Assessment of Health Risk to Utility and Landscape Workers on National Park Service Property South of East Station in Washington, D. C.

Submitted to:

WASHINGTON GAS

by:

HYDRO-TERRA, INC.
Columbia, Maryland

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1. INTRODUCTION

Under contract with Washington Gas (WG), Hydro-Terra (HT) completed in March 1999 an environmental study of the East Station study area titled "Additional Remedial Investigation and Feasibility Study (Phase IV)" (RI/FS). The East Station study area includes property owned by WG and currently being developed as Maritime Plaza, National Park Service (NPS) and Corps of Engineers property along the Anacostia River, and District of Columbia (DC) public property (see Figure 1 on Page 7). Also included was a portion of the Anacostia River. The work was completed in compliance with U.S. Environmental Protection Agency (USEPA) guidance, and the study plan, findings, and recommendations were reviewed by that agency as well as by the NPS and DC.

The RI/FS scope included the completion of a multi-media sampling program and a human health risk assessment. The risk assessment evaluated 32 exposure scenarios. Four of the scenarios were specific to the NPS property. The receptor in three of the NPS exposure scenarios was a juvenile using the property in its current condition as a public park, and the exposure pathways were inhalation of soil gas, ingestion of soil, and dermal contact with soil. The fourth scenario was for an office worker on the NPS property breathing dust generated by vehicle traffic under current usage of the property, while the property is being converted to a public park, and following conversion. Exposure of a utility maintenance worker and other receptors to chemicals on the study area were not specific to the NPS property. Following review of the RI/FS, the NPS requested that utility maintenance worker exposure be specific to their property and that the health effects to landscape workers also be evaluated. This added assessment was completed on November 27, 2000 using sampling data gathered during the RI/FS. Following review of the findings from the assessment, the NPS asked that additional soil sampling be performed on the NPS property and that the risk levels be re-calculated using the data from the new sampling sites as well as from those sites on the NPS property sampled during the completion of the RI/FS. This report presents the findings from the expanded investigation requested by the NPS.

A plan (work plan) for collecting additional soil samples and re-assessing human-health risks specific to the NPS property was prepared by HT on September 21, 2001 and submitted to the NPS for review and approval. The recommended work plan accepted by the NPS is found in Appendix A. The only modification to the approved work was to analyze the new soil samples for total cyanides in addition to the plan-specified polynuclear aromatics hydrocarbons (PAHs) and Target-Analyte-List (TAL) metals.

2. SOIL SAMPLING

The work plan required collection of soil samples from 12 new locations (TB-70 through TB-81) on the NPS property, six of which were required to be located along the seawall. The locations of the new sampling sites and the eight former sampling sites also used in this investigation are shown on Figure 2, Page 8.

The new soil borings were completed on October 24, 2001 using a Geoprobe to drive a steel sampling tube into the ground to a depth of 42 to 48 inches depending on sample recovery. To obtain a representative sample of the penetrated soil column, all of the soil contained in the sample-dedicated cylindrical plastic sleeve removed from the steel sampling tube was, following logging, mixed in an aluminum pan prior to collecting a sample for laboratory analysis. The samples were analyzed for the presence of PAHs, TAL metals, and total cyanides. The analytical results are shown in Table 1, Page 10-11, and the laboratory reports are found in Appendix B. The logs of the soil borings are found in Appendix C. The data-validation report is found in Appendix E.

As previously mentioned, the analytical results from soil samples obtained from eight soil borings completed during the RI/FS were also used in assessing risks. Those borings and the sample-collection depths are listed below. The logs of the borings are found in Appendix C.

