2 U	2 U	2 U	5 U	745
SR-AB67-01	SD	RF	DS	3570	6 U	46 J	187	1 U	1 U	500 U	4	3 M	17	33900	9	500 U	2670 J	0 U	8 M	313 M	1 U	1 U	1 U	7 MJ	26
SMC-RS-11	SD	RF	DS	20 U	6 U	1 U	20 U	1 U	1 U	1990 M	1 U	5 U	12	10 U	17	1680 M	2 U	0 U	37	500 U	1 U	0	1 U	5 U	172
SR-AB66-01A	SD	RF	DS	7935	6 U	1 U	133	1 U	1 U	500 U	8	7 M	12 M	13750	21	500 U	794	0 U	14 M	919 M	1 U	1 U	1 U	10 MJ	62
SR-AB68-01	SD	RF	DS	6360	6 U	45 J	174	1 U	1 U	500 U	6 M	3 M	12	40300	19 J	500 U	1900 J	0 U	13 M	500 U	1 U	1 U	1 U	11 MJ	52
SMC-SP-25	SD	RF	SP	20 U	3 U	572	20 U	3 U	4 U	1380	7	5 U	55 J	10 U	59	3040	2 U	0 U	5	500 U	3 U	3 U	3 U	5 U	141
SR-AB44-03				8570	4 U	1 U	137	0 U	1	1460	9	7	46 J	21200	402	1870	374 J	0	13	482 J	0 U	0 U	0 U	13 J	338
SR-AB43-02				5720 J	5 J	10	85	0	2	1470	8	6	3 U	15400	143	2900	342 J	0	7	381 J	0 J	1 U	1 U	8 J	273
SR-AB43-03				6990	3 U	7 J	119	0 U	1	500 U	19 J	7	14	19000	14	2750	392 J	0 U	11	353 J	0 J	0 U	0 U	12 J	46
SR-AB44-01				20 U	6 U	3 J	20 U	1 U	1 U	1080 M	13	5 U	10	10 U	654	500 U	2 U	0 U	19	500 U	1 U	1 U	1 U	5 U	56 E
SR-AB42-03				10200	6 U	8 J	151	1 M	1 U	500 U	12	12	11 J	23100	10	1760	605	0 U	20	1360	1 U	1 M	1 U	13	49
SR-AB44-02				6520	5 MJ	8	121	1 U	1 U	500 U	7	6 M	13	15200	14	500 U	604 J	0	13	665 M	1 U	1 U	1 U	9 MJ	63 E
SR-AB42-01A				18400	6 U	8 J	147	1 M	2	500 U	10	9 M	12	21000	504	500 U	528 J	0	17	959 M	1 U	2 M	1 U	20 J	72
SR-AB43-01				12100	6 U	11	116	1 U	1 U	500 U	4	9 M	13	20900	543	500 U	288 J	0 U	19	1120 M	1 U	1 U	1 U	16 J	44
SR-AB42-02				20 U	6 U	8	20 U	1 A	1 U	500 U	10	5 U	13	10 U	27	1870	2 U	0	28	500 U	1 U	1 U	2 A	5 U	39
SMC-AB-41	SD	RF	CL	6140	6 U	11	80	1 U	1 U	500 U	6	5 M	13	17600	77	500 U	276 J	0 U	13	428 M	1 U	1 U	1 U	9 MJ	23 U
SR-AB58-02	SD	RF	MD	20 U	6 U	4	20 U	1 A	1 U	1610	14	5 U	11	10 U	15 J	2160	2 U	0	29	500 U	1 U	1 U	2 A	5 U	38
SR-AB60-02	SO	RF	MD	4230	6 U	28	50	1 U	1 U	500 U	10 J	4 M	8	11700	15 J	500 U	573 J	0 U	8 M	492 M	1 U	1 U	1 U	6 MJ	43
SR-TP01-04	SO	RF	TP	20 U	6 U	5 J	20 U	1 A	1 U	500 U	23	5 U	14	10 U	13	1720	2 U	0	25	500 U	1 U	1 U	2 A	5 U	37
SR-AB94-02	SO	RF	MD	5980	6 U	29	63	1 U	1 U	500 U	12 J	6 M	10 J	15300	33 J	500 U	208 J	0 A	11	654 M	1 U	1 U	1 U	8 MJ	54
SMC-AB-15	SO	RF	AB	20 U	6 U	10 J	20 U	1 A	1 U	500 U	11	5 U	13	10 U	24	1920	2 U	0 A	24	500 U	1 U	1 U	2 A	5 U	49 E
SR-AB68-02	SO	RF	MD	8950	6 U	18	283	0 M	1 U	500 U	9	8 M	9 J	14700	25 J	500 U	503 J	0 U	15	990 M	1 U	1 U	2	8 MJ	52
SMC-AB-17	SO	RF	AB	20 U	6 U	2 J	20 U	1	1 U	500 U	20	5 U	11	10 U	13	1990	2 U	0 A	30	500 U	1 U	1 U	2 A	5 U	51
SR-AB67-02	SO	RF	MD	10100	6 U	28	107	0 M	1 U	500 U	9	9 M	7	215	8	500 U	599 J	0	15	1120 M	1 U	1 U	1 U	5 U	42
SMC-AB-19	SO	RF	AB	20 U	6 U	8 J	20 U	1 A	1 U	500 U	12	5 U	11	10 U	20	500 U	2 U	2	16	500 U	1 U	1 U	2 A	7 M	40 E
SR-AB66-02	SO	RF	MD	7700	6 U	10	76	0 M	1 U	848 M	11 J	7 M	21	12400	12	500 U	266 J	0 A	13	587 M	1 U	1 U	2 J	5 U	65
SMC-AB-21	SO	RF	AB	20 U	6 U	5 J	20 U	1	1 U	500 U	8	5 U	227	10 U	63	3120	2 U	0 A	27	500 U	1 U	1 U	1	9 MJ	64
SR-AB65-02	SO	RF	MD	8160	6 U	5	114	1 U	1 U	500 U	11	6 M	11 J	15800	34	500 U	477 J	0 A	15	421 M	1 U	1 U	1 U	5 U	158
SMC-AB-23	SO	RF	AB	20 U	6 U	21	20 U	1 A	1 M	725 M	5	5 U	11	10 U	19	500 U	2 U	0 U	14	500 U	1 U	1 U	1	12 JM	44 E
SR-AB64-02	SO	RF	MD	10100	6 U	10	102	0 M	1 U	500 U	14	7 M	18	14100	15	500 U	169 J	0 A	13	1060 M	1 U	1 M	1 U	5 U	40
SMC-AB-25	SO	RF	AB	20 U	6 U	8 J	20 U	1 A	1 U	2640	8	5 U	11	10 U	11	2060	2 U	0 A	21	500 U	1 U	1 U	2 A	5 U	54
SR-AB63-02	SO	RF	MD	20 U	6 U	6	20 U	1 A	1 U	500 U	9	5 U	19	10 U	9	500 U	2 U	0 A	39	500 U	1 U	1 U	2 A	5 U	22
SMC-AB-27	SO	RF	AB	20 U	6 U	17	20 U	1 U	1 U	1070 M	7	5 U	12	10 U	9	1640	2 U	0 A	12	500 U	1 U	1	1 U	12 M	98 E
SR-AB62-02	SO	RF	MD	9180	6 U	3	121	0 M	1 U	1750	15	8 M	13	15800	42 J	500 U	333 J	0 U	16	838 M	1 U	1 M	1 U	5 U	97
SMC-AB-29	SO	RF	AB	20 U	6 U	3	20 U	1 U	1 U	500 U	7	5 U	18	10 U	21	2630	2 U	0 U	18	500 U	1 U	2 A	1 U	5 U	43
SR-AB61-02	SO	RF	MD	20 U	6 U	8	20 U	1 A	1 U	500 U	17 J	5 U	8	15	10	500 U	2 U	0 U	31	500 U	1 U	1 U	2 A	5 U	34
SMC-AB-31	SO	RF	AB	20 U	6 U	3	20 U	1 U	1 A	500 U	1 U	5 U	16	10 U	10	1780	2 U	0 U	18	500 U	1 U	2 A	1 U	11	45 E
SMC-AB-14	SO	RF	AB	12000	6 U	1 U	103	0 M	1 U	500 U	4	8 M	17	16500	21	500 U	377	0	13	462 M	1 U	1 U	1 U	5 U	40
SMC-MW-01	SO	RF	MW	20 U	6 U	1 U	20 U	1 U	1 U	1020 M	22	5 U	10	10 U	12	3920	2 U	0 U	15	500 U	1 U	1	1 U	8 MJ	40
SR-AB59-02	SO	RF	MD	7600	6 U	9	104	0 M	1 U	500 U	7	6 M	9 J	15700	763	500 U	272	0 U	9	500 U	1 U	1 U	1 U	5 U	35
SMC-MW-08	SO	RF	MW	20 U	6 U	3	20 U	1 U	1	500 U	1 U	5 U	14	10 U	21	2130	2 U	0 U	17	1850	1 U	1 U	1 U	19 J	65 E
SMC-AB-13	SO	RF	AB	18200	6 U	9	163	1 M	1 U	2340	7 J	9 M	7	17700	1 U	1900	181 J	1 U	12	500 U	1 U	1 U	1 U	5 U	33
MC-MW-100	SO	RF	MW	20 U	6 U	14	20 U	1 U	1 U	500 U	5	5 U	14	10 U	44	500 U	2 U	0 U	12	500 U	1 U	1 U	1 U	8 MJ	41
R-AB57-02	SO	RF	MD	8430	6 U	21	132	0 M	1 U	500 U	23 J	7 M	28	14000	17 J	1560	388	0 U	20	1770	1 U	1 U	1 U	5 U	28
MC-MW-55	SO	RF	MW	20 U	6 U	6 J	20 U	1 U	1 U	500 U	6	5 U	17	10 U	10	500 U	2 U	0 U	18	500 U	1 U	1 U	1 U	15 J	85
R-AB56-02	SO	RF	MD	12200	15 MJ	6	168	1 M	1 U	1420	7	15	12	34000	13	1870	657	0 U	11	459 M	1 U	2 M	1 U	5 U	59
MC-AB-37	SO	RF	AB	20 U	6 U	16	20 U	1 U	1 U	500 U	23	5 U	12	10 U	40	500 U	2 U	0 U	12	887 M	1 U	0	3	8 MJ	51
R-AB55-02	SO	RF	MD	7500	6 U	7 J	84	1 U	1 U	1170	9	7 M	3 U	14400	13	1640	217 J	0 U	4 U	500 U	1 U	1 U	1 U	6 M	38
MC-MW-25	SO	RF	MW	6500	10 MJ	12 *	145	0 M	2	500 U	39	7 M	10 J	20900	8	500 U	377	0 U	17	988 M	1 U	1 M	1 U	5 U	31
R-AB54-02	SO	RF	MD	20 U	6 U	9 J	20 U	1 U	1 U	500 U	12 J	5 U	14	10 U	13	2170	310	0 U	4 U	500 U	1 U	1 U	1 U	6 JM	38 E
MC-MW-27	SO	RF	MW	6960	6 U	12	113	0 M	1 U	500 U	1 U	7 M	12 J	17600	9	500 U	2490 J	0 U	12	1370	1 U	2 M	1 U	8 MJ	41