1. SB-1 (0 to 2 ft & 2 to 4 ft)
2. SB-11 (0 to 2 ft & 2 to 4 ft)
3. SB-12 (0 to 2 ft & 2 to 4 ft)
4. SB-13 (0 to 2 ft & 2 to 4 ft)
5. TB-50 (0 to 2 ft)
6. PS-5S (0 to 2 ft)
7. PS-6S (3 to 5 ft)
8. PS-7S (3 to 5 ft)

As stated in the work plan, the sampling results from the 0 to 2-foot and 2- to 4-foot depths at each of the SB locations were averaged to provide chemical concentrations representative of the soil from 0 to 4 feet in depth at those locations. Chemicals not detected in a sample were assumed to be present at one half their detection limits.

3. SOIL-GAS SAMPLING

Twelve (12) soil-gas samples collected on the NPS property during the RI/FS were used to quantify the health risk due to inhalation of soil gas by the two receptors (utility maintenance workers and landscape workers). The sampling locations are shown on Figure 3, Page 9, and the

analytical results are found in Table 2, Page 12. The samples were typically drawn from depths of between two to four feet depending on penetration resistance.

4. CHEMICALS OF POTENTIAL CONCERN

As indicated in the approved work plan, the chemicals of potential concern (COPC) for the three exposure pathways (inhalation, ingestion, and dermal) involving the two receptors (maintenance and landscape workers) are the same as identified for exposures of utility maintenance workers evaluated as part of the RI/FS. The COPCs for each pathway are listed below. The derivation of the COPCs is found in Appendix D of the RI/FS report. A copy of the relevant section of that appendix is provided in Appendix D of this report. Section 8 of the RI/FS also contains a discussion of the COPC-selection process. A copy of Section 8 is found in Appendix F of this report.

1. Inhalation of Soil Gas in Subsurface Environment

a. Carcinogenic Risk: Benzene

b. Non-Carcinogenic Risk: Benzene, Ethylbenzene, Toluene, and Xylenes

2. Dermal Contact with of Subsurface Soil

a. Carcinogenic Risk: Benzo[a]anthracene, Chrysene, Benzo[b]fluoranthene, Benzo[k]fluoranthene, Benzo[a]pyrene, Indeno[1,2,3cd]pyrene Dibenzo[a,h]anthracene, Arsenic, and Beryllium

b. Non-Carcinogenic Risk: Total PAHs, Dibenzofuran, Aluminum, Antimony, Arsenic, Beryllium, Cadmium, Chromium, Copper, Iron, Manganese, Thallium, Vanadium, and Total Cyanides

2. Ingestion of Subsurface Soil

Same COPCs as dermal contact.

5. EXPOSURE ASSESSMENT

Section 8 of the RI/FS found in Appendix F of this report describes the exposure setting on all of the properties and the assumptions used in calculating human intake factors (HIFs). The HIF tables relevant to this assessment are found in Appendix G along with the risk

calculations. The body weight of the utility maintenance worker was assumed to be 70 kg. Exposure frequency, duration, and time were assumed to be 5 days per year, 20 years, and 8 hours, respectively. Other assumptions are described in Section 8.2.3.1.3 of Appendix E. The exposure frequency for landscape workers was assumed to be 2.5 days per year, and, since they do not work in environments where the breathing zone is below ground, they are assumed to be exposed to soil gases through inhalation at one half the exposure concentration to utility maintenance workers. All other exposure assumptions were assumed to be the same as for utility maintenance workers. The 95 percent upper confidence limits (95% UCLs) for the COPCs are listed below. The derivation of the values is shown in Appendix H.

1. Subsurface Soil Gas

a. Benzene	0.50 mg/m3
b. Toluene	0.50 mg/m3
c. Ethylbenzene	0.50 mg/m3
d. Xylenes	0.50 mg/m3

2. Subsurface Soil

a. Benzo[a]anthracene	1.810 mg/kg
b. Benzo[a]pyrene	2.831 mg/kg
c. Benzo[b]flouranthene	2.095 mg/kg
d. Benzo[k]fluoroanthene	1.821 mg/kg
e. Chrysene	2.168 mg/kg
f. Dibenzo[a,h]anthracene	1.863 mg/kg
g. Indeno[1,2,3]pyrene	1.942 mg/kg
h. Total PAHs	63.158 mg/kg
i. Dibenzofuran	2.401 mg/kg
j. Total Cyanides	2.500 mg/kg
k. Arsenic	12.734 mg/kg
l. Beryllium	1.250 mg/kg
m. Aluminum	6,860.000 mg/kg
n. Antimony	1.250 mg/kg
o. Cadmium	1.250 mg/kg
p. Chromium	28.411 mg/kg
q Copper	101.500 mg/kg
r. Iron	26,824.000 mg/kg
s. Manganese	422.867 mg/kg
t. Thallium	1.000 mg/kg
u. Vanadium	39.638 mg/kg

In calculating the 95 percent upper confidence limits (95% UCLs), chemicals not found in samples above their detection limit, but present in other samples above the detection limit, were assumed to be present at one half the detection limit. If an estimated concentration below the detection limit was provided by the laboratory, that value rather than one half the detection limit was used in the calculation of the 95% UCL. For the two locations where duplicate samples were collected and analyzed, the sample showing the highest level of contamination was used in determining 95% UCLs.

6. TOXICITY ASSESSMENT & RISK CHARACTERIZATION

A discussion of carcinogenic and noncarcinogenic effects and toxicity values is provided in Section 8.3 of the RI/FS report. A copy of Section 8 from that report is found in Appendix F of this report. The carcinogenic and noncarcinogenic risks to utility maintenance workers and landscape workers exposed to COPCs on the NPS property under the planned future use as a public park, assuming no environmental remediation, are listed below. The risk calculations are found in Appendix G. As indicated in the approved work plan, the risk levels were determined using the same USEPA guidance followed in completing the earlier RI/FS.

1. Inhalation of Subsurface Soil Gases

a. Utility Maintenance Worker	
(1) Carcinogenic Risk	1.14E-05
(2) Noncarcinogenic Risk (Hazard Index)	8.34E-01
b. Landscape Worker	
(1) Carcinogenic Risk	2.84E-06
(2) Noncarcinogenic Risk (Hazard Index)	2.01E-01

2. Ingestion of Subsurface Soil

a. Utility Maintenance Worker	
(1) Carcinogenic Risk	3.54E-07
(2) Noncarcinogenic Risk (Hazard Index)	3.76E-03
b. Landscape Worker	
(1) Carcinogenic Risk	1.77E-07
(2) Noncarcinogenic Risk (Hazard Index)	1.88E-03

3. Dermal Contact with Subsurface Soil

a. Utility Maintenance Worker

(1)	Carcinogenic Risk	1.11E-06
(2)	Noncarcinogenic Risk (Hazard Index)	2.67E-03

b. Landscape Worker

(1)	Carcinogenic Risk	5.57E-07
(2)	Noncarcinogenic Risk (Hazard Index)	1.33E-03

None of the carcinogenic risks exceeded the threshold level of one increased cancer case in a population of 10,000 (1:0E-04) accepted by the USEPA or the non-cancer health risk (hazard index) threshold of one (1.0).

Uncertainties associated with risk assessment are described in Section 8.4 of the RI/FS report (see Appendix F).

7. RISK MANAGEMENT

While not considered in calculating health risks, utility companies customarily promote the health of their workers by requiring engineering controls such as vapor ventilation, by providing safety training, and by requiring use of personal protective equipment and clothing. It is assumed that landscaping contractors do not normally provide their workers with in depth training or protective equipment customarily provided to utility workers; however, the nature of their work results in significantly less exposure to COPCs as evidenced by calculated risk levels. Utility workers are assumed to be working below ground in trenches and at depths were vapor concentrations and soil contamination is normally higher than in the upper 18 inches of soil that landscape workers normally come in contact with. Deeper planting of trees is normally performed with a tree spade, a practice that minimizes exposure to contaminated soil and soil vapors.