SOIL INORGANICS
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	TL	VN	ZN
SR-AB53-02	SO	RF	MD	20 U	6 U	7 J	20 U	1 U	1 U	500 U	7	5 U	8	10 U	31	2730	241 J	0 U	21	500 U	1 U	1 U	1 U	5 U	47
SMC-MW-29	SO	RF	MW	8010	6 U	50	124	0 M	1 U	500 U	54	8 M	9	21500	25	500 U	159 J	0 A	17	575 M	1 U	1 U	1 U	6 M	21
SR-AB50-03	SO	RF	DP	20 U	6 U	10 J	20 U	1 U	1 U	9320	6	5 U	13	10 U	15 J	1310 M	2 U	0 U	39	500 U	1 U	1 U	1 U	5 U	79
SR-AB49-03	SO	RF	DP	6190	6 U	1 U	107	0 M	1 U	500 U	37	6 M	9	15100	13	500 U	284 J	0 U	20	857 M	1 U	1 M	1 U	12 J	48
SMC-MW-32	SO	RF	MW	20 U	6 U	6 J	20 U	1 U	3	1180	9	5 U	26	10 U	15	500 U	2 U	0 U	37	500 U	1 U	15	1 U	5 U	127
SR-AB48-03	SO	RF	DP	8380	6 U	14	112	1 U	1 U	500 U	12 J	8 M	14 J	24700	9	500 U	214 J	0 A	16	1340	1 U	1 U	1 U	11 JM	54
SMC-MW-34	SO	RF	MW	20 U	6 U	11 J	20 U	1	1 U	632 M	12	5 U	20	10 U	20 *	2430	2 U	0 U	58	500 U	1 U	1 U	1 U	5 U	89
SR-AB47-03	SO	RF	DP	10200	6 U	1 U	92	1 M	1 U	500 U	7	9 M	12	23000	8	1830	138 J	0 A	23	313 M	1 U	1 M	1 U	5 MJ	46
SMC-MW-38	SO	RF	MW	20 U	6 U	9	20 U	1	1 U	500 U	17 J	5 U	28	10 U	6	2610	2 U	0 U	38	500 U	1 U	1 U	1 U	5 U	165
SR-AB59-03	SO	RF	DP	5170	6 U	14	68	1 U	1 U	998 M	17 J	5 M	14	12700	47	500 U	2 U	0 U	20	500 U	1 U	1 U	1 U	5 U	43
SMC-MWC-38	SO	RF	CL	20 U	6 U	3 J	20 U	1	1 U	1400	16	5 U	18	10 U	18 *	1980	2 U	0 U	16	500 U	1 U	1 U	1 U	5 U	108
SR-AB60-03	SO	RF	DP	20 U	6 U	5 J	20 U	1 A	1 U	996 M	11 J	5 U	17 J	10 U	8 J	500 U	247	0 U	25	914 MJ	1 U	1 U	2 A	9 M	54
SMC-MWC-41	SO	RF	CL	20 U	6 U	3 J	20 U	1 U	1 U	500 U	11	5 U	10	10 U	15 *	2110	500 J	0 U	23	669 M	2	25	6	8 M	40 J
SR-AB61-03	SO	RF	DP	8300	6 U	18	83	0 M	1 U	1270	13	10 M	11 J	17200	21	2050	263 J	0 U	22	1500	1 U	1 M	1 U	13 M	55
SMC-AB-42	SO	RF	CL	8130	6 U	5	119	0 M	1 U	500 U	14	8 M	10	14100	3	500 U	2 U	0 U	16	500 U	1 U	1 U	1 U	5 U	50
SR-AB62-03	SO	RF	DP	10400	1 U	88	113	0 M	1 U	2060	9	13 M	14	12600	31 J	2350	151	0 U	19	500 U	1 U	1 U	1 U	7 MJ	46
SMC-MWC-37	SO	RF	CL	20 U	6 U	0 J	20 U	1 A	1 U	5380	18	5 U	13	10 U	2 *	500 U	2 U	0 U	21	1520	1 U	1 U	2 A	5 U	40
SMC-AB-30	SO	RF	AB	7170	6 U	6 J	113	0 M	1 U	1460	9	7 M	10 J	18300	11	500 U	219 J	0	20	1420	1 U	1 M	1 U	9 MJ	50 E
SMC-MWC-40	SO	RF	CL	20 U	6 U	12 *	20 U	1 A	1 U	500 U	13	5 U	16 J	10 U	20 *	500 U	291 J	0 U	15	500 U	1 U	1 U	2 A	10 MJ	53 E
SR-AB52-03	SO	RF	DP	8460	6 U	8 J	68	0 M	1 U	500 U	7	8 M	18	15800	12	5630	2 U	0 U	23	1340	1 U	1 U	1 U	5 U	54
SR-AB101-01	SO	RF	DP	9850	6 U	6	145	0 M	1 U	68800	1 U	10 M	8 J	23400	29	500 U	610 J	0	4 U	500 U	1 U	2 M	1 U	8 MJ	52 E
SR-AB45-03	SO	RF	DP	20 U	6 U	12	20 U	1 U	1	500 U	8	5 U	17	10 U	11	1940	2 U	0 U	23	1790	1 U	1 U	1 U	5 U	81
SMC-AB-26	SO	RF	AB	9200	6 U	1 U	142	0 M	1 U	500 U	14	8 M	18	25600	18	500 U	514 J	0 U	16	500 U	1 U	1 M	1 U	16 J	64
SR-AB53-03	SO	RF	DP	20 U	6 U	8	20 U	1 U	1 U	500 U	20 J	5 U	6	10 U	11	2070	2 U	0	19	807 M	1 U	14	1 U	5 U	28
SMC-AB-28	SO	RF	AB	11500	6 U	1 U	80	1 U	1 U	500 U	8	11 M	18	26400	3	500 U	515 J	0 U	12	500 U	1 U	1 U	1 U	12 M	48
SR-AB55-03	SO	RF	DP	20 U	111	14 J	20 U	1 U	1 U	728 M	20	5 U	10	10 U	18	3190	2 U	0 U	14	772 M	8	1 U	1 U	5 U	61
SR-AB64-03	SO	RF	DP	7980	6 U	10	50 M	1 U	1 U	500 U	19 J	8 M	16	19500	11	500 U	395 J	0 U	13	500 U	1 U	1 U	1 U	11 MJ	41
SMC-MWP-56	SO	RF	MW	20 U	135	11 J	20 U	1 U	1 U	500 U	10 J	5 U	14	10 U	33 *	3390	2 U	0 U	13	664 M	1 U	1 U	1 U	5 U	36
SR-AB65-03	SO	RF	DP	7470	5 MJ	15	49 M	1 U	1 U	500 U	11	7 M	12	18900	13	1890	1080 J	1	20	500 U	1 U	1 U	1 U	10 MJ	47
SMC-MWD-46	SO	RF	MW	20 U	6 U	1 U	20 U	1 U	1 U	750 M	1 U	5 U	16	10 U	22 *	3130	2 U	0 U	20	596 MJ	1 U	1 U	1 U	5 U	40
SR-AB66-03	SO	RF	DP	7880	6 U	15	158	1 U	1 U	500 U	14	6 M	15 J	19100	11	1270 M	190	0 U	19	500 U	1 U	1 U	1 U	8 M	44
SMC-MWC-39	SO	RF	MW	20 U	6 U	8 J	20 U	1 U	1 U	500 U	14	5 U	18	10 U	11 *	2250	2 U	0 U	23	1470	1 U	1 U	1 U	5 U	55
SR-AB67-03	SO	RF	DP	7060	6 U	16	62	0 M	1 U	500 U	8	8 M	16 J	16600	12	500 U	2260 J	0 U	19	500 U	1 U	1 M	1 U	25 J	97 E
SMC-AB-40	SO	RF	AB	20 U	6 U	5 J	20 U	1 U	1 U	500 U	14	5 U	20	10 U	51	2800	2 U	0	10 M	1400 J	1 U	1 U	1 U	5 U	40
SR-AB68-03	SO	RF	DP	22700	6 U	9	166	1 M	1 U	500 U	13	12 M	15 J	27800	10 J	500 U	797	0 A	15	1200	1 U	1 M	1 U	14	104
SMC-MW-50	SO	RF	MW	20 U	6 U	6 J	20 U	1 A	2	2400	8	5 U	12	10 U	12	2430	329	0 U	24	221 M	1 U	1 U	2 A	8 MJ	42
SR-AB94-03	SO	RF	DP	18100	6 U	1 U	236	1 M	1	500 U	1 U	12 M	14 J	23800	69	3030	579 J	0 U	21	947 M	1 U	3	1 U	20 J	73 E
SMC-MW-52	SO	RF	MW	7390	8 MJ	11 J	88	0 M	1 U	500 U	9	8 M	6 M	21400	6	1820	309	0 U	16	500 U	1 U	2 M	1 U	7 M	117 E
SR-AB95-02	SO	RF	DP	17600	6 U	9	120	1 M	1 U	500 U	1 U	12	23 J	23100	15	4060	393 J	0	31	868 M	1 U	1 U	1 U	9 MJ	39
SMC-MW-54	SO	RF	MW	5600	6 U	6 S	88	0 M	1 U	500 U	3	5 M	13	7540	16	500 U	2 U	0 U	17	500 U	1 U	1 U	1 U	5 U	56
SR-AB45-02	SO	RF	MD	8240	6 U	23	166	0 M	1 U	500 U	43	9 M	14	24000	18	500 U	227	0 U	8	671 M	1 U	2 M	1 U	12 J	42
SMC-AB-22	SO	RF	AB	20 U	6 U	8 J	20 U	1 A	1 U	500 U	15	5 U	9	10 U	29	8590	386	0 U	17	530 M	1 U	1 U	2 A	10	70
SR-AB46-02	SO	RF	MD	13200	6 U	49	81	1 M	1 U	500 U	19	9 M	17	22200	23	500 U	358 J	0 U	16	675 MJ	1 U	2 M	1 U	16 J	73 E
SR-AB56-03	SO	RF	DP	20 U	6 U	5	20 U	1 U	1 U	500 U	1 U	5 U	31	10 U	16	500 U	154	0	13	500 U	1 U	1 U	1 U	30	41
SR-AB47-02	SO	RF	MD	12500	6 U	11 J	135	1 U	1 U	500 U	30	7 M	11	19400	14	500 U	169	0 U	30	500 U	1 U	1 U	1 U	7 MJ	74
SR-AB58-03	SO	RF	DP	9400	6 U	10	122	1 M	1 U	500 U	13	10 M	38 J	22900	8 J	500 U	558	0 A	34	1260 J	2 J	1 U	1 U	14	30
SR-AB48-02	SO	RF	MD	6630	1 U	5	84	0 M	1 U	500 U	14	7 M	7	18000	77	1600	2 U	0	11	500 U	1 U	1 U	1 U	5 U	16
SMC-AB-18	SO	RF	AB	9175	6 U	7 J	130	1 M	1 U	500 U	7	8 M	14	21000	22	500 U	2 U	0 A	16	500 U	1 U	2	1 U	5 U	60
SR-AB49-02	SO	RF	MD	20 U	6 U	10	20 U	1 U	1 U	500 U	11	5 U	17 J	10 U	14	500 U	1170	0 U	12	500 U	1 U	1 U	1 U	20	34
SMC-MW-35	SO	RF	MW	20 U	6 U	22	20 U	1	1 U	500 U	10	5 U	10	10 U	10	500 U	2 U	0 A	37	500 U	1 U	31	1 U	5 U	62
SR-AB50-02	SO	RF	MD	13100	6 U	17	149	1 M	1 U	500 U	1 U	9 M	22	19400	26 J	3150	2 U	0 A	15	434 M	1 U	2 M	1 U	5 U	44
SR-TP02-04	SO	RF	TP	20 U	10	17	20 U	1 U	1 U	500 U	6	5 U	12	10 U	118 J	500 U	2 U	0 U	21	500 U	1 U	1 U	1 U	5 U	34
SR-AB54-03	SO	RF	DP	20 U	17	5	20 U	1 U	1 U	500 U	6	5 U	6	10 U	8	500 U	3660	0 A	18	500 U	1 U	0	1 U	5 U	22
SR-AB51-02A	SO	RF	MD	20 U	6 U	7	20 U	1 A	1 U	500 U	12	5 U	14	10 U	264	500 U	2 U	0 A	33	500 U	1 U	1 U	2 A	7 M	99
SMC-MWP-02	SO	RF	MW	20 U	6 U	7	20 U	1 U	1	500 U	8	5 U	6	10 U	36 *	500 U	2 U	0 U	13	1070 MJ	1 U	1 U	1 U	5 U	29
SMC-AB-39	SO	RF	AB	6420	6 U	11	154	0 M	1 U	18300	8	7 M	43	17000	15 *	500 U	886	0 U	13	500 U	1 U	1 M	1 U	5 U	80
SR-AB52-02	SO	RF	MD	20 U	6 U	4 J	20 U	1 U	1 U	500 U	22	5 U	10	10 U	15	2720	2 U	0 U	20	500 U	1 U	1 U	1 U	5 U	55
SMC-MW-51	SO	RF	MW	20 U	6 U	1 U	20 U	1 U	1 U	31300	18	5 U	16 J	10 U	9	500 U	2 U	0 U	18	500 U	1 U	1 U	1 U	15	83
SMC-MW-31	SO	RF	MW	20 U	6 U	11 *	20 U	1 U	1	500 U	1 U	5 U	26	10 U	11	500 U	2 U	0 U	22	500 U	1 U	1 U	1 U	5 U	36
SMC-AB-20	SO	RF	AB	15000	6 U	4	221	1 M	1 U	27700	9	13	3 U	21900	100	500 U	2 U	0 U	16	500 U	1 U	1 M	1 U	5 U	56
SMC-MW-30	SO	RF	MW	20 U	6 U	1 U	20 U	1 U	1 U	500 U	15	5 U	15	10 U	8	500 U	2 U	0 U	14	814 MJ	1 U	1 U	1 U	5 U	21 U
SR-AB57-03	SO	RF	DP	20 U	6 U	16	20 U	1	1 U	12300	5	5 U	16	10 U	11 J	500 U	394	0 U	10	500 U	1 U	22	1 U	5 U	60
SMC-MW-28	SO	RF	MW	20 U	6 U	8 J	20 U	1 U	1 U	500 U	1 U	5 U	16	10 U	8	500 U	2 U	0 U	24	500 U	1 U	1 U	1 U	5 U	46
SMC-MW-33	SO	RF	MW	20 U	12 *	15	20 U	1 U	1 U	2880	1 U	5 U	20 J	10 U	7	500 U	2 U	1	25	500 U	1 U	1 U	1 U	11 M	39
SMC-MW-26	SO	RF	MW	20 U	6 U	5	20 U	1 U	1 U	500 U	19	5 U	15	10 U	8	500 U	2 U	0	24	500 U	1 U	2 A	1 U	5 U	28
SR-AB46-03	SO	RF	DP	8330	6 U	11	90	1 M	1 U	500 U	15	9 M	14	20400	18	500 U	2 U	0 U	23	500 U	1 U	2 M	1 U	5 U	37
SMC-AB-38	SO	RF	AB	20 U	6 U	13	20 U	1 U	1 U	1725	14	5 U	13	10 U	24	500 U	2 U	0 U	19	500 U	1 U	2 A	1 U	5 U	95
SMC-MWD-48	SO	RF	MW	20 U	6 U	11	20 U	1 U	1 U	500 U	20	5 U	25	10 U	33 *	500 U	2 U	0 U	19	500 U	1 U	1 U	1 U	5 U	44
SMC-AB-35	SO	RF	AB	20 U	6 U	12	20 U	1 U	1 U	9790	12	5 U	29	10 U	11	500 U	2 U	0	9	500 U	1 U	1	1 U	5 U	57
SMC-MW-53	SO	RF	MW	20 U	6 U	8	20 U	1 A	1 U	500 U	30	5 U	15	10 U	13	500 U	2 U	0 U	23	500 U	1 U	1 U	1 U	5 U	63
SMC-MW-11	SO	RF	MW	20 U	6 U	1 U	20 U	1 U	1 U	3230	12	5 U	14	10 U	28	500 U	2 U	0 U	12	500 U	1 U	1 U	2	5 U	53
SR-AB51-03	SO	RF	DP	20 U	6 U	20	20 U	1 A	1 U	500 U	18	5 U	16	10 U	29	500 U	2 U	0 J	38	500 U	1 U	1 U	2 A	5 U	50
SMC-MW-09	SO	RF	MW	20 U	6 U	6	20 U	1 A	1 U	1780	18	5 U	13	10 U	11	500 U	2 U	0 U	71	500 U	1 U	1 U	2 A	5 U	31

S[illegible] [illegible]ORGANICS
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	TL	VN	ZN
SMC-MWD-47	SO	RF	DA	20 U	6 U	1 U	20 U	1 U	1 U	2500 U	17	5 U	14	10 U	6 *	500 U	2 U	0 J	83	500 U	1 U	1 U	1 U	5 U	56
SMC-MW-07	SO	RF	MW	20 U	6 U	1 U	20 U	1 U	1 U	3175	10	5 U	8	10 U	15	500 U	2 U	0 U	33	500 U	1 U	1 U	1 U	5 U	2 U
SMC-AB-24	SO	RF	AB	20 U	6 U	1 U	20 U	1 U	1	500 U	23 J	5 U	16	10 U	791	500 U	2 U	0 U	32	500 U	1 U	1 U	1 U	5 U	574
SMC-MW-49	SO	RF	MW	20 U	6 U	4	20 U	1 U	7	500 U	6	5 U	3 U	10 U	14	6580	2 U	0 U	19	500 U	1 U	1 U	1 U	5 U	2037
SMC-AB-16	SO	RF	AB	20 U	6 U	1 U	20 U	1 U	1	500 U	1 U	5 U	580	10 U	21	500 U	2 U	0 U	20	500 U	1 U	16	1 U	5 U	444
SMC-AB-32	SO	RF	AB	20 U	6 U	10	20 U	1 U	1 U	500 U	10	5 U	1183	10 U	5	6200	2 U	0	18	500 U	1 U	14	1 U	5 U	93
SMC-MWDB-02	SO	TF	MW	20 U	6 U	20	20 U	1 U	1 U	500 U	10	5 U	198	10 U	22 *	500 U	2 U	0	18	500 U	1 U	0	1 U	5 U	105
SMC-AB-44	SO	TF	AB	20 U	6 U	20	20 U	1 U	1 U	500 U	8	5 U	33	10 U	37 *	11400	2 U	0	16	833 M	1 U	1	1 U	5 U	70
SMC-AB-45	SO	TF	AB	20 U	6 U	1 U	20 U	1 U	1 U	500 U	17	5 U	30	10 U	15 *	500 U	683 J	0 U	26	500 U	1 U	0	1 U	5 U	66
SMC-AB-43	SO	TF	AB	20 U	6 U	11 J	20 U	1 U	1 U	9740 J	5 U	5 U	15	10 U	18 *	4590	2 U	0 U	15	904 MJ	1 U	1 U	1 U	5 U	131
SMC-MWDB-01	SO	TF	MW	20 U	6 U	1 U	20 U	1 U	1 U	500 U	17	5 U	24	10 U	39	500 U	604	2	19	500 U	1 U	1 U	1 U	15 J	70
SMC-MWDB-03	SO	TF	MW	20 U	161	8 J	20 U	1 U	1 U	500 U	23	5 U	36	10 U	9 *	1030 M	2 U	0	21	500 U	1 U	1 U	1 U	5 U	100
SMC-MH-04	SO	WT	MH	9050	6 U	1 U	104	1 U	1 U	500 U	10	8 M	19 J	24300	663	500 U	382	0 U	11	500 U	1 U	1 U	1 U	12	138
SMC-MH-05	SO	WT	MH	20 U	182	22	20 U	1 U	1 U	23600	34	5 U	40	10 U	111	3250	2 U	1	11 M	500 U	1 U	1 U	1 U	5 U	66
SMC-MH-06	SO	WT	MH	8240	6 U	1 U	57	0 M	1 U	6100	13	8 M	125	18500	162	500 U	373	0 U	17	893 M	1 U	1 M	1 U	13 MJ	85
SMC-SS-13	SS	RF	CP	20 U	6 U	29	20 U	1 U	1 U	2490	17	5 U	53	10 U	109	487 M	2 U	1	16	500 U	1 U	1 U	1 U	5 U	86
SMC-SS-16	SS	RF	CP	6005	11 MJ	1 U	115	1 M	1 U	53800	20	9 M	82	29900	74	500 U	327	0 U	19	638 M	1 U	2 M	1 U	13 J	83
SMC-SS-27	SS	RF	CP	20 U	6 U	17	20 U	1 U	1 U	500 U	15	5 U	13	10 U	61	1400	2 U	5 J	18	500 U	1 U	1 U	1 U	5 U	60
SR-AB50-01	SS	RF	SF	5920	6 U	1 U	87	1 M	1 U	500 U	15 J	8 M	129	29800	29 J	500 U	598 J	0 U	9	544 M	1 U	1 M	1 U	12 MJ	586 E
SMC-SS-28	SS	RF	CP	20 U	6 U	39 J	20 U	1 U	1 U	500 U	11	5 U	13	10 U	326	1930	2 U	1	22	500 U	1 U	1 U	1 U	5 U	60
SR-AB52-01	SS	RF	SF	4220	12 MJ	1 U	73	1 M	1 U	17800	14 J	10 M	92 J	31800	45	500 U	204	0 U	20 U	848 M	1 U	2 M	1 U	10 J	42
SMC-SS-29	SS	RF	CP	20 U	13	14	20 U	1 U	1 U	1810 J	16	5 U	20	10 U	290	1780	2 U	0 U	22	500 U	1 U	1 U	1 U	5 U	80
SR-AB53-01A	SS	RF	SF	7790	6 U	1 U	138	1 M	1 M	500 U	12	11 M	77	43600	187	2500 U	519	0 U	27	368 M	2 J	2 M	1 U	13 M	90
SMC-SS-30	SS	RF	CP	20 U	6 U	13	20 U	1 U	1 U	500 U	14 J	5 U	11	10 U	373	3530	2 U	0	17	2500 U	1 U	1 U	1 U	5 U	41
SR-AB54-01	SS	RF	SF	3470	6 U	1 U	68	1 M	1 U	3640 J	15 J	6 M	69	22100	121	500 U	454 J	0 U	4 U	1390 JM	1 U	1 M	1 U	10 M	382
SMC-SS-31	SS	RF	CP	20 U	6 U	22 J	20 U	1 U	1 U	10500 J	8 J	5 U	36	10 U	51	500 U	2 U	0	42	500 U	1 U	1 U	1 U	5 U	10 U
SR-AB56-01	SS	RF	SF	6730	6 U	1 U	79	1 M	4	500 U	22 J	6 M	44	21400	108	500 U	338 J	2	32	500 U	1 U	1 U	1 U	12 MJ	85
SMC-SS-32	SS	RF	CP	20 U	6 U	16 J	20 U	1 U	3 U	4390 J	12	5 U	12	10 U	59	500 U	8 U	1	29	24	1 U	1 U	1 U	5 U	154
SR-AB47-01	SS	RF	SF	7570	6 U	5 U	100	1 U	1 U	500 U	19 J	7 M	272	22900	1020	500 U	1100	0 U	26	500 U	1 U	1 U	1 U	12 J	127
SMC-SS-33	SS	RF	CP	20 U	6 U	12 J	20 U	1 U	1 U	500 U	7	5 U	13 U	10 U	66	500 U	2 U	0 U	14 J	500 U	1 U	1 U	1 U	25 U	89
SR-AB57-01A	SS	RF	SF	6460	6 U	22	116	1 U	1 U	500 U	20	6 M	19 J	17900	59 J	500 U	2 U	1	16	500 U	1 U	1 U	1 U	19	102
SMC-SS-34	SS	RF	CP	100 U	30 U	13	100 U	3 U	1 U	500 U	18 J	25 U	37	50 U	1 U	5100 J	2 U	0 U	49	500 U	3 U	5 U	5 U	5 U	58
SR-AB58-01	SS	RF	SF	14850	6 U	7	217	1 M	1 U	500 U	21	12 M	25	23950	54 J	500 U	2 U	0 U	20	1000 M	1 U	2 M	1 U	5 U	127
SMC-SS-35	SS	RF	CP	20 U	6 U	22	20 U	1 U	1 U	500 U	9 J	5 U	20	10 U	42	500 U	2 U	0	18	500 U	1 U	1 U	1 U	5 U	54
SR-AB60-01	SS	RF	SF	20 U	6 U	7	20 U	1 U	1 U	500 U	13	5 U	26	10 U	86	500 U	2 U	1	26	500 U	1 U	1 U	1 U	5 U	114 J
SMC-SS-36	SS	RF	CP	20 U	6 U	28	20 U	1 U	1 U		9	5 U	13	10 U	28	4390	2 U	1 J	18	500 U	1 U	0	0	5 U	44
SR-AB62-01	SS	RF	SF	20 U	6 U	7	20 U	1 U	1 U		13	5 U	36	10 U	357	2920	625 J	0 U	18	949 MJ	1 U	1 U	1 U	5 U	72
SMC-SS-03	SS	RF	CP	20 U	6 U	9 J	20 U	1 U	1 U		11 J	5 U	1	10 U	3 U	1880	2 U	0	20	1100 M	0	0	1 U	5 U	46
SR-AB46-01A	SS	RF	SF	20 U	6 U	6	20 U	1 U	1 U		12 J	5 U	41 J	10 U	51	2010	2 U	1	17	1270 M	1 U	1 U	1	12 MJ	60
SMC-SS-05	SS	RF	CP	20 U	6 U	21	20 U	1 U	1 U		12	5 U	10	10 U	1190	3700	2 U	0 J	20	1140 M	1 U	0	12	5 U	58 E
SMC-SS-07	SS	RF	CP	10000 J	6 U	6	130 J	1 MJ	1 U		13	8 MJ	47	19400 J	219	3910	592	0 U	14	1460	1 U	1 MJ	1 U	5 U	82 E
SMC-SS-25	SS	RF	DS	20 U	6 U	8 J	20 U	1 U	1 U		15	5 U	18	10 U	92	1410	473 J	0 U	21	1090 M	0	0	1 U	5 U	70 E
SMC-SS-09	SS	RF	CP	20 U	1	13 J	20 U	1	3		14 J	5 U	18 J	10 U	59	12000	578 J	0 U	18	805 M	1 U	1 U	1	11	122 E
SMC-SS-24	SS	RF	DS	20 U	6 U	18 J	20 U	0	2		7 J	5 U	119 J	10 U	677	500 U	414 J	0 U	33	635 MJ	1 U	0	1 U	15 J	66
SMC-SS-11	SS	RF	CP	8920	6 U	7 J	78	0 M	1 U		26	9 M	34 J	19800	110	2750	584 J	0 U	18	500 U	1 U	2 M	1 U	13 J	77 E
SMC-SS-23	SS	RF	DS	7120	6 U	11 J	92	1 M	1 U		12	10 M	16 J	36600	1 U	500 U	485 J	0 U	28	1270	1 U	1 M	1 U	10 J	57
SR-TP36-04	SS	RF	TP	8190	6 U	11 J	130	1 M	1 U		11 J	8 M	59 J	24700	128 J	2500	367 J	0 U	14	500 U	1 U	1 M	1 U	13 J	224
SMC-SS-22	SS	RF	DS	7330	6 U	43 J	101	0 M	1 U		1 U	7 M	17	15800	57	500 U	420		17	1230	1 U	2 M	1 U	15 J	99 E
SMC-SS-15	SS	RF	CP	9050	6 U	6 J	3130	51 M	1 U		1 U	7 M	101 J	27200	145	1800	2 U		16	500 U	1 U	1 M	1 U	13 J	166
SMC-SS-21	SS	RF	DS	9090	5 MJ	21	117	1 U	2		3	7 M	20 J	18400	23	9270	588 J		14 J	503 M	1 U	1 U	1 U	8 M	58 E
SR-AB51-01	SS	RF	SF	6460	6 U	14 J	120	1 M	1 U		14	8 M	42	32500	64	2090	2 U		21	744 M	1 U	2 M	1 U	5 U	95
SR-AB45-01	SS	RF	SF	5200	6 U	10	28 M	0 M	1 U		8	6 M	53 J	13700	98	1095 U	432 J		21	782 M	1 U	1 U	1 U	18 J	45 J
SR-AB64-01	SS	RF	SF	20 U	6 U	7 J	20 U	1	1 U		4	5 U	29	10 U	78	2500 J	2 U		34	1360	1 U	1 U	1 U	5 U	57
SR-AB48-01	SS	RF	SF	11600	6 U	31	144	1 M	1 U		8	9 M	18 J	29300	44	3130	243 J		17 J	973 M	1 U	2	1 U	5 U	95 EJ
SR-AB65-01	SS	RF	SF	20 U	6 U	8 J	20 U	1 U	1 U			5 U	28	10 U	408	500 U	332		12 J	1440	1 U	1 U	1 U	9 M	98 E
SR-AB94-01	SS	RF	SF	8950	12 UJ	6 S	92	0 M	1 U			9 M	16	17400	65	500 U	438 J		16	500 U	1 U	1 M	1 U	10 MJ	58 J
SR-AB61-01	SS	RF	SF	20 U	6 U	14 J	20 U	1 U	1 U			5 U	22	10 U	126	2610 J	664 J		16	500 U	1 U	1 U	1	10 M	96 E
SR-AB95-01	SS	RF	SF	7960	6 U	6 J	100	0 M	1 U			7 M	28	15100	8	6430 J	605 J		13 J	824 M	1 U	1 U	1 U	11 MJ	58
SMC-SS-04	SS	RF	CP	5550	1 U	8 J	76	0 M	1 U			6 M	10 J	16900	63	500 U	592 J		4 U	823 M	1 U	1 U	1 U	12 J	106
SR-TP01-01	SS	RF	TP	8000	6 U	21 J	108	0 M	1 U			7 M	14 J	18900	308	1800	2 U		4 U	500 U	1 U	2 M	2 UMJ	13	92 J
SMC-SS-08	SS	RF	CP	10600	6 U	17	130	0 M	1 U			8 M	19	15900	157	2470 J	2 U		9	653 M	1 U	1 U	1 U	5 U	61 J
SR-TP02-01	SS	RF	TP	11400 J	6 U	17	125 J	1 MJ	1 U			8 MJ	14	18100 J	74	500 U	956 J		15	617 M	1 U	1 U	1 U	5 U	101
SMC-SS-12	SS	RF	CP	11200	6 U	7 J	134	0 M	1 U			9 M	25	24000	90	500 U	487 J		9	500 U	1 U	2 M	1 U	11 MJ	76 J
SR-TP34-02	SS	RF	TP	20 U	6 U	4 J	20 U	1	2			5 U	23 J	10 U	51	500 U	2 U		11	500 U	1 U	1 U	1 U	8 MJ	207 J
SR-AB49-01	SS	RF	SF	20 U	6 U	24	20 U	1 U	1 U			5 U	12 J	10 U	59	500 U	305 J		4 U	500 U	1 U	1 U	1 U	5 U	2 U
SR-TP34-04	SS	RF	TP	8890 J	6 U	11 J	115 J	0 MJ	7			8 MJ	30	18200 J	100	500 U	250 J			500 U	1 U	1 U	1 U	8 M	89
SR-AB55-01	SS	RF	SF	7870 J	6 U	8 J	89 J	1 MJ	4			7 MJ	29	17100 J	18	500 U	2 U			500 U	1 U	1 U	1 U	10 MJ	68
SR-TP35-04	SS	RF	TP	20 U	6 U	24	20 U	1	1 U			5 U	24 J	10 U	33 J	500 U	2 U			500 U	1 U	1 U	1 U	5 U	78
SR-AB59-01	SS	RF	SF	5950	6 U	18	79	0 M	1 U			5 M	3 U	15000	47		2 U			500 U	1 U	1 M	1 U	5 U	72
SMC-SS-06	SS	RF	CP	7540 J	6 U	20	148 J	0 MJ				7 MJ	34	15200 J	56		2 U				1 U	2 MJ	1 U	5 U	82
SMC-SS-14	SS	RF	CP	20 U	6 U	20	20 U	1 U				5 U	27	10 U	88		2 U				1 U	1 U	1 U	5 U	40