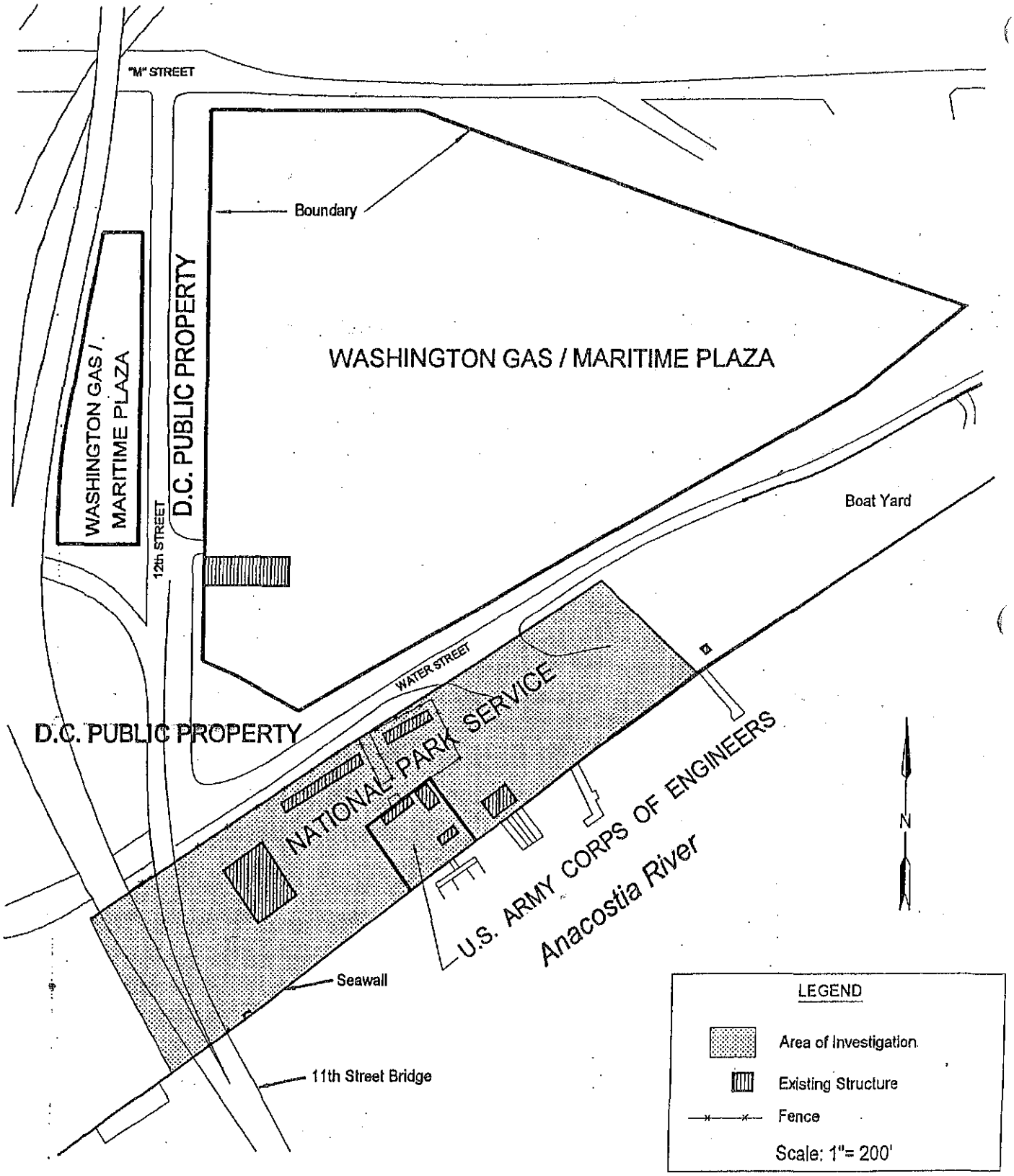

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Figure 1: East Station Study Area

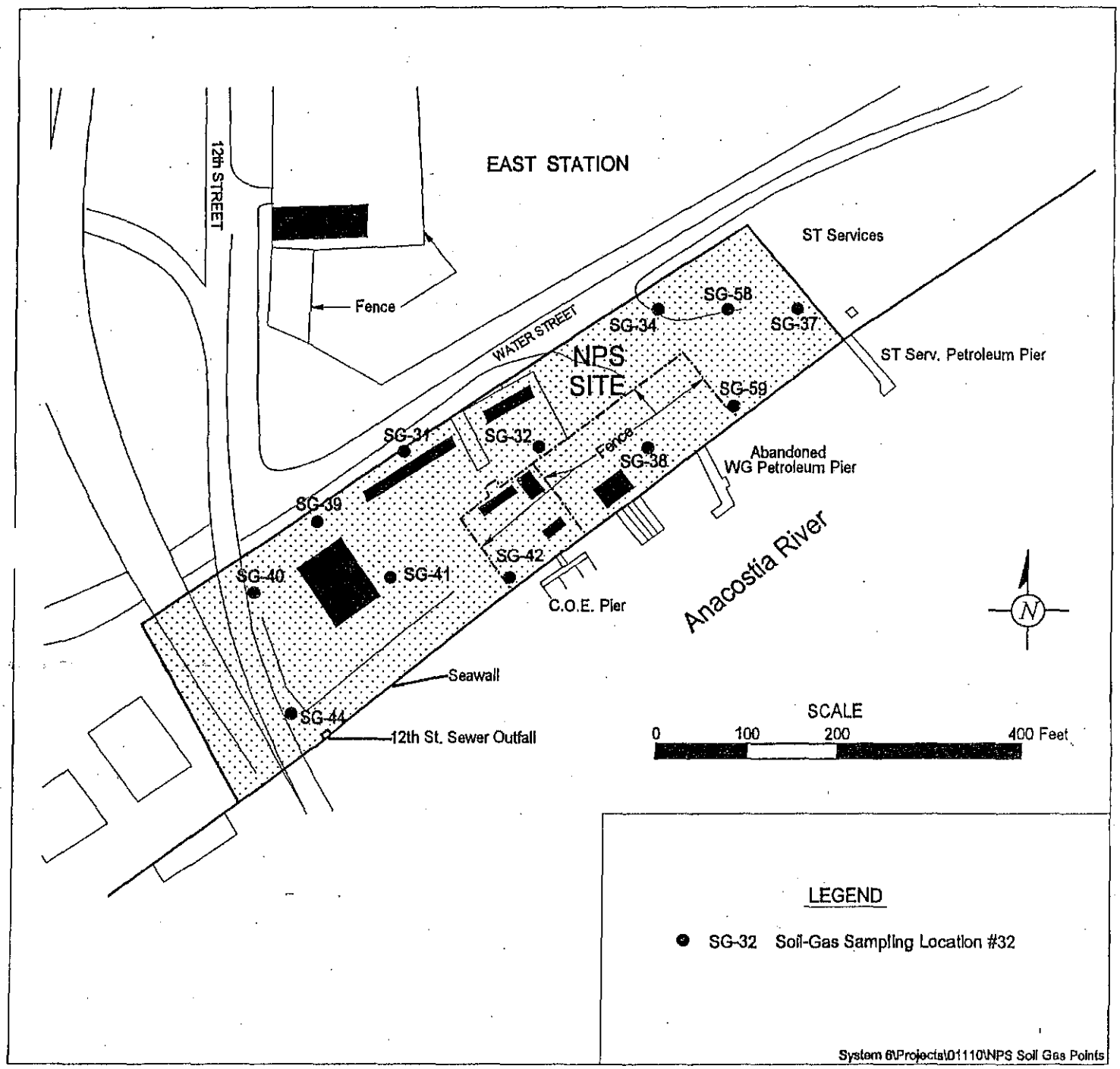

Figure 3: Soil Gas Sampling Locations on NPS Property

TABLE 1: Results From Subsurface Soil Sampling

PAHs Method EPA 8270	SAMPLE ID (Results Reported in ug/kg)																				
	SB-1*	SB-11	SB-12*	SB-13*	TB-50	TB-70	TB-71	TB-72	TB-73	TB-74	TB-75	TB-75 (DUP-2)	TB-76	TB-77	TB-78	TB-78 (DUP-1)	TB-79	TB-80	TB-81	P-5S	P-6S	P-7S
Acenaphthene	1255	490	500	94	<65	<9900	<1650	<1650	<9900	<4950	<1650	<1650	<3300	<1650	3300	e5000	<1650	<3300	<1650	3300	23000	<350
Acenaphthylene	863	2800	758	260	<180	<9900	<1650	<1650	<9900	<4950	e640	e900	e390	<1650	e1300	e1900	e210	e770	<1650	4400	5300	<960
Anthracene	1300	1395	470	88	<61	<9900	e210	<1650	<9900	<4950	<1650	e230	<3300	<1650	2700	e3600	<1650	<3300	<1650	8200	21000	<330
Benzo[a]anthracene	2600	5000	1600	127	<87	<9900	e620	e200	e7600	e940	e980	e1300	e1100	<1650	3100	e4800	e320	e920	e690	16000	9400	<470
Benzo[a]pyrene	2600	14650	3990	61	<41	<9900	e650	<1650	e5500	<4950	1900	e890	e530	<1650	2700	e3700	e330	e1300	e650	15000	6400	<220
Benzo[b]fluoranthene	2050	6950	2263	76	<53	<9900	e320	<1650	e5200	e1200	e1600	2000	e590	<1650	1900	e2600	e330	e1100	e610	8700	4200	<280
Benzo[g,h,i]perylene	2200	16750	2160	64	<22	<9900	<1650	<1650	e2300	<4950	1800	2200	<3300	<1650	e1100	<6600	<1650	e1300	e360	12000	2600	<230
Benzo[k]fluoranthene	1700	4750	2263	86	<55	<9900	e450	<1650	e8900	e1100	1900	1900	e770	<1650	2100	e3100	e310	e1300	e700	8700	1800	<290