SOIL INORGANICS
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	AL	SB	AS	BA	BE	CD	CA	CR	CO	CU
SR-TP36-01	SS	RF	TP	20 U	6 U	13	20 U	1 U				5 U	33
SR-TP37-04	SS	RF	TP	20 U	6 U	22	20 U	1 U				5 U	21
SMC-SS-10	SS	RF	CP	20 U	6 U	1 U	20 U	1 U				5 U	20
SR-AB63-01	SS	RF	SF	20 U	6 U		20 U	1 U				5 U	9
SR-TP37-02	SS	RF	TP	20 U	6 U		20 U	1 U				5 U	
SMC-S-06	SS	TF	PT	20 U	6 U		20 U	1 U				5 U	
SMC-S-03	SS	TF	PT										
SMC-S-04	SS	TF	PT										
SMC-S-01	SS	TF	PT										
SMC-S-05	SS	TF	PT										
SMC-S-02	SS	TF	PT										
SMC-SBW-01	SS	WT	PT										

FE	PB	MG	MN	HG	NI	K	SE	AG	TL	VN	ZN
10 U	81 J		2 U				1 U	1 U	1 U	5 U	
10 U	23 J		2 U				1 U	1 U	1 U	5 U	
10 U	133						1 U	1 U	1 U	5 U	
10 U	113						1 U	1 U	1 U		
10 U	87 J						1 U	1 U	1 U		
10 U	28						1 U	41	1 U		
	104										
	66										
	32										
	47										
	60										
	84										

SURFACEWATER VOLATILES
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	METHYL CHLORIDE	ACETONE	CARBON DISULFIDE	1,1-DICHLOROETHANE
SMC-SW-02	SW	GR	HF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SW-24	SW	GR	LF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SW-23	SW	GR	LF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SW-01	SW	GR	HF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SW-37	SW	GR	LF	5.0 U	8.3 C	2.5 U	2.5 U
SMC-SW-09	SW	GR	HF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SW-36	SW	GR	LF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SW-35	SW	GR	LF	5.0 U	35.0 C	2.5 U	2.5 U
SMC-SW-04	SW	GR	HF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SW-03	SW	GR	HF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SW-10	SW	GR	HF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SW-11	SW	GR	HF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SW-21	SW	GR	LF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SW-18	SW	GR	LF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SW-25	SW	GR	LF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SW-16	SW	GR	LF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SW-05	SW	GR	HF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SW-26	SW	GR	LF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SW-20	SW	GR	LF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SW-19	SW	GR	LF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SW-15	SW	GR	LF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SWB-40	SW	GR	LF	20.3 C	150.0 C	2.5 U	2.5 U
SMC-SW-17	SW	GR	LF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SW-06	SW	GR	HF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SW-14	SW	GR	LF	5.0 U	5.0 U	2.5 U	2.5 U
SR-SW49-01	SW	RF	DS	5.0 U	33.0 UJ	2.5 U	2.5 U
SMC-SP-01	SW	RF	OF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SP-03	SW	RF	OF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SP-02	SW	RF	OF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SP-30	SW	RF	PL	5.0 U	5.0 U	2.5 U	2.5 U
SMC-SP-28	SW	RF	PL	5.0 U	5.0 U	2.5 U	2.5 U
SR-SW53-01	SW	RF	OF	5.0 U	4.7 UJ	2.5 U	2.5 U
SMC-SW-38	SW	RF	DS	5.0 U	10.0 C	2.5 U	2.5 U
SMC-SP-24	SW	RF	SP	5.0 U	5.0 U	2.5 U	2.5 U
SR-SW52-01	SW	RF	SP	5.0 U	41.0 J	2.5 U	2.5 U
SMC-SW-31	SW	RF	DS	5.0 U	15.0 C	2.5 U	2.5 U
SR-SW54-01	SW	RF	SP	5.0 U	11.0 UJ	2.5 J	2.5 U
SR-SW51-01	SW	RF	DS	5.0 U	9.6 UJ	2.5 U	2.5 U
SMC-SW-32	SW	RF	DS	12.0 C	11.0 C	2.5 U	2.5 U
SMC-SW-30	SW	RF	DS	5.0 U	9.3 C	2.5 U	2.5 U
SMC-SP-26	SW	RF	SP	5.0 U	5.0 U	2.5 U	2.5 U
SR-SW50-01A	SW	RF	DS	5.0 U	10.1 UJ	2.5 U	2.5 U
SMC-SP-04	SW	WE	OF	5.0 U	5.0 U	2.5 U	2.5 U
SMC-MH-01GW	SW	WT	MH	99.0 C	67.0 C	2.5 U	2.5 U
SMC-SW-33	SW	WT	OS	99700.0 C	6000.0 C	110.0 E	580.0
SMC-MH-02GW	SW	WT	MH	7.5 C	120.0 C	2.5 U	2.5 U
SR-MH01-01	SW	WT	MH	8.0	5.0 U	2.5 U	2.5 U
SMC-SW-34	SW	WT	OS	330.0 C	170.0 C	2.5 U	2.5 U
SMC-MH-03GW	SW	WT	MH	11100.0 C	1400.0 C	5.0	5.0

TRANS-1,2-DICHLOROETHENE	CHLOROFORM	2-BUTANONE	1,1,1-TRICHLOROETHANE	VINYL ACETATE	1,2-DICHLOROPROPANE
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
26.0	2.5 U	7.8 E	16.0	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
28.0	2.5 U	13.0	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.4	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
19.0	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.3	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	R	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	R	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	R	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	7.2 E	13.0	5.0 U	2.5 U
2.5 U	2.5 U	R	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	R	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	6.7 E	370.0	5.0 U	2.5 U
2.5 U	2.5 U	6.9 E	2.1 E	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	R	2.5 U	5.0 U	2.5 U
2.5 U	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
140.0	2.5 U	24.0	32.0	5.0 U	2.5 U
3300.0	2.5 U	6800.0	1100.0	5.0 U	300.0 E
3.5 E	6.6	5.0 U	2.5 U	2.0 E	2.5 U
15.0	2.5 U	5.0 U	2.5 U	5.0 U	2.5 U
55.0	2.5 U	5.0 U	39.0	5.0 U	2.5 U
5.0	5.0	3200.0	5.0	10.0	5.0

SURFACEWATER VOLATILES
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	TRICHLOROETHENE	BENZENE	4-METHYL-2-PENTANONE	2-HEXANONE	TOLUENE
SMC-SW-02	SW	GR	HF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SW-24	SW	GR	LF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SW-23	SW	GR	LF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SW-01	SW	GR	HF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SW-37	SW	GR	LF	13.0	4.1 E	5.0 U	5.0 U	0.5 U
SMC-SW-09	SW	GR	HF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SW-36	SW	GR	LF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SW-35	SW	GR	LF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SW-04	SW	GR	HF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SW-03	SW	GR	HF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SW-10	SW	GR	HF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SW-11	SW	GR	HF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SW-21	SW	GR	LF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SW-18	SW	GR	LF	1.9	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SW-25	SW	GR	LF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SW-16	SW	GR	LF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SW-05	SW	GR	HF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SW-26	SW	GR	LF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SW-20	SW	GR	LF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SW-19	SW	GR	LF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SW-15	SW	GR	LF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SWB-40	SW	GR	LF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SW-17	SW	GR	LF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SW-06	SW	GR	HF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SW-14	SW	GR	LF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SR-SW49-01	SW	RF	DS	2.5 U	2.0	5.0 U	5.0 U	0.7
SMC-SP-01	SW	RF	OF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SP-03	SW	RF	OF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SP-02	SW	RF	OF	2.5 U	2.2 U	5.0 U	5.0 U	3.0 U
SMC-SP-30	SW	RF	PL	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SP-28	SW	RF	PL	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SR-SW53-01	SW	RF	OF	2.5 U	0.5 J	5.0 U	5.0 U	0.5 U
SMC-SW-38	SW	RF	DS	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SP-24	SW	RF	SP	2.5 U	120.0	5.0 U	5.0 U	54.0
SR-SW52-01	SW	RF	SP	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SW-31	SW	RF	DS	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SR-SW54-01	SW	RF	SP	2.5 U	0.6 J	5.0 U	5.0 U	0.5 U
SR-SW51-01	SW	RF	DS	2.5 U	1.0 U	5.0 U	5.0 U	0.5 U
SMC-SW-32	SW	RF	DS	2.5 U	1.3 E	5.0 U	5.0 U	0.5 U
SMC-SW-30	SW	RF	DS	2.5 U	0.9 E	5.0 U	5.0 U	0.5 U
SMC-SP-26	SW	RF	SP	2.5 U	5.0 U	5.0 U	5.0 U	0.5 U
SR-SW50-01A	SW	RF	DS	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-SP-04	SW	WE	OF	2.5 U	2.5 U	5.0 U	5.0 U	0.5 U
SMC-MH-01GW	SW	WT	MH	49.0	48.0	5.0 U	5.0 U	0.5 U
SMC-SW-33	SW	WT	DS	55000.0	3300.0	20000.0 E	5.0 U	0.5 U
SMC-MH-02GW	SW	WT	MH	2.5 U	4.2 E	5.0 U	19.0	20.0
SR-MH01-01	SW	WT	MH	2.5 U	14.0	5.0 U	5.0 U	7.0
SMC-SW-34	SW	WT	DS	30.0	7.6 E	5.0 U	5.0 U	0.5 U
SMC-MH-03GW	SW	WT	MH	5.0	280.0	10.0	10.0	1.0

CHLOROBENZENE	ETHYLBENZENE	TOTAL XYLENES
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
10.0	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	1.3 J	5.0
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	39.0	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	200.0	2.5 U
2.5 U	7.0	19.0
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	2.5 U
2.5 U	0.2 J	1.0
2.5 U	2.5 U	2.5 U
2.5 U	2.5 U	102.0
43000.0 E	3800.0	2700.0
2.5 U	2.5 U	2.0 E
2.5 U	2.5 U	36.0
2.5 U	2.5 U	2.5 U
5.0	5.0	140.0

SURFACEWATER SEMI-VOLATILES
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	2,4-DIMETHYLPHENOL	BENZOIC ACID	NAPHTHALENE	4-CHLORO-3-METHYLPHENOL
SMC-SW-18	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-02	SW	GR	HF	5 U	25 U	5 U	5 U
SMC-SW-16	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-09	SW	GR	HF	5 U	25 U	5 U	5 U
SMC-SW-15	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-04	SW	GR	HF	5 U	25 U	5 U	5 U
SMC-SW-20	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-01	SW	GR	HF	5 U	25 U	5 U	5 U
SMC-SW-35	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-26	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-37	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-25	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SWB-40	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-06	SW	GR	HF	5 U	25 U	5 U	5 U
SMC-SW-36	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-11	SW	GR	HF	5 U	25 U	5 U	5 U
SMC-SW-10	SW	GR	HF	5 U	25 U	5 U	5 U
SMC-SW-14	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-24	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-05	SW	GR	HF	5 U	25 U	5 U	5 U
SMC-SW-21	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-17	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-23	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-03	SW	GR	HF	5 U	25 U	5 U	5 U
SMC-SW-19	SW	GR	LF	5 U	25 U	5 U	5 U
SR-SW49-01	SW	RF	DS	5 U	25 U	5 U	5 U
SMC-SP-03	SW	RF	OF	5 U	25 U	5 U	5 U
SMC-SP-30	SW	RF	PL	5 U	25 U	5 U	5 U
SMC-SP-02	SW	RF	OF	5 U	25 U	2	5 U
SMC-SP-26	SW	RF	SP	5 U	25 U	5 U	5 U
SMC-SP-01	SW	RF	OF	5 U	25 U	5 U	5 U
SR-SW50-01A	SW	RF	DS	5 U	25 U	5 U	5 U
SMC-SW-31	SW	RF	DS	5 U	25 U	5 U	67
SR-SW51-01	SW	RF	DS	5 U	25 U	5 U	5 U
SMC-SW-38	SW	RF	DS	5 U	25 U	5 U	5 U
SMC-SP-24	SW	RF	SP	5 U	25 U	5	5 U
SR-SW52-01	SW	RF	SP	5 U	25 U	5 U	5 U
SMC-SP-28	SW	RF	PL	5 U	25 U	5 U	5 U
SR-SW54-01	SW	RF	SP	5 U	18 E	5 U	5 U
SMC-SW-32	SW	RF	DS	5 U	25 U	5 U	5 U
SMC-SW-30	SW	RF	DS	5 U	25 U	5 U	5 U
SR-SW53-01	SW	RF	OF	5 U	25 U	5 U	5 U
SMC-SP-04	SW	WE	OF	5 U	25 U	5 U	5 U
SMC-MH-02GW	SW	WT	MH	5 U	25 U	5 U	5 U
SMC-SW-33	SW	WT	DS	5 U	25 U	150	5 U
SMC-MH-01GW	SW	WT	MH	5 U	25 U	5 U	84 E
SMC-MH-03GW	SW	WT	MH	1 E	25 U	5 U	5 U
SMC-SW-34	SW	WT	DS	5 U	25 U	1 E	5 U
SR-MH01-01	SW	WT	MH			5 U	