Chrysene	2900	5850	1973	80	<61	<9900	e730	e210	e8800	e1400	e1400	1700	e1400	<1650	3600	e5000	e400	e1100	e820	18000	11000	<330
Dibenzo[a,h]anthracene	2925	2850	778	97	<66	<9900	<1650	<1650	e3900	<4950	<1650	<1650	<3300	<1650	<1650	<6600	<1650	<3300	<1650	5700	1700	<360
Fluoranthene	4900	14100	2100	61	55	<9900	e500	e450	14000	e1500	1800	2600	e1800	<1650	4700	6700	e440	e1700	e1000	27000	19000	<230
Fluorene	940	900	588	109	<76	<9900	<1650	<1650	<9900	<4950	<1650	<1650	<3300	<1650	2800	e4000	<1650	<3300	e530	4100	24000	<410
Ideno[1,2,3-cd]pyrene	1800	8950	1695	91	<62	<9900	<1650	<1650	<9900	<4950	<1650	<1650	<3300	<1650	<1650	<6600	<1650	<3300	<1650	11000	2500	<340
2-Methylnaphthalene	6650	2650	18950	543	<380	<9900	<1650	<1650	45000	<4950	<1650	<1650	<3300	<1650	4000	e5200	<1650	<3300	<1650	6200	1900	<2000
Naphthalene	15950	5000	55098	124	47	<9900	<1650	<1650	39000	<4950	<1650	<1650	<3300	<1650	<1650	<6600	<1650	<3300	<1650	11000	13000	210
Phenanthrene	3550	9500	2105	69	44	<9900	e510	e270	12000	e1200	e400	e500	e1700	<1650	5400	7500	e240	e610	<1650	35000	54000	440
Pyrene	4950	25000	3680	251	71	<9900	e830	e430	14000	e2300	3900	5300	e2400	e450	8800	12000	e680	3300	e1800	36000	26000	220
Dibenzofuran	1085	2485	<10000	<1800	<380	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	e2200	e2400	<2000

*Average concentrations of two samples from different depths as allowed in the work plan. Non-detected analytes were assumed to be present at one half the detection limit.

Note: Numbers with a "less than" (<) symbol in front indicate that the analyte was not detected at or below the indicated method detection limit.
Numbers preceeded by an "e" indicate that the analyte was detected at an estimated concentration below the method detection limit.
"NA" indicates that dibenzofuran was not analyzed in the sample.

TABLE 1: Results From Subsurface Soil Sampling (Continued)

TAL Metals mg/kg	SAMPLE ID																		
	EPA Method	SB-1*	SB-11*	SB-12*	SB-13*	TB-70 0'-3.5'	TB-71 0'-3.5'	TB-72 0'-3.5'	TB-73 0'-3.5'	TB-74 0'-3.5'	TB-75 0'-3.5'	DUP 2 TB-75 0'-3.5'	TB-76 0'-3.5'	TB-77 0'-3.5'	TB-78 0'-3.5'	DUP 1 TB-78 0'-3.5'	TB-79 0'-3.5'	TB-80 0'-3.5'	TB-81 0'-3.5'
Aluminum	200.8	15420	8250	9320	37450	5200	7200	3600	7200	2600	2500	1600	4200	3300	2700	4800	2800	2900	200
Antimony	200.8	<0.29	<0.34	0.48	36.8	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
Arsenic	200.8	8.6	5.8	5.9	1.3	9.3	2.7	2.9	2.1	12	3.4	5.4	17	16	13	11	2.9	5.3	12
Barium	200.8	73.45	63.2	61.6	116	110	32	28	78	130	420	280	68	61	56	54	42	36	210
Beryllium	200.8	0.41	0.67	0.25	0.46	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
Cadmium	200.8	<0.02	1.08	0.54	3.65	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
Calcium	215.1	220	1262	10530	16875	9600	5300	1200	240	210	6	8	69	1200	180	140	6200	16000	36
Chromium	200.8	35.5	16.4	25.1	24.8	20	9.4	9.2	15.0	36.0	7.3	6.8	33.0	41.0	19.0	18.0	12.0	12.0	17.0
Cobalt	200.8	4	7.1	6.1	5.7	3.5	6.8	3.5	5.2	4.0	2.3	2.2	14.0	4.5	5.4	13.0	2.5	3.7	4.8
Copper	200.8	38.8	272.5	34.05	213	48	18	33	50	58	190	200	270	120	110	89	19	34	60
Iron	236.1	38950	27750	30750	22300	7300	9300	9400	11000	30000	7100	7300	65000	38000	21000	18000	7800	11000	16000
Lead	200.8	55.1	77.45	93.75	737	1100	28	79	200	750	40	39	1300	50	450	520	43	100	12000
Magnesium	242.1	2950	762	5428	6640	2400	1600	810	1900	350	370	510	380	3400	690	1200	2900	9200	82
Manganese	200.8	92.65	238.50	150.5	429	960	180	120	400	150	44	31	450	380	180	190	93	120	82
Mercury	200.8	0.13	0.34	<0.10	0.32	0.8	0.1	<0.1	0.9	0.4	0.2	0.1	0.2	0.4	0.2	0.2	0.1	0.2	0.3
Nickel	200.8	29.25	29.65	31.95	27.25	16	18	11	15	31	8.8	10.0	28	38	16	18	8.6	19	24
Potassium	258.1	973.5	697	885	736.5	580	460	210	650	590	130	160	220	580	440	580	170	210	120
Selenium	200.8	0.97	0.83	<0.81	<0.74	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
Silver	200.8	<0.17	<0.20	0.37	5.30	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
Sodium	273.1	114.25	120.85	10845	1885	850	940	77	230	160	62	110	78	1000	930	1400	78	100	84
Thallium	200.8	26.1	<0.97	<0.93	<0.85	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.80
Vanadium	200.8	49.55	27.00	50.65	37.85	50	20	13	14	21	9.6	8.7	33	50	14	18	12	16	34
Zinc	200.8	30.9	149.8	52.3	658	64	37	64	200	670	89	80	370	55	130	140	24	65	79
Total Cyanides	9010B	44.25	29.25	7.4	<2.0	<5.0	<5.0	<5.0	21	26	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0