2-METNAPHTHALENE	ACENAPHTHENE	4-NITROPHENOL	2,6-DINITROTOLUENE	DIETHYLPHTHALATE	FLUORENE
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	1 U
5 U	1 U	25 U	5 U	5 U	1 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	1 E	40 E	30	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	3
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	1 E	1 E
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
5 U	5 U	25 U	5 U	5 U	5 U
710	5 U	25 U	5 U	5 U	170
5 U	5 U	25 U	5 U	5 U	5 U
140 E	5 U	25 U	5 U	5 U	60 E
2 E	5 U	25 U	5 U	5 U	5 U
5 U	5 U		5 U	5 U	5 U

RFACEWATER SEMI-VOLATILES
INCLAIR REFINERY

MPLEID	TYPE1	LOC	TYPE2	PHENOL	2-CHLOROPHENOL	1,3-DICHLOROBENZENE	1,4-DICHLOROBENZENE	1,2-DICHLOROBENZENE	2-METHYLPHENOL	BIS[2-CHLOROISOPROPYL]ETHER	4-METHYLPHENOL	NITROBENZENE	2-NITROPHENOL
IC-SW-18	SW	GR	LF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
IC-SW-02	SW	GR	HF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
IC-SW-16	SW	GR	LF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	20	5 U
IC-SW-09	SW	GR	HF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
IC-SW-15	SW	GR	LF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	3	5 U
IC-SW-04	SW	GR	HF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
IC-SW-20	SW	GR	LF	5 U	5 U	2	5 U	5 U	5 U	5 U	5 U	5 U	5 U
IC-SW-01	SW	GR	HF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
IC-SW-35	SW	GR	LF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
IC-SW-26	SW	GR	LF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
IC-SW-37	SW	GR	LF	5 U	5 U	5 U	1 E	5 U	5 U	5 U	5 U	3 E	5 U
IC-SW-25	SW	GR	LF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
IC-SWB-40	SW	GR	LF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
IC-SW-06	SW	GR	HF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
IC-SW-36	SW	GR	LF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
IC-SW-11	SW	GR	HF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
IC-SW-10	SW	GR	HF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
IC-SW-14	SW	GR	LF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	2	5 U
IC-SW-24	SW	GR	LF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
IC-SW-05	SW	GR	HF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
IC-SW-21	SW	GR	LF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
IC-SW-17	SW	GR	LF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	8	5 U
C-SW-23	SW	GR	LF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
C-SW-03	SW	GR	HF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
C-SW-19	SW	GR	LF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
-SW49-01	SW	RF	DS	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
IC-SP-03	SW	RF	OF	5 U	5 U	5 U	4	5 U	5 U	5 U	5 U	5 U	5 U
IC-SP-30	SW	RF	PL	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
C-SP-02	SW	RF	OF	5 U	5 U	5 U	29	5 U	5 U	5 U	5 U	5 U	5 U
C-SP-26	SW	RF	SP	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
C-SP-01	SW	RF	OF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
-SW50-01A	SW	RF	DS	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
-SW-31	SW	RF	DS	2 E	92	5 U	5 U	5 U	5 U	5 U	5 U	5 U	6 E
SW51-01	SW	RF	DS	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
-SW-38	SW	RF	DS	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1 E	5 U
-SP-24	SW	RF	SP	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SW52-01	SW	RF	SP	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
-SP-28	SW	RF	PL	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SW54-01	SW	RF	SP	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
-SW-32	SW	RF	DS	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
-SW-30	SW	RF	DS	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SW53-01	SW	RF	OF	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
-SP-04	SW	WE	OF	5 U	5 U	5 U	5 U	5 U	40 E	5 U	5 U	5 U	5 U
-MH-02GW	SW	WT	MH	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
-SW-33	SW	WT	OS	5 U	5 U	5 U	5 U	120	5 U	5 U	5 U	5 U	5 U
-MH-01GW	SW	WT	MH	5 U	5 U	5 U	5 U	5 U	5 U	5 U	22 E	5 U	5 U
-MH-03GW	SW	WT	MH	5 U	5 U	5 U	5 U	5 U	5 U	1031	5 U	19 E	5 U
-SW-34	SW	WT	DS	15	5 U	5 U	4 E	5 U	15	5 U	5 U	5 U	5 U
MH01-01	SW	WT	MH			5 U	5 U	5 U		5 U		5 U	

SU[illegible] :R SE[illegible] ...TILES
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	N-NITROSODIPHENYLAMINE	PENTACHLOROPHENOL	PHENANTHRENE	DI-n-BUTYLPHTHALATE
SMC-SW-18	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-02	SW	GR	HF	5 U	25 U	5 U	5 U
SMC-SW-16	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-09	SW	GR	HF	5 U	25 U	5 U	5 U
SMC-SW-15	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-04	SW	GR	HF	5 U	25 U	5 U	5 U
SMC-SW-20	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-01	SW	GR	HF	5 U	25 U	5 U	5 U
SMC-SW-35	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-26	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-37	SW	GR	LF	5 U	25 U	5 U	1 EC
SMC-SW-25	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SWD-40	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-06	SW	GR	HF	5 U	25 U	5 U	5 U
SMC-SW-36	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-11	SW	GR	HF	5 U	25 U	5 U	5 U
SMC-SW-10	SW	GR	HF	5 U	25 U	5 U	5 U
SMC-SW-14	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-24	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-05	SW	GR	HF	5 U	25 U	5 U	5 U
SMC-SW-21	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-17	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-23	SW	GR	LF	5 U	25 U	5 U	5 U
SMC-SW-03	SW	GR	HF	5 U	25 U	5 U	5 U
SMC-SW-19	SW	GR	LF	5 U	25 U	5 U	5 U
SR-SW49-01	SW	RF	DS	5 U	25 U	5 U	5 U
SMC-SP-03	SW	RF	OF	5 U	25 U	5 U	5 U
SMC-SP-30	SW	RF	PL	5 U	25 U	5 U	5 U
SMC-SP-02	SW	RF	OF	5	25 U	5	5 U
SMC-SP-26	SW	RF	SP	5 U	25 U	5 U	5 U
SMC-SP-01	SW	RF	OF	5 U	25 U	5 U	5 U
SR-SW50-01A	SW	RF	DS	5 U	25 U	5 U	5 U
SMC-SW-31	SW	RF	DS	5 U	89	5 U	2 EC
SR-SW51-01	SW	RF	DS	5 U	25 U	5 U	5 U
SMC-SW-38	SW	RF	DS	5 U	25 U	5 U	2 EC
SMC-SP-24	SW	RF	SP	5 U	25 U	3 U	5 U
SR-SW52-01	SW	RF	SP	5 U	25 U	5 U	5 U
SMC-SP-28	SW	RF	PL	5 U	25 U	5 U	5 U
SR-SW54-01	SW	RF	SP	5 U	25 U	5 U	5 U
SMC-SW-32	SW	RF	DS	5 U	25 U	5 U	1 EC
SMC-SW-30	SW	RF	DS	2 E	25 U	5 U	1 EC
SR-SW53-01	SW	RF	OF	5 U	25 U	5 U	5 U
SMC-SP-04	SW	WE	OF	5 U	25 U	5 U	5 U
SMC-MW-02GW	SW	WT	MW	5 U	25 U	5 U	1 EC
SMC-SW-33	SW	WT	OS	970	25 U	240	5 U
SMC-MW-01GW	SW	WT	MW	5 U	25 U	5 U	2 EC
SMC-MW-03GW	SW	WT	MW	160 E	25 U	130 E	5 U
SMC-SW-34	SW	WT	DS	2 E	25 U	5 U	5 U
SR-MW01-01	SW	WT	MW	5 U		5 U	5 U

FLUORANTHENE	PYRENE	BUTYLBENZYLPHTHALATE
5 U	5 U	5 U
5 U	5 U	5 U
5 U	5 U	5 U
5 U	5 U	5 U
5 U	5 U	5 U
5 U	5 U	5 U
5 U	5 U	5 U
5 U	5 U	5 U
5 U	5 U	5 E
5 U	5 U	5 U
5 U	5 U	5 U
5 U	5 U	5 U
5 U	5 U	5 U
5 U	5 U	5 U
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5 U	5 U	5 U
5 U	5 U	5 U
5 U	5 U	5 U
5 U	5 U	5 U
5 U	5 U	5 U
5 U	5 U	5 U
5 U	5 U	5 U
5 U	5 U	47
5 U	5 U	5 U
5 U	5 U	1 E
5 U	5 U	5 U
5 U	5 U	5 U
5 U	5 U	5 U
5 U	5 U	5 U
5 U	5 U	3 E
5 U	5 U	10
5 U	5 U	5 U
5 U	5 U	5 U
5 U	5 U	5 U
360	180	1710
5 U	5 U	5 U
78 E	140 E	26 E
5 U	5 U	5 U
5 U	5 U	5 U

SURFACEWATER SEMI-VOLATILES
SIRCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	BIS[2-ETHYLHEXYL]PHTHALATE	DI-n-OCTYLPHTHALATE	BENZO[k]FLOURANTHENE	BENZO[a]PYRENE
SMC-SW-18	SW	GR	LF	5 U	5 U	5 U	5 U
SMC-SW-02	SW	GR	HF	5 U	5 U	5 U	5 U
SMC-SW-16	SW	GR	LF	5 U	5 U	5 U	5 U
SMC-SW-09	SW	GR	HF	5 U	5 U	5 U	5 U
SMC-SW-15	SW	GR	LF	5 U	5 U	5 U	5 U
SMC-SW-04	SW	GR	HF	5 U	5 U	5 U	5 U
SMC-SW-20	SW	GR	LF	5 U	5 U	5 U	5 U
SMC-SW-01	SW	GR	HF	5 U	5 U	5 U	5 U
SMC-SW-35	SW	GR	LF	56 EC	5 U	5 U	5 U
SMC-SW-26	SW	GR	LF	5 U	5 U	5 U	5 U
SMC-SW-37	SW	GR	LF	5 U	5 U	5 U	5 U
SMC-SW-25	SW	GR	LF	5 U	5 U	5 U	5 U
SMC-SWB-40	SW	GR	LF	20 C	5 U	5 U	5 U
SMC-SW-08	SW	GR	HF	5 U	5 U	5 U	5 U
SMC-SW-36	SW	GR	LF	5 U	5 U	5 U	5 U
SMC-SW-11	SW	GR	HF	5 U	5 U	5 U	5 U
SMC-SW-10	SW	GR	HF	5 U	5 U	5 U	5 U
SMC-SW-14	SW	GR	LF	5 U	5 U	5 U	5 U
SMC-SW-24	SW	GR	LF	5 U	5 U	5 U	5 U
SMC-SW-05	SW	GR	HF	5 U	5 U	5 U	5 U
SMC-SW-21	SW	GR	LF	5 U	5 U	5 U	5 U
SMC-SW-17	SW	GR	LF	5 U	5 U	5 U	5 U
SMC-SW-23	SW	GR	LF	5 U	5 U	5 U	5 U
SMC-SW-03	SW	GR	HF	5 U	5 U	5 U	5 U
SMC-SW-19	SW	GR	LF	5 U	5 U	5 U	5 U
SR-SW49-01	SW	RF	DS	5 U	5 U	5 U	5 U
SMC-SP-03	SW	RF	OF	5 U	5 U	5 U	5 U
SMC-SP-30	SW	RF	PL	5 U	5 U	5 U	5 U
SMC-SP-02	SW	RF	OF	5 U	5 U	5 U	5 U
SMC-SP-26	SW	RF	SP	5 U	5 U	5 U	5 U
SMC-SP-01	SW	RF	OF	5 U	5 U	5 U	5 U
SR-SW50-01A	SW	RF	DS	6 J	5 U	5 U	5 U
SMC-SW-31	SW	RF	DS	38 C	15	5 U	7
SR-SW51-01	SW	RF	DS	5 U	5 U	5 U	5 U
SMC-SW-38	SW	RF	DS	2 EC	5 U	10	5 U
SMC-SP-24	SW	RF	SP	5 U	5 U	5 U	5 U
SR-SW52-01	SW	RF	SP	5 U	5 U	5 U	5 U
SMC-SP-28	SW	RF	PL	5 U	5 U	5 U	5 U
SR-SW54-01	SW	RF	SP	5 U	5 U	5 U	5 U
SMC-SW-32	SW	RF	DS	63 C	11	11	5 U
SMC-SW-30	SW	RF	DS	22 C	6 E	5 U	5 U
SR-SW53-01	SW	RF	OF	5 U	5 U	5 U	5 U
SMC-SP-04	SW	WE	OF	5 U	5 U	5 U	5 U
SMC-MH-02GW	SW	WT	MH	35 EC	120 E	345	5 U
SMC-SW-33	SW	WT	DS	4360 C	101	575	5 U
SMC-MH-01GW	SW	WT	MH	65 C	10 E	24	5 U
SMC-MH-03GW	SW	WT	MH	340 C	95 E	44 E	5 U
SMC-SW-34	SW	WT	DS	3 EC	5 U	5 U	5 U
SR-MH01-01	SW	WT	MH	5 U	5 U	5 U	5 U

SURFACEWATER INORGANICS
SINCLAIR REFINERY

SAMPLEID	TYPE1	LOC	TYPE2	AL		AS		BA		BE		CD		CA		CR		CO		CU		FE		PB
SMC-SW-16	SW	GR	LF	100	U	89		100	U	3	U	3	U	2500	U	5	U	25	U	13	U	50	U	
SMC-SW-19	SW	GR	LF	100	U	5	U	100	U	3	U	3	U	2500	U	5	U	25	U	13	U	50	U	
SMC-SW-05	SW	GR	HF	100	U	5	U	100	U	3	U	3	U	2500	U	5	U	25	U	13	U	50	U	
SMC-SW-24	SW	GR	LF	100	U	5	U	100	U	3	U	3	U	2500	U	5	U	25	U	13	U	50	U	
SMC-SW-23	SW	GR	LF	100	U	5	U	100	U	3	U	3	U	2500	U	5	U	25	U	13	U	50	U	
SMC-SW-26	SW	GR	LF	100	U	5	U	100	U	3	U	3	U	2500	U	5	U	25	U	13	U	50	U	
SMC-SW-10	SW	GR	HF	100	U	5	U	100	U	3	U	8		2500	U	5	U	25	U	5		50	U	
SMC-SW-35	SW	GR	LF	100	U	5	U	100	U	3	U	3	U	2500	U	5	U	25	U	33		50	U	4
SMC-SW-09	SW	GR	HF	100	U	5	U	100	U	3	U	3	U	2500	U	5	U	25	U	7		50	U	
SMC-SW-37	SW	GR	LF	100	U	45		100	U	3	U	3	U	2500	U	5	U	25	U	18		50	U	5
SMC-SW-04	SW	GR	HF	100	U	5	U	100	U	3	U	9		2500	U	5	U	25	U	13	U	50	U	
SMC-SWB-40	SW	GR	LF	100	U	5	U	100	U	3	U	3	U	2500	U	5	U	25	U	13	U	50	U	2
SMC-SW-01	SW	GR	HF	100	U	5	U	100	U	3	U	3	U	2500	U	5	U	25	U	13	U	50	U	
SMC-SW-15	SW	GR	LF	100	U	5	U	100	U	3	U	3	U	2500	U	5	U	25	U	13	U	50	U	
SMC-SW-18	SW	GR	LF	100	U	5	U	100	U	3	U	3	U	2500	U	5	U	25	U	13	U	50	U	
SMC-SW-03	SW	GR	HF	100	U	5	U	100	U	3	U	3	U	2500	U	5	U	25	U	13	U	50	U	
SR-SW47-01	SW	GR	LF	59	M	5	U	75	M	3	U	3	U	19700		5	U	6	M	13	U	652		
SMC-SW-21	SW	GR	LF	100	U	5	U	100	U	3	U	3	U	2500	U	5	U	25	U	13	U	50	U	
SMC-SW-14	SW	GR	LF	100	U	5	U	100	U	3	U	3	U	2500	U	5	U	25	U	13	U	50	U	
SMC-SW-02	SW	GR	HF	100	U	5	U	100	U	3	U	3	U	2500	U	5	U	25	U	13	U	50	U	
SR-SW48-01	SW	GR	LF	28	M	5	U	71	M	3	U	3	U	19500		5	U	25	U	13	U	438		
SMC-SW-17	SW	GR	LF	100	U	5	U	100	U	3	U	3	U	2500	U	5	U	25	U	13	U	50	U	
SMC-SW-11	SW	GR	HF	100	U	5	U	100	U	3	U	3	U	2500	U	5	U	25	U	4		50	U	
SMC-SW-36	SW	GR	LF	100	U	5	U	100	U	3	U	3	U	2500	U	8	U	25	U	28		50	U	1
SMC-SW-25	SW	GR	LF	100	U	5	U	100	U	3	U	3	U	2500	U	5	U	25	U	13	U	50	U	
SMC-SW-20	SW	GR	LF	100	U	5	U	100	U	3	U	3	U	2500	U	5	U	25	U	13	U	50	U	
SMC-SW-06	SW	GR	HF	100	U	5	U	100	U	3	U	5		2500	U	5	U	25	U	13	U	50	U	
SMC-SW-38	SW	RF	DS	100	U	5	U	100	U	3	U	3	U	2500	U	5	U	25	U	30		50	U	
SR-SW50-01A	SW	RF	DS	65	M	5	U	138	M	3	U	3	U	27750		5	U	25	U	13	U	50	U	
SMC-SP-30	SW	RF	PL	100	U	12		100	U	3	U	3	U	2500	U	6		25	U	16		50	U	10
SR-SW50-01D	SW	RF	DS	100	U	10	U	135	M	3	U	3	U	27500		5	U	25	U	13	U	3040		
SMC-SP-26	SW	RF	SP	100	U	11		100	U	3	U	3	U	2500	U	5	U	25	U	13	U	50	U	
SR-SW51-01	SW	RF	DS	442		5	U	202		3	U	3	U	31300		5	U	5	M	13	U	50	U	
SMC-SP-03	SW	RF	OF	100	U	13		100	U	3	U	6		2500	U	10		25	U	3		235		1
SMC-SW-32	SW	RF	DS	100	U	5	U	100	U	3	U	3	U	2500	U	5	U	25	U	13		50	U	11
SR-SW53-01	SW	RF	OF	40	M	5	U	53	M	3	U	3	U	39200		5	U	25	U	13	U	20300		
SMC-SP-01	SW	RF	OF	100	U	5	U	100	U	3	U	3	U	2500	U	11		25	U	13	U	5840		
SR-SW52-01	SW	RF	SP	100	U	25		268		3	U	3	U	33200		5	U	8	M	13	U	50	U	
SR-SW50-01	SW	RF	DS	29	M	5	U	140	M	3	U	3	U	28000		5	U	25	U	13	U	50	U	
SR-SW54-01	SW	RF	SP	556		5	U	147	M	3	U	3	U	32100		5	U	8	M	13	U	2040		
SMC-SP-24	SW	RF	SP	100	U	31		100	U	3	U	3	U	2500	U	5	U	25	U	13	U	50	U	
SMC-SW-30	SW	RF	DS	100	U	5	U	100	U	3	U	3	U	2500	U	5	U	25	U	48		50	U	15
SR-SW49-01	SW	RF	DS	100	U	5	U	91	M	3	U	3	U	22900		5	U	25	U	13	U	50	U	
SMC-SP-02	SW	RF	OF	100	U	3		100	U	4		3	U	2500	U	5	U	25	U	16				4
SMC-SP-28	SW	RF	PL	100	U	5	U	100	U	3	U	3	U	2500	U	5	U	25	U	13	U			2
SMC-SW-31	SW	RF	DS	100	U	5	U	100	U	3	U	3	U	2500	U	5	U	25	U	13	U			5

		MG		MN		HG		NI		K		AG		NA		TL		ZN	
3	U	2500	U	8	U	0	U	20	U	2500	U	5	U	2500	U	5	U	10	U
3	U	2500	U	8	U	0	U	20	U	2500	U	5	U	2500	U	5	U	10	U
3	U	2500	U	8	U	0	U	20	U	2500	U	5	U	2500	U	5	U	13	
3	U	2500	U	8	U	0	U	20	U	2500	U	6		2500	U	5	U	9	
3	U	2500	U	8	U	0	U	5		2500	U	5	U	2500	U	5	U	26	
3	U	2500	U	8	U	0	U	20	U	2500	U	5	U	2500	U	5	U	10	U
3	U	2500	U	8	U	0	U	20	U	2500	U	5	U	2500	U	5	U	10	U
7		2500	U	8	U	0	U	799		2500	U	5	U	2500	U	5	U	87	
3	U	2500	U	8	U	0	U	20	U	2500	U	8		2500	U	5	U	10	U
2		2500	U	8	U	0	U	1316		2500	U	5	U	2500	U	5	U	81	
3	U	2500	U	8	U	2		12		2500	U	9		2500	U	5	U	10	
4	*	2500	U	8	U	0	U	20	U	2500	U	5	U	2500	U	5	U	31	
3	U	2500	U	8	U	0	U	31		2500	U	5	U	2500	U	5	U	17	
3	U	2500	U	8	U	0	U	20	U	2500	U	5	U	2500	U	5	U	10	U
3	U	2500	U	8	U	0	U	13		2500	U	5	U	2500	U	5	U	10	U
3	U	2500	U	8	U	0	U	20	U	2500	U	5	U	2500	U	5	U	13	
3	U	5190		151		0	J	20	U	2460	M	5	U	10900		5	U	10	U
3	U	2500	U	8	U	0	U	20	U	2500	U	5	U	2500	U	5	U	10	U
3	U	2500	U	8	U	0	U	20	U	2500	U	5	U	2500	U	5	U	10	U
3	U	2500	U	8	U	0	U	20	U	2500	U	5	U	2500	U	5	U	22	
9	U	5140		127		0	U	20	U	2520	M	5	U	10700		5	U	10	U
3	U	2500	U	8	U	0	U	20	U	2500	U	5	U	2500	U	5	U	10	U
3	U	2500	U	8	U	0	U	20	U	2500	U	5	U	2500	U	5	U	10	U
1		2500	U	8	U	0	U	527		2500	U	5	U	2500	U	5	U	33	
3	U	2500	U	8	U	0	U	20	U	2500	U	5	U	2500	U	5	U	10	U
3	U	2500	U	8	U	2		20	U	2500	U	5	U	2500	U	5	U	10	U
3	U	2500	U	8	U	0	U	20	U	2500	U	6	U	2500	U	5	U	10	U
5		2500	U	8	U	0	U	630		2500	U	5	U	2500	U	5	U	46	
5	U	11100		3255		0	U	20	U	2445	M	5	U	10150		5	U	10	U
0		2500	U	8	U	0	U	37		2500	U	5	U	2500	U	5	U	123	
5	U	11000		3210		0	U	20	U	2390	M	5	U	10100		5	U	24	
9	U	2500	U	8	U	0	U	20	U	2500	U	5	U	2500	U	5	U	11	
8	U	11000		3720		0	J	20	U	3360	M	5	U	13200		5	U	121	
2		2500	U	8	U	0	U	20	U	2500	U	5	U	2500	U	5	U	10	U
5		2500	U	8	U	0	U	1242		2500	U	5	U	2500	U	5	U	10	U
9	U	9550		28		0	U	20	U	2840	M	5	U	17200		5	U	10	U
3	U	2500	U	8	U	0	U	20	U	2500	U	5	U	2500	U	5	U	23	
3	U	17800		8970		0	U	20	U	2600	M	5	U	12200		5	U	163	
3	U	11200		3300		0	U	20	U	2500	M	5	U	10200		5	U	20	
0	U	7340		1040		0	U	20	U	3180	M	5	U	21200		5	U	106	
5		2500	U	8	U	0	U	20	U	2500	U	5	U	2500	U	5	U	330	
5		2500	U	8	U	0	U	244		2500	U	5	U	2500	U	5	U		
9	U	6780		1360		0	UJ	20	U	2470	M	5	U	9330		10	UJ		
1		2500	U	8	U	0	U	21		2500	U	5	U	2500	U	5	U		
0		2500	U	8	U	0	U	5		2500	U	5	U	2500	U	5	U		
0		2500	U	8	U	0	U	1622		2500	U	5	U	2500	U	5	U		

APPENDIX B
FATE/TRANSPORT AND TOXICITY PROFILES

Benzene

Fate and Transport

Volatilization appears to be the major transport process of benzene from surface waters to the ambient air, and atmospheric transport of benzene occurs readily (USEPA, 1979), although direct oxidation of benzene in environmental waters is unlikely, cloud chamber data indicate that it may be photo-oxidized rapidly in the atmosphere. Inasmuch as volatilization is likely to be the main transport process accounting for the removal of benzene from water, the atmospheric destruction of benzene is probably the most likely fate process. Values for benzene's log octanol/water partition coefficient indicate that adsorption onto organic material may be significant under conditions of constant exposure. Sorption processes are likely removal mechanisms in both surface water and ground water. Although the bioaccumulation potential for benzene appears to be low, gradual biodegradation by a variety of microorganisms probably occurs. The rate of benzene biodegradation may be enhanced by the presence of other hydrocarbons (Clements, 1985).

Pharmacokinetics

Benzene is a recognized human carcinogen [IARC, (1982) cited in Clements, 1985]. Several epidemiological studies provide sufficient evidence of a causal relationship between benzene exposure and leukemia in humans, with a latent period of up to 10 years. It produces leukopenia and thrombocytopenia, which may progress to pancytopenia. Similar adverse effects on the blood-cell-producing system occur in animals exposed to benzene. In both humans and animals, benzene exposure is associated with chromosomal damage, although it is not mutagenic in micro-organisms. Benzene was fetotoxic and caused embryolethality in experimental animals (Clements, 1985).

Human Health

Exposure to very high concentrations of benzene [about 20,000 ppm (66,000 mg/m^3) in air] can be fatal within minutes [IARC, (1982) cited in Clements, 1985]. The prominent signs are central nervous system depression and convulsions, with death usually following as a consequence of cardiovascular collapse. Milder exposures can produce vertigo, drowsiness, headache, nausea, and eventually unconsciousness if exposure continues. Deaths from cardiac sensitization and cardiac arrhythmias have also been reported after exposure to unknown concentrations. Although most benzene hazards are associated with inhalation exposure, dermal absorption of liquid benzene may occur, and prolonged or repeated skin contact may produce blistering, erythema, and a dry scaly dermatitis (Clements, 1985).

Environmental Toxicity

The EC5D values for benzene in a variety of invertebrate and vertebrate freshwater aquatic species range from 5,300 μg/liter to 386,000 μg/liter [USEPA, (1980) cited in Clements, 1985]. However, only values for the rainbow trout (5,300 μg/litter) were obtained from a flow based on remeasured concentrations. Results based on unmeasured concentrations in static tests are likely to underestimate toxicity for relatively volatile compounds like benzene. A chronic test with *Daphnia magna* was incomplete, with no adverse effects observed at test concentrations as high as 98,000 μg/liter (Clements, 1985).

Methyl Chloride

Fate and Transport

Methyl chloride (Chloromethane) is known to be ubiquitous in the environment. It enters the environment from natural as well as anthropogenic sources, and has been detected in finished drinking water, in seawater, and in the troposphere (USEPA, 1979).

Volatilization is the major transport process for removal of methyl chloride from aquatic systems. Once in the troposphere, methyl chloride is attacked by hydroxyl radicals with the subsequent formation of formyl chloride as the principal initial product. Any unreacted methyl chloride reaching the stratosphere will undergo photodissociation.

Based on the information currently reviewed, it appears that oxidation, hydroysis, and biodegradation are not important fate processes of methyl chloride in the aquatic environment. No information was found indicating that adsorption and bioaccumulation are important environmental transport processes for methyl chloride (USEPA, 1979).

Table A-1 summarizes the aquatic fate data for methyl chloride (USEPA, 1979).

Sorption of methyl chloride to soil or sediment has not been studied; however, its relatively low log octanol/water partition coefficient (0.91) suggest that partition occurs primarily into air or water (Clement, 1985).

Pharmacokinetic

According to the International Agency for Research on Cancer (IARC), methyl chloride is excreted in human blood and expired air. Increased excretion of urinary S-methylcysteine was reported in persons exposed to methyl chloride. (IARC, 1986). Exposure to high concentrations adversely affect the central nervous system, kidney, and liver in humans. (Clements, 1985).

TABLE A-1
SUMMARY OF AQUATIC FATE OF METHYL CHLORIDE

Environmental Process	Summary Statement	Rate	Half-Life $(t_{1/2})$	Confidence of Date
Photolysis	Probably not significant in aquatic systems	-	-	Medium
Oxidation[c]	The predominant fate of this compound is attack by hydroxyl radicals in the troposphere.	$8.5\times10^{-14} cm^3 sec^{-1}$	0.37 years[a]	High
Hydrolysis	Is probably not a significant fate.	$1.9\times10^{-8} sec^{-1}$	417 days	High
Volatilization	Primary transport process from the aquatic environment.	-	27 minutes[b]	Medium
Sorption	Probably not significant.	-	-	Medium
Bioaccumulation	Probably does not significantly bioaccumulate in organisms.	-	-	Medium
Biotransformation/	Probably not important.	-	-	Medium

a. Reported as a lifetime (time for reduction to 1/e of original concentration) of 0.37 years.

b. Half-lives are on the order of several minutes to a few hours, depending on the degree of agitation. The value reported was determined in a stirred container.

c. The predominant environmental process which is thought to determine the fate of the compound.

(USEPA, 1979)

Human Health

Methyl chloride was found to be carcinogenic in male mice exposed to the compound via inhalation for a 2-year period. A significantly increased incidence of benign and malignant kidney tumors was found in animals exposed to 2,100 mg/m^3. An increased incidence of hepatocellular carcinomas that was marginally significant was also found using an acturial analysis of the data. Negative results for carcinoginicity for female mice and male and female rats were obtained in the same study. Methyl chloride has been found to be mutagenic using the Ames assay, with and without a metabolic activivating system. Methyl chloride has also been shown to be teratogenic in mice, causing heart defects in fetuses exposed to utero at a airborne concentration of 1,050 mg/m^3 on gestation days 6 to 17 (Clements, 1985).

Methyl chloride is not considered to be highly toxic. Repeated or prolonged human exposure to sufficient concentrations (greater than 100 mg/m^3) can result in central nervous system (CNS) effects including blurred vision, headache, nausea, loss of coordination, and personality changes. Renal and heptic toxicity have also been reported in humans. Animal studies shown CNS effects and binding sulfhydryl-containing cellular macromolecules. This latter effect interferes with metabolism and is probably responsible for the observed tissue toxicity (Clements, 1985).

Environmental Toxicity

The only information available on the effects of methyl chloride in wildlife is an acute study on the bluegill that reported an LC_{50} value of 500 mg/liter for this species. Data on the other chlorinated methanes indicate that aquatic toxicity declines with decreased chlorination. Thus methyl chloride should be less toxic than chloroform or carbon tetreachloride, neither of which had any effect on Daphnia magna or the fathead minnow, respectively, during chronic exposure to 3,400 μg/liter. No information on the toxicity of methyl chloride to terrestrial wildlife or domestic animals was found in the literature reviewed (Clements, 1985).

Dose Response

Estimates of the carcinogenic risks associated with lifetime exposure to various concentrations of halomethanes in water are:

Risk	Concentration
10^{-5}	1.9 µg/liter
10^{-6}	0.19 µg/liter
10^{-6}	0.019 µg/liter

OSHA established a TWA for methyl chloride as 210 mg/m^3, with a ceiling level of 420 mg/m^3 (Clements, 1985).

Nitrobenzene

Fate and Transport

The aquatic fate of metrobenzene might involve both photoreduction of the mitro group and biodegradation. It is not possible with the available data, to determine which of these two fates predominates. It should be noted that both photochemical and biological degration can lead potentially to a large variety of organic metrogen compounds (USEPA, 1979).

Photoreduction of the nitro group and/or hydrooxylation of the ring while adsorbed on humans could be an important abiotic fate. Biodegration to the same type of reduction products could also be an important fate process. (USEPA, 1979).

Pharmacokinetics

Nitrobenzene acts through an unknown intermediate to change hemoglobin to methemoglobin. The intense methemoglobinemia produced by all these chemicals may lead to asphyxia, sever enough to injure the cells of the central nervous system. Pathologic findings in acute fatalities from nitrobenzene derivitives, include chocolate color of the blood, injury to the kidney, liver, and spleen, and hemolysis. Bladder wall ulceration and mecrosis may also occur [Dreisbach, (1977) cited in Clements, 1985].

Human Health

Nitrobenzene causes cyanosis at methemoglobin levels above 15 percent, headache, shallow respiration and dizziness at methemoglobin levels of 40-50 percent, confusion, drop in blood pressure, lethargy and stupor at 60 percent, and convulsions, coma, blood pressure fall, and possibly death at methemoglobin levels of 70 percent or higher. Jaundice, pain, or urination and amenia may appear later [Dreisbach, (1977) cited in Clements, 1985].

Environmental Toxicity

Nitrobenzene is considered a reproductive toxin to mammals. No environmental toxicity information is available for nitrobenzene.

Dose-Response

The fatal dose (LD_{50}) in animals for nitrobenzene is 700 mg/kg. Ingestion of 1 gram of nitrobenzene may cause death. The TLV for nitrobenzene is 1 ppm [Dreisbach, (1977) cited in Clements, 1985].

The oral acceptable intake for nitrobenzene is 5.0 E-03 (mg/kg/day) subchronic and 5.0 E-04 (mg/kg/day) chronic. The inhalation intake for nitrobenzene is 6.0 E-03 (mg/kg/day) subchronic and 6.0 E-04 (mg/kg/day) chronic (SPHEM, 1988).

Trichloroethylene

Fate and Transport

Trichloroethylene (TCE) rapidly volatilizes into the atmosphere where it reacts with hydroxyl radicals to produce hydrochloric acid, carbon monoxide, carbon dioxide, and carboxylic acid. This is probably the most important transport and fate process for trichloroethylene in surface water and in the upper layer of soil. TCE absorbs to organic materials and can be bioaccumulated to some degree. However, it is unclear whether trichloroethylene bound to organic material can be degraded by microorganisms or must be desorbed to be destroyed. There is some evidence that higher organisms can metabolize TCE. Trichloroethylene leaches into the ground water fairly readily, and it is a common contaminant of ground water around hazardous waste sites.

Pharmacokinetics

Trichloroethylene is carcinogenic to mice after oral administration, producing hepatocellular carcinomas [NCI, (1976), NTP, (1982) cited in Clements, 1985]. It was found to be mutagenic using several microbial assay systems. Trichloroethylene does not appear to cause reproductive toxicity or teratogenicity.

Human Health

TCE has been shown to cause renal toxicity, hepatotoxicity, neurotoxicity, and demeratological reactions in animals following chronic exposure to levels greater than 2,000 mg/m^3 for 6 months. Trichloroethylene has low acute toxicity; the acute oral LD$_{50}$ value in several species ranged from 6,000 to 7,000 mg/kg.

Environmental Toxicity

There was only limited data on the toxicity of trichloroethylene to aquatic organisms. The acute toxicity to freshwater species was similar in the three species tested, with LC$_{50}$ values of about 50 mg/liter. No

LC_{50} values were available for saltwater species. However, a dose of 2 mg/liter caused erratic swimming and loss of equilibrium in the grass shrimp. No chronic toxicity tests were reported.

No information on the toxicity of trichloroethylene to domestic animals or terrestrial wildlife was available in the literature reviewed.

Xylene

Fate and Transport

Volatilization and subsequent photo-oxidation by reaction with hydroxyl radicals in atmosphere are probably important transport and fate processes for xylene in the upper layer of soil and in aquatic environments. Products of the hydroxylation reaction include carbon dioxide, peroxyacetylnitrate (PAN), and cresol. Xylene binds to sediment in water and to organics in soils and undergoes microbial degradation. Biodegradation is probably the most important fate process in both soils and the aquatic environment. Xylene have been shown to persist for up to 6 months in soil. Because of their low water solubility and rapid biodegration, xylenes are unlikely to leach into ground water in high concentrations.

Pharmacokinetics

The National Toxicology Program (NTP) is testing xylene for carcinogenicity by administering it orally to rates and mice. Although the results have not been finalized, it does not appear to be carcinogenic in rates. Results have not been reported for mice. Xylene was not found to be mutagenic in a batter of short-term assays. Xylene is not teratogenic but has caused fetotoxicity in rates and mice (Clements, 1985).

Human Health

Acute exposure to rather high levels of xylene affects the central nervous system and irritates the mucous membranes. There is limited evidence of effects on other organ systems, but, it was not possible to attribute these effects solely to xylene as other solvents were present. The oral LD_{50} value of xylene in rates is 5,000 mg/kg.

Environmental Toxicity

Xylene adversely affected adult trout at concentrations as low as 3.6 mg/liter in a continuous flow system and trout fry avoided xylene at concentrations greater than 0.1 mg/liter. The LC_{50} value in adult trout was determined to be 13.5 mg/liter. LC_{50} values for other freshwater fish were around 30 mg/liter in a static system, which probably underestimated toxicity. Only a few studies have been done on the toxicity of xylene to saltwater species. These indicated that the m- and o-xylene isomers probably have similar toxicities and are probably less toxic than p-xylene, and that saltwater species are generally more susceptible than freshwater species to the determental effects on xylene (LC_{50} = 10 mg/liter for m- and o-xylene and LC_{50} = 2 mg/liter for p-xylene). However, it should be stressed that these generalizations are based on limited data (Clements, 1985).

No information on the toxicity of xylenes to terrestrial wildlife and domestic animals was available in the literature reviewed. However, because of the low acute toxicity of xylenes, it is unlikely that they would be toxic to wild or domestic birds or mammals.

Benzo(a)pyrene

Fate and Transport

Benzo(a)pyrene is relatively insoluble in water and has a high log octanal/water partition coefficient. As a result, benzo(a)pyrene will adsorb onto suspended particulates and biota and its transport will be largely determined by the hydrogeologic conditions of the aquatic system. The ultimate fate of benzo(a)pyrene is believed to be biodegradation and bio-transformation by benthic organisms, although the process may be slow. (USEPA, 1979).

Lu, et al using a laboratory model ecosystem, studied the environmental fate and transport of radiolabed benzo(a)pyrene. Their studies failed to detect any volatile radioactivity or $^{14}CO_2$ in traps from their aquatic microsy, thus supporting the premise that benzo(a)pyrene is not significantly transported by volatilization (USEPA, 1979).

Pharmacokinetics

Benzo(a)pyrene is readily absorbed by inhalation, oral, and dermal routes of administration. Metabolism is important in absorption of benzo(a)pyrene via the lungs and the skin; intestinal absorption appears to be less dependent on metabolic factors.

Absorbed benzo(a)pyrene is rapidly distributed to several tissues. Benzo(a)pyrene metabolites are subject to enteroheptic circulation as evidenced by time-dependent increases in the intestinal tissue concentrations of these intermediates (ATSDR, 1987).

Human Health

No quantitative information on the absorption of benzo(a)pyrene via the respiratory tract was found for human subjects. Absorption of benzo(a)pyrene via this route is inferred from the isolation of urinary metabolites of benzo(a)pyrene in subjects exposed to polycyclic aromatic hydrocarbons in an industrial environment (ATSDR, 1987). Dermal absorption of benzo(a)pyrene through human skin was determined under ultro conditions. The extent of permeation after 24 hours was established as 3 percent of an applied dose of (^{14}C) benzo(a)pyrene (10 ug/cm^2). (ATSDR, 1987).

Benzo(a)pyrene is a moderately potent experimental carcinogen in many species by many routes of exposure. There are no reports directly correlating human benzo(a)pyrene exposure and tumor development, although humans are likely to be exposed by all routes. There are a number of reports associating human cancer and exposure to mixtures of PAHs that include benzo(a)pyrene. In view of these observations and its well established carcinogenic activity in laboratory animals, it is reasonable to conclude that benzo(a)pyrene would be expected to be carcinogenic in humans by all routes of exposure (ATSDR, 1987).

Environmental Toxicity

There is very little information on the environmental toxicity of PAHs. They probably are not very toxic to aquatic organisms (Clements, 1985).

Dose Response

Exposure criteria and TLVs have been developed for benzo(a)pyrene. The Occupational Safety and Health Administration has set an 8-hour TWA concentration limit of 02. mg/m^3 for the benzene-soluble fraction of coal tar pitch volatiles (anthracene, benxo(a)pyrene, phenanthrene, acridine, chrysene, pyrene) NIOSH (1977) recommends a concentration limit for coal tar, coal tar pitch, creosote and mixtures of these substances at 0.1 mg/m^3 of the cyclohexane-extractable fraction of the sample, determined as a 10-hour TWA. NIOSH (1977) concluded that these specific coal tar products, as well as coke oven emissions, are carcinogenic and can increase the risk of lung and skin cancer in workers. NIOSH (1977) also recommends a ceiling limit for exposure to asphalt fumes for 5 mg airborne particulates/m^3 of air (USEPA, 1984).

Environmental quality criteria for PAH have been recommended for ambient water, which specify concentration limits intended to protect humans against adverse health effects. The [U.S. EPA (1980b) cited in Clements, 1985] has recommended a concentration limit of 28 ng/l for the sum of all carcinogenic PAHs in ambient water. This value is based on a mathematical extrapolation of the results from studies with mice treated orally with benzo(a)pyrene, and acknowledges the conservative assumption that all carcinogenic PAHs are equal in potency to benzo(a)pyrene. Daily consumption of water containing 28 ng/l of carcinogenic PAH over an entire lifetime is estimated on the basis of the animal bioassay to keep the lifetime risk of cancer development below 1 change in 100,000 (USEPA, 1984). The U.S. EPA computed a q_1* of 1.53 $(mg/kg/day)^{-1}$ for oral exposure and q_1* of 6.11 $(mg/kg/day)^{-1}$ for inhalation exposure (USEPA, 1984).

Arsenic

Fate and Transport

In the natural environment, arsenic has four different oxidation states and chemical speciation is important in determining arsenic's distribution and mobility. Interconversions of the +3 and +5 states as well as organic complextion, are the most important. Arsenic is generally quite mobile in the environment. In the aquatic environment, volatilization is important when toxicological activity or highly reducing conditions produce arsine methylarsenics. Sorption by the sediment is an important fate for the chemical. Arsenic is metabolized to organic arsenics by a number of organisms: this increases arsenic's mobility in environment. Because of its general mobility, arsenic tends to cycle through the environment. Its ultimate fate is probably the deep ocean, but it may pass through numerous stages before finally reaching the sea (Clements, 1985).

Pharmacokinetics

Arsenic has been implicated in the production of skin cancer in humans. There is also extensive evidence that inhalation of arsenic compounds causes lung cancer in workers. Arsenic compounds cause chromosome damage in animals, and humans exposed to arsenic compounds have been reported to have an elevated incident of chromosome aberrations. Arsenic compounds have been reported to be teratogenic, fetotoxic, and embryotoxic in several animal species, and an increased incidence of multiple malformations among children born to women occupationally exposed to arsenic has been report (Clements, 1985).

Human Health

Arsenic compounds also cause moncancerous, possibly precancerous, skin changes in exposed individuals. Several cases of progressive polyneuropathy involving motor and memory nerves and particularly affecting the extremities. Also methylinated long-axon neurons have been reported in individuals occupationally exposed to inorganic arsenic. Polyneupathies have also been reported after the ingestion of arsenic-contaminated foods (Clements, 1985).

Environmental Toxicity

Various inorganic forms of arsenic appear to have similar levels of toxicity. They all seem to be much more toxic than organic forms. Acute toxicity to adult freshwater animals occurs at levels of arsenic trioxide as low as 812 μg/liter and at levels as low as 40 μg/liter in early life stages of aquatic organisms. Acute toxicity to saltwater fish occurs at levels around--mg/liter, while some invertebrates are unaffected at much lower levels (508 μg/liter). Arsenic toxicity does not appear to increase greatly with chronic exposure, and it does not seem that arsenic is bioconcentrated to a great degree (Clements, 1985).

Arsenic poisoning is a rare but uncommon toxic syndrome among domestic animals. Arsenic causes hyperemia and edema of the gastrointestinal tract, hemorrhage of the cardiac serosal surfaces and peritoneum, and pulmonary congestion and edema; to terrestrial wildlife was not reported in the literature reviewed (Clements, 1985).

Barium

Fate and Transport

Barium is extremely reactive, decomposes in water, and readily forms insoluble carbonate and sulfate salts. Barium is generally present in solution in surface or ground water only in trace amounts. Large amounts will not dissolve because natural waters usually contain sulfate, and the solubility of barium sulfate is generallly low. Barium is not soluble at more than a few parts per million in water that contains sulfate at more than a fee parts per million. However, barium sulfate may become considerabley more soluble in the presence of chloride andother anions. Monitoring programs whow that it is rare to find barium in drinking water at concentrations greater than 1 mg/liter. Atmospheric transport of barium, in the form of particultes, can occur. Bioaccumulation is not an important process for barium (Clements, 1985).

Pharmacokinetics

There are no reports of carcinogenicity, mutagenicity, or teratogenicity associated with exposure to barium to its compounds. Effects on gametogenesis and on the reproductive organs are reported in male and female rates after inhalation of barium carbonate; intratesticular injection of barium chloride affects the male reproductive organs (Clements, 1985).

Human Health

Insoluble forms of barium, particularly barium sulfate, are not toxic by ingestion or inhalation because only minimal amount are absorbed. However, soluble barium compounds are highly toxic in humans after exposure by either route. The most important effect of acute barium poisoning is a strong, prolonged stimulant action on muscle. Smooth, cardiac, and skeletal muschels are all affected, and a transient increase in blood pressure due to vasoconstriction can occur. Effects on the hematopoietic system and cerebral cortex have also been reported in humans. Accidental ingestion of soluble barium salts has resulted in gastroenteritis, muscular paralysis, and ventricular fibrillation and extra systoles. Potassium deficiency can occur in cases of acute poisoning. Does of barium carbonate anf barium chloride of 57 mg/kg and 11.4 mg/kg, respectively, have been reported to be fatal in humans. Digitalis-like toxicity, muscle stimulation, and effects on the hematopoietic and central nervous systems have been confirmed in experimental animals. There are no adequate animal data available for determine the chronic effects of low level exposure to barium by ingestion (Clements, 1985).

Baritosis, a benign pneumoconiosis, is an occupational disease arising from the inhalation of barium sulfate dust, bariim oxide dust, and barium carbonate. The radiologic changes produced in the lungs are reversible with cessation of exposure. Other reports of industrial exposure to barium compounds describe pulmonary nodulation with or without a decrease in lung function. Dusts of barium oxide are considered potential agents of dermal and nasal irritation. The biological half-life for barium is less than 24 hours (Clements, 1985).

Environmental Toxicity

Adequate data for characterization of toxicity to wildlife and domestic animals are not available.

Lead

Fate and Transport

Some industrially produced lead compounds are readily soluble in water (USEPA, 1979). However, metallic lead and the common lead minerals are insoluble in water. Natural compounds of lead are not usually mobile in normal surface or ground water because the lead leached from ores is adsorbed by ferric hydroxide or combines with carbonate or sulfate ions to form insoluble compounds.

Movement of lead and its inorganic and organolead compounds as particulates in the atmosphere is a major environmental transport process. Lead carried in the atmosphere can be removed by either wet or dry deposition. Although little evidence is available concerning the photolysis of lead compounds in natural waters, photolysis in the atmosphere occurs readily. These atmospheric processes are important in determining the form of lead entering aquatic and terrestrial systems (Clements, 1985).

The transport of lead in the aquatic environment is influenced by the speciation of the ion. Lead exists mainly as the divalent cation in most unpolluted waters and becomes adsorbed into particulate phases. However, in polluted waters, organic complexation is mot important. Volatilization of lead compounds probably is not important in most aquatic environments (Clements, 1985).

Sorption processes appear to exert a dominant effect on the distribution of lead in the environment. Adsorption to inorganic solids, organic materials, and hydrous iron and manganese oxides usually controls the mobility of lead and results in a strong partitioning of lead to the bed sediments in aquatic systems. The sorption mechanism most important in a particular system varies with geological setting, pH, Eh, availability of ligands, dissolved and particulate ion concentrations, salinity, and chemical composition. The equilibriem solubility of lead with carbonate, sulfate, and sulfide is low. Over most of the normal pH range, lead carbonate, and lead sulfate control solubillty of lead in aerobic conditions, and lead sulfide and the metal control aolubility in anaerobic conditions. Lead is storngly complexed to organic materials present in aquatic systems and soil. Lead in soil is not easily taken up by plants, and therefore, its availability to terrestrial organisms is somewhat limited (Clements, 1985).

Bioaccumulation of lead has been demonstrated for a variety of organisms, and bioconcentration factors are within the range of 100-1,000. Microcosm studies indicate that lead is not biomagnified through the food chain. Biomethylation of lead by micor-organisms can remobilize lead to the environment. The ultimate sink of lead is probably the deep oceans (Clements, 1985).

Pharmacokinetics

There is evidence that several lead salts are carcinogenic in mice or rates, causing tumors of the kidneys after either oral or parenteral administration. Data concerning the carcinogenicity of lead in humans are inconclusive. The available data are not sufficient to evaluate the carcinogenicity of organic lead compounds or metallic lead. There is equivocal evidence that exposure to lead causes genotoxicity in humans and animals. The available evidence indicates that lead presents a hazard to reproduction and exerts a toxic effect on conception, pregnancy, and the fetus in humans and experimental animals [USEPA, (1977, 1980) cited in Clements, 1985]

Human Health

Many lead compounds are sufficiently soluble in body fluids to be toxic [USEPA, (1977 and 1980) cited in Clements, 1985]. Exposure of humans or experimental animals to lead can result in toxic effects in the brain and central nervous system, the peripheral nervous system, the kidneys, and the hematopoietic system. Chronic exposure to inorganic lead by ingestion or inhalation can cause lead encephalopathy, and severe cases can result in permanent brain damage. Lead poisoning may cause peripheral neuropathy in adults and children, and permanent learning disabilities that are clinically undetectable in children may be caused by exposure to relatively low levels. Short-term exposure to lead can cause reversible kidney damage, but prolonged exposure at high concentrations may result in progressive kidney damage and possibley kidney failure. Anemia, due to inhibition of hemoglobin synthesis and a reduction in the life span of circulating red blood cells, is an early manifiestation of lead poisoning. Several studies with experimental animals suggest that lead may interfere with various aspects of the immune response.

Environmental Toxicity

Freshwater vertebrates and invertebrates are more sensitive to lead in soft water than in hard water [USEPA, (1980, 1983) cited in Clements, 1985]. At a hardness of about 50 mg/liter $CaCO_3$, the median effect concentrations for nine families range from 140 µg/liter to 236,600 µg/liter. Chronic values for Daphnia magna and the rainbow trout of about 50 mg/liter. Acute-chronic ratios calculated for three freshwater species ranged from 18 to 62. Bioconcentration factors, ranging from 42 for young brook trout to 1,700 for a snail, were reported. Freshwater algae show an inhibition of growth at concentrations above 500 µg/liter (Clements, 1985).

Acute values for twelve saltwater species range from 476 µg/liter for the common mussel to 27,000 µg/liter for the softshell clam. Chronic exposureto lead causes adverse effects in mysid shrimp at 37 µg/liter, but not at 17 µg/liter. The acute-chronic ratio for this species is 118. Reported bioconcentration factors range from 17.5 for Quahog clam to 2,570 for the blue mussel. Saltwater algae are adversely affected at approximate lead concentrations as low as 15.8 µg/liter (Clements, 1985).

Although lead is known to occur in the tissue of many free-living wild animals, including birds, mammals, fishes, and invertebrates, reports of poisoning usually involve waterfowl. There is evidence that lead, at concentrations occasionally found near roadsides and smelters, can eliminate or reduce populations of bacteria and fungi on leaf surfaces and in soil. Many of these micro-organisms play key roles in the decomposer food chain (Clements, 1985).

Cases of lead poisoning have been reported for a variety of domestic animals, including cattle horses, dogs, and cats. Several types of anthropogenic sources are cited as the source of lead in these reports. Because of their curiosity and their indiscriminate eating habits, cattle experience the greatest incidence of lead toxicity among domestic animals (Clements, 1985).

Nickel

Fate and Transport

Nickel is a highly mobile metal in aquatic systems because many nickel compounds are highly soluble in water. However, the insoluble sulfide is formed under reducing conditions and in the presence of sulfur. Above pH 9, precipitation of the hydroxide or carbonate exhibits some control on nickel mobiliity. In aerobic environments below pH 9, soluble compounds are formed with hydroxide, carbonate, sulfate, and organic ligands (Clements, 1985).

In natural, unpolluted waters, sorption and coprecipitation processes involving hydrouls iron and manganeise oxides are probably at least moderately effective in limiting the mobility of nickel. In more organic-rich, polluted waters, it appears that little sorption of nickel is likely. The lack of other controls on nickel mobility probably makes incorporation into bed sediments an important fate of nickel in surface waters. However, much of the nickel entering the aquatic environment will be transported to the oceans (Clements, 1985).

In general, nickel is not accumulated in significant amounts by aquatic organisms. Bioconcentration factors are usually on the order of 100 to 1,000. Uptake of nickel from the soil by plants can also occur. Photolysis, volatilization, and biotransformaton are not important environmental fate processes for nickel. However, atmospheric transport of nickel and nickel compounds on particulate matter can occur (Clements, 1985).

Pharmacokinetics

There is extensive epidemiological evidence indicating excess cancer of the lung and nasal cavity for workers at nickel refineries and smelters, and weaker evidence for excess risk in workers at nickel electroplating and polishing operations. Respiratory tract cancers have occurred in excess at industrial facilities that are methllurgically diverse in their operations. The nickel compounds that have been implicated at having carcinogenic potential are insoluble dusts of nickel subsulfide and nickel oxides, the vapor of nickel carbonyl, and soluble studies with experimental animals suggest that nickel subsulfide and nickel carbonyl are carcinogenic in rats. Evidence for the carcinogenicity of nickel metal and other compounds is relatively that nickel compounds can also produce various types of malilgnant tumors in experimental animals after administration by other routes, including sugcutaneious, intramuscular, implantation, intravenous, intrarenal, and intrapleural. Carcinogenic potential is not strongly dependent on route or site of administration but appears to be inversely related to the solubility of compounds in aqueous media. Insoluble compounds, such nickel carbonyl, and nickelocene are carcinogenic, whereas soluble nickel salts such as nickel chloride, nickel sulfate, and nickel ammonium sulfate, are not (Clements, 1985).

Mammalian cell transformation data indicate that several nickel compounds are mutagenic and can cause chromosomal alteratins. The available information is inadequate for assessing teratogenic and reproductive effects of nickel in humans and experimental animals (Clements, 1985).

Human Health

Dermatitis and other dermatological effects are the most frequent effects of exposure to nickel and nickel-containing compounds. The dermatitis is a sensitization reaction. Most information regarding acute toxicity of nickel involves inhalation exposure to nickel carbonyl. Clinical manifestations of acute poisoning include both immediate and delayed symptoms. Acute chemical pneumonitis is produced, and death may occur at exposures of 30 ppm (107 mg/m^3) for 30 minutes. Rhinitis, nasal sinusitis, and nasal mucosal injury are among the effects reported among workers chronically exposed to various nickel compounds. Studies with experimental animals suggest that nickel and nickel compounds have relatively low acute and chronic oral toxicity (Clements, 1985).

Environmental Toxicity

In freshwater, toxicity depends on hardness; nickel tends to be more toxic in softer water. Acute values for exposure to a variety of nickel salts, expressed as nickel, range from 510 μg/liter for *Daphnia magna* to 46,200 μg/liter for banded killifish at comparable hardness levels. Chronic values range from 14.8 μg/liter for *Daphnia magna* in soft water to 530 μg/liter for the fathead minnow in hard water. Acute-chronic ratios for *Daphnia magna* range from 14 in hard water to 83 in soft water, and are approximately 50 in both hard and soft water for the fathead minnow. Residue data for the fathead minnow indicate a bioconcentration factor of 61. Freshwater algae experience reduced growth at nickel concentrations as low as 100 μg/liter (Clements, 1985).

Acute values for saltwater species range from 152 μg/liter for mysid shrimp to 350,000 μg/liter for the mummichog. A chronic value of 92.7 μg/liter is reported for the mysid shrimp, which gives an acute-chronic ratio of 5.5 for the species. Reduced growth is seen in saltwater algae at concentratons as low as 1,000 μg/liter. Bioconcentration factors ranging from 299 to 416 have been reported for the oyster and mussel (Clements, 1985).

Zinc

Fate and Transport

Zinc can occur in both suspended and dissolved forms. Dissolved zinc may occur as the free (hydrated) zinc ion or as dissolved complexes and compounds with varying degrees of stability and toxicity. Suspended (undissolved) zinc may be dissolved following minor changes in water chemistry or may be sorbed to suspended matters. The predominant fate of zinc in aerobic aquatic systems is sorption of the divalent cation by hydrous iron and manganese oxides, clay minerals, and organic material. The efficiency of these materials in removing zinc from solution varies according to their compositions and concentrations; the pH and salinity of the water; the concentrations of complexing ligands; and the concentration of zinc. Concentrations of zinc in suspended and bed sediments always exceed concentrations in ambient water. In reducing environments, precipitation of zinc sulfide limits the mobility of zinc. However, under aerobic conditions, precipitation of zinc compounds is probably important only where zinc is present in high concentrations. Zinc tends to be more readily sorbed at higher pH than lower pH and tends to be desorbed from sediments as salinity increases. Compounds of zinc with the common ligands of surface waters are soluble in most neutral and acidic solutions, so that zinc is readily transported in most unpolluted, relatively organic-free waters (Clements, 1985).

The relative mobility of zinc in soil is determined by the same factors affecting its transport in aquatic systmes. Atmospheric transport of zinc is also possible. However, except near sources such as smelters, zinc concentrations in air are relatively low and fairly constant (Clements, 1985).

Since it is an essential nutrient, zinc is strongly bio-accumulated even in the absence of abnormally high ambient concentrations. Zinc does not appear to be biomagnified. Although zinc is actively bioaccumulated in aquatic systems, the biota appear to represent a relatively minor sink compared to the sediments. Zinc is one of the most important metals in biological systems. Since it is actively bioaccumulated, the environmental concentrations of zinc probably exhibit seasonal fluctuations (Clements, 1985).

Pharmacokinetics

Testicular tumors have been produced in rats and chickens when zinc salts are injected intratesticularly, but not when other routes of administration are used. Zinc may be indirectly important with regard to cancer since its presence seems to be necessary for the growth of tumors. Laboratory studies suggest that although zinc-deficient animals may be more susceptible to chemical induction of cancer, tumor growth is slower in these animals. There is not evidence that zinc deficiency has any etiological role in human cancer. There are no data available to suggest that zinc is mutagenic or teratogenic in animals or humans (Clements, 1985).

Studies with animals and humans indicate that metabolic changes may occur due to the interaction of zinc and other changes may occur due to the inteeaction of zinc and other metals in the diet. Exposure to cadmium can cause changes in the distribution of zinc, with increases in the liver and kidneys, organs where cadmium also accumulates. Excessive intake of zinc may cause copper deficiencies and result in anemia. Interaction of zinc with iron or lead may also lead to changes that are produced when the metals are ingested individually (Clements, 1985).

Human Health

Zinc is an essential trace element that is involved in enzyme functions, protein synthesis, and carbohydrate metabolism. Ingestion of excessive amounts of zinc may cause fever, vomiting, stomach cramps, and diarrhea. Fumes of freshly formed zinc oxide can penetrate deep into the alveoli and cause metal fume fever. Zinc oxide dust does not produce this disorder. Contact with zinc chloride can cause skin and eye irritation. Inhalation of mists or fumes may irritate the respiratory and gastrointestinal tracts. Zinc in excess of 0.25 percent in diet of rates causes growth retardation, hypochromic anemia, and defective mineralization of bone. No zinc toxicity is observed at dietary levels below 0.25 percent (Clements, 1985).

Environmental Toxicity

Zinc produces acute toxicity in freshwater organisms over a range of concentrations from 90 to 58,100 µg/liter and appears to be less toxic in harder water. Acute toxicity is similar for freshwater fish and invertebrates. Chronic toxicity values range from 47 to 852 µg/liter and appear to be relatively unaffected by hardness. A final acute-chronic ratio for freshwater species of 3.0 has been reported. Although most freshwater plants appear to be insensitive to zinc, one species, the alga Seleanstrum capricornutum, exhibited toxic effects at concentrations from 30 to 700 µg/lilter. Reported acute toxicity values range from 2,730 to 83,000 µg/liter for saltwater fish and from 166 to 55,000 µg/liter for invertebrate saltwater species. Zince produces chronic toxicity in the mysid shrimp at 166 µg/liter. The final acute-chronic ratio for saltwater species is 3.0. Toxic effects are observed in saltwater plant species in zinc concentrations of 50 to 25,000 µg/liter. Bioconcentration factors of edible portions of aquatic organisms range from 43 for the soft-shell clam to 16,700 for the oyster (Clements, 1985).

Zinc poisoning has occurred in cattle. In one outbreak, poisoning was caused by food accidentally contaminated with zinc at a concentration of 20 g/kg. An estimated intake of 140 gram of zinc per cow per day for about 2 days was reported. The exposed cows exhibited severe enteritis, and some died or had to be slaughtered. Postmortem findings showed severe pulmonary emphysema with changes in the myocardium, kidneys, and liver. Zinc concentrations in the liver were extremely high. Based on relatively limited data, some researchers have speculated that exposure to excessive amounts of zinc may constitute a hazard to horses. Laboratory studies and findings in foals living near lead-zinc smelters suggest that excessive exposure to zinc may produce bone changes, joint afflictions, and lameness. In pigs given dietary zinc at concentrations greater than 1,000 mg/kg, decreased food intake and weight gain were observed. At dietary levels greater than 2,000 mg/kg, deaths occurred as soon as 2 weeks after exposure. Severe gastrointestinal changes and brain damage, both of which were accompanied by hemorrhages, were observed, as well as changes in the joints. High concentrations of zinc were found in the liver (Clements, 1985).

EPA's Comments regarding:
Draft Sinclair Refinery Endangerment Assessment Report

Page	Par	Comment
1-1	2	Identify EPA guidance manuals used during the preparation of the report
1-5	1	Typo - operating
	3	Typo - downgradient
2-1	2	Replace "evaluate the need for" with "gather data to determine the nature and extent"
2-2		Add footnote noting chemicals analyzed by SMC Martin and EBASCO
2-3	1	Typo - carcinogen
2-3	3	Clarify last sentence
2-4		Provide frequency as fraction in "hits" column
2-5		Add footnote noting groundwater wells depicted are both shallow and deep
2-11	2	Delete "national and" Reword last sentence removing comparison to national averages
2-12		Remove "National Range" column and modify footnotes
2-18	1	Typo - location
2-19	1	Change "ridge" to "area" and Typo - northern
3-1	2	Change "ARAR" to "standard" and add sentence noting likely contaminant migration pathway is from soil to groundwater
3-2		Reword Title to Table 3-1 removing reference

		to ARARs
3-9	4	Typos - "an" and "aquifer"
3-14	2	Typo - pore
3-18	2	Change "five" to "four" and add sentence clarifying known uses of upper aquifer
3-21	2	Typos - "exposures" and "legitimate"
	3	Typo - volatile
3-31	3	Typo - matter
3-34	2	Add phrase to clarify that downgradient surface water samples were used for this exposure scenario
4-1	2	Modify explaination of RfD by inserting "intake levels with no expected adverse health effect" and Typo - "doses" and "RfDs"
4-3	2	Modify explaination of RfD as above, and Replace "does not" with " is not expected to", and Replace "which does not" with "that is not expected to"
4-16	2	Typo - million, and Replace "acceptable target risk" with "EPAs risk range, and Replace "generally range from" with "is"
5-3	2	Delete "is within.....risk limits."

APPENDIX C
SUPPORTING CALCULATIONS

The emission rate from the exposed soil area was estimated for a ten-hour period, simulating 10 hours of continuous exposure. The depth of dry zone, d, was estimated at approximately 1 centimeter. This is a reasonable estimate based on the fact that when the trench is excavated, the soils will be exposed at the surface for the first time. This term represents the depletion of the contaminant at the soil surface with time due to the volatilization of organics in successive unimolecular layers from soil particles (Versar, 1988).

Volatilized contaminants are expected to remain in the trench. All compounds have vapor densities greater than 1, which is the vapor density of air and are, therefore, heavier than air. Emission rates for volatiles released from the trench are presented in Table C-1.

Deposition of volatilized contaminants through precipitation scavenging is expected to impact offsite soils, surface waters and potentially edible biota only to a limited extent due to the extremely low emission rates. These intermedia transfers are difficult to quantify and therefore deposition will not be modeled in this assessment.

Ambient air concentration in the trench for each chemical was determined using the same box model used in evaluating dust concentrations on site. Concentrations were estimated at distances of 10m and 50m to evaluate risk to workers and those adjacent to the trench. Box heights of 1.4m and 3.8m, which correspond to 10m and 50m distances, were also employed. Because the orientation of a future trench is not known, the width of the trench relative to the dominant wind direction cannot be determined exactly. The most conservative width (1m) would be from wind parallel to the trench, while the least conservative width (300m) would be perpendicular to the trench. A crosswind width of 50m was chosen to simulate the dominantly oblique angle that the wind would take much of the time. An annual average windspeed of 4.6 m/s was acquired from the Binghamton, New York weather station (Ebasco, 1989). Ambient concentrations of volatile organic compounds emitted from the trench are presented in Table C-2.

TABLE C-1.
EMISSION RATES FOR VOLATILES ESCAPING SOILS IN TRENCH

	D_{AB} (cm2/sec)	C_o (g/cm2)	C_b (g/cm2)	AREA (cm2)	SIDE LENGTH (m)	DEPTH (cm)	TIME (s)	EMISSION RATES (g/s)	(mg/s)
Benzene	7.81E-03	2.82E-08	2.03E-06	1.50E+07	38.73	1.00E+00	3.60E+04	1.66E-03	1.66E+00
Methyl Chloride	7.19E-02	4.25E-09	6.95E-06	1.50E+07	38.73	1.00E+00	3.60E+04	3.01E-03	3.01E+00
Trichloroethene	1.18E-02	2.50E-09	8.32E-06	1.50E+07	38.73	1.00E+00	3.60E+04	4.17E-04	4.17E-01
Xylene	8.09E-03	3.92E-08	3.64E-05	1.50E+07	38.73	1.00E+00	3.60E+04	4.18E-03	4.18E+00

EMISSION RATE CALCULATION

$$E_i = \frac{2D_{AB}C_oA}{d + \sqrt{\frac{2D_{AB}C_ot}{C_B} + d^2}}$$

E = (2DabCuA)/[d+SORT(((2DabCut)/Cb+d 2)]

E = Emission rate of contaminant over time, (g/s)
D_{AB} = Phase transfer coefficient, (cm^2/t)
C_o = Liquid phase concentration of contaminant in soil, approximated by mean ground-water concentration in monitoring wells on site, (g/s)
C_B = Max contaminant concentration in soil (ug/kg), assuming a soil built density of 1.4 g/cm^3, EX: (10 ug/kg) (1.4 g/cm3) = 1.4E-02 g/cm^3
A = Contaminated surface area, surface area of 30,000cm long trench, 200cm deep and 100cm wide = 1.5E+07 cm^3
d = Depth of "Dry Zone", assume contamination and soil moisture are virtually at the surface in freshly dug trench
t = Time, ten hour day of expocure, 36,000s

TABLE C-2.
AMBIENT CONCENTRATIONS FOR VOLATILES ESCAPING FROM TRENCH (10 m)

COMPOUND	Mean Emission Max. (Qmax) (g/s) (A)	Box Width (W) (m) (B)	Wind Speed On Site (u10) (m/s) (C)	Box Height (H) (m) (D)	Wind Speed In Box (um) (m/s) (E)	Mean Ambient Concentration (Cmax) (g/m3) (F)	(Cmax) (mg/m3) (F)
Benzene	1.66E-03	50	4.6	1.4	1.27	1.87E-05	1.87E-02
Methylene Chloride	3.01E-03	50	4.6	1.4	1.27	3.39E-05	3.39E-02
Trichloroethene	4.17E-04	50	4.6	1.4	1.27	4.70E-06	4.70E-03
Xylene	4.18E-03	50	4.6	1.4	1.27	4.71E-05	4.71E-02

AMBIENT CONCENTRATIONS FOR VOLATILES ESCAPING FROM TRENCH (50 m)

COMPOUND	Mean Emission Max. (Qmax) (g/s) (A)	Box Width (W) (m) (B)	Wind Speed On Site (u10) (m/s) (C)	Box Height (H) (m) (D)	Wind Speed In Box (um) (m/s) (E)	Mean Ambient Concentration (Cmax) (g/m3) (F)	(Cmax) (mg/m3) (F)
Benzene	1.66E-03	50	4.6	3.8	2.28	3.83E-06	3.83E-03
Methylene Chloride	3.01E-03	50	4.6	3.8	2.28	6.95E-06	6.95E-03
Trichloroethene	4.17E-04	50	4.6	3.8	2.28	9.63E-07	9.63E-04
Xylene	4.18E-03	50	4.6	3.8	2.28	9.66E-06	9.66E-03

Notes:

A = From Table 3-5.
B = Assuming an oblique attach angle for wind for most of the year.
C = From Bradford. PA weather station data (Gems. 1989).
D = From Table 3-5 for a 10 m and 50 m receptor.
E = From supporting calculations in text.

C.2 SURFACE RUNOFF CONTAMINATION ANALYSIS

Releases by overland flow of contaminants from source areas at Sinclair Refinery are estimated using the Modified Universal Soil Loss Equation (MUSLE) and sorption partition coefficients derived from each compound's octanol-water partition coefficient K_{ow} (Haith, 1980; Mills, et al., 1982). The MUSLE allows estimation of the amount of surface soil eroded in a storm event of given intensity, while sorption coefficients allow the projection of the amounts of contaminant carried along with the soil and the amount carried in dissolved form.

Soil loss calculation: The modified universal soil loss equation is (Mills et al., 1982):

$$Y(S)_E = a\ (V_r q_p)^{0.56}\ KLSCP$$

Where: $Y(S)_E$ = sediment yield (metric tons)
a = conversion constant (11.8 metric)
V_r = volume of runoff (m^3)
q_p = peak flow rate (m^3/sec)
K = soil erodibility factor (tons/acre/runoff)
L = slope-length factor (dimensionless)
S = slope-steepness factor (dimensionless)
C = cover factor (dimensionless, 1.0 for bare soil)
P = erosion control practice factor (dimensionless, 1.0 for uncontrolled waste site)

Volume of runoff (V_r)

$V_r = aAQ_r$

Where: a = conversion constant (100 metric)
A = contaminated area, (ha)
= 24.28 ha (digitized from site map)

Q_r = depth of runoff, (cm)
$= (R_t - 0.2S_w)^2/(R_t + 0.8S_w)$

R_t = total storm rainfall, (cm)
= 2.54 cm (1-inch storm)
S_w = water retention factor (cm)
= (1000/CN-10)a
CN = curve number (dimensionless)
= 82 (Versar, 1988, Table 3-4)
a = conversion constant (2.54 metric)
= (1000/CN-10)2.54
= 5.56 cm

$Q_r = [2.54\text{ cm} - 0.2(5.56\text{ cm})]^2/[2.54\text{ cm} + 0.8(5.56\text{ cm})]$
= 0.29 cm

V_r = 100 (24.28 ha)(0.29 cm)
= 704.2 m^3

Peak Flow Rate

$$q_p = \frac{aAR_tQ_r}{T_r(R_t - 0.2S_w)}$$

Where T_r = peak storm duration (hours), assume 1 hour
a = conversion factor, 0.028 metric

$$q_p = \frac{(0.028)(24.28\text{ha})(2.54\text{cm})(0.29\text{cm})}{(1\text{ hr})[2.54\text{cm} - 0.2(5.56\text{cm})]}$$

= 0.351 m^3/sec

Soil Erodibility Factor

K = 0.64 (Estimated)

Slope Length and Slope Steepness Factors

LS = 0.1 (USEPA, 1988, Figure 2-6)

Cover Factor

C = 0.042 (USEPA, 1988, Table 2-4)

Erosion Control Practice Factor

P = 1.0 (USEPA, 1988)

Soil Loss Calculation

$$Y(S)_E = (11.8)[(704.2\text{m}^3)(0.351\text{m}^3/\text{sec})]^{0.56}(0.64)(0.01)(0.042)(1)$$

$$= 0.694 \text{ metric tons/event}$$

The following equations were used to predict the degree of soil/water partitioning for given compounds once storm event soil loss has been calculated.

Dissolved/sorbed contaminant loading calculation: (USEPA, 1988, p. 2-41)

$$S_s = [1/(1 + \theta_c/K_d\beta)]\, C_{soil}\, A$$

$$D_s = [1/(1 + (K_d\beta)/\theta_c)]\, C_{soil}\, A$$

Where: S_s = sorbed substance quantity, (kg)
D_s = dissolved substance quantity, (kg)
θ_c = available water capacity of the top cm of soil, (dimensionless)
K_d = sorption partition coefficient, (cm^3/g)
β = soil bulk density, (g/cm^3)
C_{soil} = soil substance concentration, (kg/ha-cm)
A = contaminated area (ha-cm)

Available Water Capacity

θ_c = 0.139 cm available water/cm soil (dimensionless) (Baes, et al, 1983)

Sorption Partition Coefficient

Chemical	K_d (cm^3/g)
Arsenic	6.70
Barium	33.7
Benzene	8,300
Benzo(a)pyrene	5.5E+08
Lead	99
Methyl Chloride	3,500
Nickel	54.6
Nitrobenzene	3,600
TCG	12,600
Xylene	24,000
Zinc	16

K_d for As, and Zn from Baes et al., 1983.

K_d for Bezene, Benzo(a)pyrene, Methyl Chloride, Nitrobenzene, TCE, and Xylenes from Koc as published in SPHEM (U.S. EPA, 1986) and using Kd = Koc/Organic Carbon Content (O.C.) O.C. estimated at 1% (0.01)

K_d for Barium estimated using Koc method; Koc estimated from solubility, S, for BaSo4 in water of 1.6 mg/L and using Koc=3.64-0.55log(S), (Lyman, 1982)

K_d for Ni estimated by comparison with other metals and considering controling factors such as atomic radius and valence number

Soil Bulk Density

B = 1.49 g/cm^3 (Based on site information).

Soil Substance Concentration

	Average Concentration found in Surface Soils (mg/kg)
Arsenic	8.43
Barium	49.1
Benzene	0.0028
Benzo(a)pyrene	0.188
Lead	57.1
Methyl Chloride	0.0098
Nickel	17
Nitrobenzene	0.165
TCG	0.0025
Xylene	0.0025
Zinc	74.3

Conversion of concentrations form mg/kg to kg/ha:

$$C \frac{kg}{ha} = C \frac{mg\ chem.}{kg\ soil} \bullet \beta \frac{g\ soil}{cm^3} \bullet \frac{1\ kg\ soil}{1000\ g\ soil} \times \frac{1\ kg\ chem.}{1x10^6\ mg\ chem} . \frac{1x10^8\ cm^2}{ha} . \frac{1cm}{1cm}$$

$$C \frac{kg}{ha} = C . \beta . (0.01)$$

The soil contaminant concentrations are as follows:

Arsenic 8.43 mg/kg x 1.49 g/cm^3 x 0.1 = 1.26
Barium 49.1 mg/kg x 1.49 g/cm^3 x 0.1 = 7.32
Benzene 0.0028 mg/kg x 1.49 g/cm^3 x 0.1 = 4.17E-04
Benzo(a)pyrene 0.188 mg/kg x 1.49 g/cm^3 x 0.1 = 2.80E-02
Lead 57.1 mg/kg x 1.49 g/cm^3 x 0.1 = 8.51
Methyl Chloride 0.0098 mg/kg x 1.49 g/cm^3 x 0.1 = 1.46E-03
Nickel 17 mg/kg x 1.49 g/cm^3 x 0.1 = 2.53
Nitrobenzene 0.165 mg/kg x 1.49 g/cm^3 x 0.1 = 2.46E-02
TCG 0.0025 mg/kg x 1.49 g/cm^3 x 0.1 = 3.73E-04
Xylene 0.0025 mg/kg x 1.49 g/cm^3 x 0.1 = 3.73E-04
Zinc 74.3 mg/kg x 1.49 g/cm^3 x 0.1 = 11.1

Calculation of Sorbed/Dissolved Substance Quantity

$$S_s = [1/(1 + 0.139/K_d \times 1.49)]\ C_{soil}\ A$$

$$D_s = [1/(1 + (K_d \times 1.49)/0.0139)]\ C_{soil}\ A$$

	K_d (cm^3/g)	C_{soil} (kg/ha)	A (ha)	S_s (kg)	D_s (kg)
Arsenic	6.70	1.26	0.19	2.35E-01	3.28E-03
Barium	33.70	7.32	0.19	1.39	3.84E-03
Benzene	8,300.00	4.17E-04	0.19	7.93E-05	8.91E-10
Benzo(a)pyrene	5.50E+08	2.80E-02	0.19	5.32E-03	9.03E-13
Lead	99.00	8.51	0.19	1.61	1.52E-03
Methyl Chloride	3,500.00	1.46E-03	0.19	2.77E-04	7.39E-09
Nickel	54.60	2.53	0.19	4.80E-01	8.21E-04
Nitrobenzene	3,600.00	2.46E-02	0.19	4.67E-03	1.21E-07
TCG	12,600	3.73E-04	0.19	7.08E-05	5.24E-10
Xylene	24,000	3.73E-04	0.19	7.08E-05	2.75E-10
Zinc	16	11.1	0.19	2.09	1.22E-02

Loading to Estuary from Surface Water

$\text{Total Loading} = PXi + PQi$
$PXi = [Y(S)_E/aA\beta]S_s$
$PQi = [Q_r/R_t]\ D_s$

Where: PX_i = sorbed substance loss per event, (kg)
PQ_i = dissolved substance loss per event, (kg)
a = constant (100, metric)

and as calculated before:

$Y(S)_E$ = 0.649 metric tons
A = 24.28 ha
β = 1.49 g/cm^3
Q_r = 0.29 cm
R_t = 2.54 cm

Chemical	S_s (kg)	D_s (kg)	PX_i (kg)	PQ_i (kg)	Total (kg)
Arsenic	2.35E-01	3.28E-03	7.81E-06	3.74E-04	3.82E-04
Barium	1.39	3.84E-03	4.60E-05	4.38E-04	4.84E-04
Benzene	7.93E-05	8.91E-10	2.63E-09	1.02E-10	2.73E-09
Benzo(a)pyrene	5.32E-03	9.03E-13	1.77E-07	1.03E-13	1.77E-07
Lead	1.61	1.52E-03	5.36E-05	1.74E-04	2.27E-04
Methyl Chloride	2.77E-04	7.39E-09	9.20E-09	8.44E-10	1.00E-08
Nickel	4.80E-01	8.21E-04	1.59E-05	9.37E-05	1.10E-04
Nitrobenzene	4.67E-03	1.21E-07	1.55E-07	1.38E-08	1.69E-07
TCG	7.08E-05	5.24E-10	2.35E-09	5.98E-11	2.41E-09
Xylene	7.08E-05	2.75E-10	2.35E-09	3.14E-11	2.38E-09
Zinc	2.09	1.22E-02	6.94E-05	1.39E-03	1.46E-03

C.3 GROUND-WATER MODELING

The Soil Contamination Evaluation Methodology (SOCEM)(CH2M Hill, 1985) was used to characterize the impact that contaminated ground water below the Sinclair Refinery site may have on the Genesee River. Versar has used actual ground-water monitoring results to estimate contaminant concentrations reaching Genesee River. The model assumes the following:

- steady state conditions,
- continuous source of contaminants,
- constant source concentration,
- no retardation of contaminants,
- no losses or decay mechanisms (degradation, volatilization),
- no longitudinal dispersion,
- no diffusion, and
- no precipitation recharge.

These assumptions will produce a conservative estimate of potential offsite contaminant concentrations. The numbers can be viewed essentially as a "worst-case" situation since they do not allow for important loss mechanisms. Exposure levels computed from these numbers will therefore be biased high. This conservative approach is taken to ensure that the potential human or environmental health risks will be identified, and that selected remedial alternatives will be protective.

The codified version of SOCEM used in this endangerment assessment was based on the EPA Vertical and Horizontal Spread (VHS) model (50 FR 7882), adapted from an equation presented by Domenico and Palciauskas (1982). The SOCEM version of their equation is given by:

$$C_{gw} = C_o * \mathrm{erf}[Z/(2(d*X)^{0.5})] * \mathrm{erf}[Y/(4(d*X)^{0.5})]$$

Where: C_{gw} = Contaminant concentration at the ground-water receptor, in this case, Genesee River;
C_o = Initial ground-water contaminant concentration at the source, in this case, concentrations in monitoring wells;
d = Aquifer transverse dispersivity;
X = Distance to receptor in the direction of ground-water flow;
Y = Width of contaminated zone at the site boundary (measured perpendicular to the direction of ground-water flow);
Z = Thickness of the contaminated zone at the site boundary (measured downward from the ground-water table); and
$\mathrm{erf}(f)$ = The error function of any function (f).

The developers of SOCEM (CH2M Hill, 1985) intended that the method be used to evaluate the effect that alternate remedial options may have on reducing contaminant concentrations at the receptor. They suggest that it be used as a straight forward, simplified procedure to characterize the threat that contaminated soil may pose to ground water at Superfund sites, even though they do not suggest a way of estimating one of the most critical input values to the SOCEM model, the initial source concentration in ground water from contaminated soil. To reduce uncertainty associated with generated ground-water concentration values from soil concentration values, the ground-water exposure assessment relies on the ground-water monitoring data and not soils concentration data. In such an approach, each monitoring well with constituent concentration, C_o, acts as a source of contaminated ground water that will be transported to Genesee River.

If each location where samples were taken is treated as a source of contamination, the contribution of contamination introduced to Genesee River can be calculated using the VHS model or SOCEM. SOCEM was used to calculate concentrations of contaminated water released to Genesee River for each indicator chemical identified at each sampling location, and totaled for all indicator chemicals from each sampling location.

In order to determine the values for the parameters used in the SOCEM equation, seven monitoring wells were chosen to represent source contamination at the site. These wells, MW-7, -9, -10, -11, -27, -32, and -55 were chosen based on their proximity to the river, and the depth at which each well was screened.

Pertinent well-specific information used in the modeling is shown in the following tables, while the sources of the information is explained here. Chemical concentration data were obtained from the Ebasco RI Report, 1989 and appear as the second column in the tables. The distance from source (monitoring well) to receptor (Genesee River) was measured for each of the seven wells from a scale map in the RI report. Contamination zone width, Y, was determined by measuring the length of the site boundary (the river) represented by the seven wells, and then dividing by seven to obtain the approximate length represented by each well. Transverse dispersivity, d, for each well was determined by examing well log information in the RI report and assigning a value of 0.3 or 3 depending on soil characteristics as reported in the logs. Contamination zone thickness was also determined from well logs by substracting the dept to water from either the depth to the bottom of the well screening or the depth to the aquitard clay layer, whichever was shallower.

The SOCEM tables also show the results of the modeling as an average concentration entering the river of all of the modeled wells. The amount of contaminant entering the river was determined by combining the concentration information with ground-water flow rate information. Ground-water flow rate was determined by examining pump test and slug test data for wells near the seven modeled wells to obtain a maximum value for hydraulic conductivity, k, of 140 ft/day (42.67 m/day), (140 is greater than 14/15 of all pump test results). The hydraulic gradient, i, was reported to be 0.016 ft/ft (or m/m) in the northern portion of the site, so this value was used to determine q, the ground-water flow rate as:

$$q = k \times i$$

The resulting ground-water flow rate was used in the equation:

$$Q = q\left(\frac{m}{day}\right) * A\ (m^2) * 1000\ \frac{L}{m^3} * \frac{1\ day}{86400\ sec}$$

to determine Q, the ground-water volumetric flow rate, where A is the cross-sectional area into which the ground water is flowing. The cross-sectional area was determined by representing the are at the Genesee River into which the ground water flows as a rectangle at length l, and and a depth equal to the average thickness at the aquifer as determined by the seven SOCEM modeled wells. The value used for l and depth are:

$l = 1096m$ (3,598 ft)
and $d = 3.51m$ (11.52 ft)
so, therefore:
$A = 3849\ m^2$

and $Q = 30.42\ \frac{L}{Sec}$

The concentrations of contaminants in the Genesee River are the result of contributions of suspended and dissolved contaminants from surface runoff and contributions of contaminants from ground-water migration. The following equation provides a rough estimate of the concentration of a substance downstream from a point source release into a flowing water body, after dilution by the receiving water body (Versar, 1988, p 3-31).

$$C_r = \frac{C_e Q_e}{Qt}$$

Where C_r = concentration of substance in stream, (μg/L)
C_e = concentration of substance in effluent, (μg/L)
Q_e = effluent flow rate, (L/sec)
Q_t = combined effluent and stream flow rate, (L/sec)

The three contaminant contributions include (1) surface runoff, suspended contaminants (srs), (2) surface runoff, dissolved contaminants (srd), and (3) ground-water interception (gw). Therefore, the contaminant concentration in the stream is as follows:

$$C_r = \frac{(C_{srs} \bullet Q_{sr}) + (C_{srd} \bullet Q_{sr}) + (C_{gw} \bullet Q_{gw})}{Q_r}$$

Where C_x = concentration, (μg/l), of contributor x, and
Q_x = is flow rate, (l/sec) of contributor x.

Since the surface runoff and ground water infiltration flow rates are much smaller than the river flow rate, Q_t has been replaceed by Q_r, the river flow rate. This Q_r is not the same as the runoff depth used in the MUSLE equation which uses the same notation. Flow rates in Genesee River were reported to be 10,052 l/sec on the average, with a minimum rate of 679 l/sec.

Contaminant Concentration in Surface Runoff, Suspended

$$C_{srs} = \frac{\text{sorbed substance loss per event}}{\text{runoff depth x area}}$$

$$= \frac{PX_i}{Q_r A}$$

Where A = 24.289 ha x (1 x 10^6 dm^2/ha) = 2.42 x 10^7 dm^2

$$C_{srs} = \frac{PX_i}{(0.29\text{cm})(0.1\ \text{dm/cm})(2.42 \times 10^7\ \text{dm}^2)(1\ \text{l/dm}^3)}$$

$$= \frac{PX_i\ (10^9 \mu\text{g/kg})}{701{,}800}$$

Chemical	PX_i (Kg)	C_{srs} (μg/l)
Arsenic	7.81E-06	1.11E-12
Barium	4.60E-05	6.53E-12
Benzene	2.63E-09	3.73E-16
Benzo(a)pyrene	1.77E-07	2.51E-14
Lead	5.36E-05	7.61E-12
Methyl Chloride	9.20E-09	1.31E-15
Nickel	1.59E-05	2.26E-12
Nitrobenzene	1.55E-07	2.20E-14
TCG	2.35E-09	3.33E-16
Xylene	2.35E-09	3.33E-16
Zinc	6.94E-05	9.85E-12

Contaminant Concentration in Surface Runoff Dissolved

$$C_{srd} = \frac{\text{dissolved substance loss per event}}{\text{runoff depth x area}}$$

$$= \frac{PQ_i}{QrA}$$

$$= \frac{PQ_i\ (10^9 \mu g/kg)}{701{,}800}$$

Chemical	PQ_i (Kg)	C_{srd} (μg/l)
Arsenic	3.74E-04	5.31E-11
Barium	4.38E-04	6.22E-11
Benzene	1.02E-10	1.44E-17
Benzo(a)pyrene	1.03E-13	1.46E-20
Lead	1.74E-04	2.47E-11
Methyl Chloride	8.44E-10	1.20E-16
Nickel	9.37E-05	1.33E-11
Nitrobenzene	1.38E-08	1.96E-15
TCG	5.98E-11	8.50E-18
Xylene	3.14E-11	4.46E-18
Zinc	1.39E-03	1.98E-10

Surface Runoff Flow Rate

$$Q_{sr} = \frac{Q_r A}{\Delta t}$$

Where Δt = total storm duration. assume 1 hour

$$Q_{sr} = \frac{0.29cm(0.10dm/cm)(2.43 \times 10^5 dm^2) \quad 1\frac{L}{dm^3}}{1hr\ (3600\ sec/hr)}$$

$$= 194.9\ L/sec$$

Contaminant Concentration in Ground Water

Ground-water contaminant concentrations were obtained form the VHS modeling (SOCEM).

Chemical	Cgw (µg/L)
Arsenic	515
Barium	599.00
Benzene	84.3
Benzo(a)pyrene	2.73
Lead	25.5
Methyl Chloride	2.73
Nickel	67.4
Nitrobenzene	520
TCG	1.64
Xylene	63.3
Zinc	3647

The resulting surface water concentrations are as follows:

Chemical	Cr(µg/L)
Arsenic	1.56E+00
Barium	1.81E+00
Benzene	2.55E-01
Benzo(a)pyrene	8.26E-03
Lead	7.72E-02
Methyl Chloride	8.26E-03
Nickel	2.04E-01
Nitrobenzene	1.57E-00
TCG	4.96E-03
Xylene	1.92E-01
Zinc	1.10E+01