*Average concentrations of two samples from different depths as allowed in the work plan. Non-detected analytes were assumed to be present at one half the detection limit.

Note: Numbers with a "less than" (<) symbol in front indicate that the analyte was not detected at or above the method detection limit.

TABLE 2:

RESULTS FROM SOIL-GAS SAMPLING

SAMPLE ID	DATE ANALYZED	BENZENE	TOLUENE	ETHYL-BENZENE	XYLENES	TOTAL FID VOLATILES*
Detection Limit		1.00 ug/L	1.00 ug/L	1.00 ug/L	1.00 ug/L	10.0 µg/L
SG-31	18-Jul-96	ND	ND	ND	ND	ND
SG-32	22-Jul-96	190	ND	20.4 J	10.9 J	590
SG-34	18-Jul-96	ND	ND	ND	ND	ND
SG-37	22-Jul-96	ND	25.4 J	340 J	320 J	11,500
SG-38	18-Jul-96	ND	ND	ND	ND	ND
SG-39	18-Jul-96	ND	ND	ND	ND	ND
SG-40	22-Jul-96	3.15	2.47 J	ND	9.11 J	85
SG-41	22-Jul-96	ND	ND	ND	ND	ND
SG-42	18-Jul-96	ND	ND	ND	ND	ND
SG-44	18-Jul-96	ND	ND	ND	ND	ND
SG-58	18-Jul-96	ND	ND	ND	ND	ND
SG-59	18-Jul-96	ND	ND	ND	ND	ND

J - The associated numerical value is an estimated quantity, due to a variance from quality control standards.

ND - Indicates no analytes detected ath the detection limits, analyte concentrations in Soil Gas EPA Method 8020M

* Calculated using the sum of the areas of all integrated chromatogram peaks and the instrument response factor for toluene.

APPENDIX A

Work Plan

HYDROLOGY GEOLOGY ENGINEERING

September 21, 2001

Ms. Mary Jean Brady
Project Management Area Head
Washington Gas
6801 Industrial Road
Springfield, Virginia 22151

RE: Revised Soil Sampling and Associated Human-Health Risk Assessment, NPS Property

Dear Mary Jean:

We have reviewed the August 20, 2001 comments from the National Park Service (NPS) concerning the assessment of health risks to utility and landscaping workers. We propose to conduct the revised assessment in the following manner.

Soil Sampling

Sample the soil at 20 locations on the approximately 3.2-acre area being considered for reclamation. The sampling locations and depths are described below.

- Eight previously sampled locations SB-1 (0 to 4 ft), SB-11(0 to 4 ft), SB-12 (0 to 4 ft), SB-13 (0 to 4 ft), TB-50 (0 to 2 ft), P-5S (0 to 2 ft), P-6S (3 to 5 ft), and P-7S (3 to 5 ft). The "TB" and "P" designated samples were analyzed only for polynuclear aromatic hydrocarbons (PAHs). The locations of all of the sampling sites are shown on the attached figure.

- Twelve new locations (TB-70 through TB-81), each sampled from 0 to 3.5 feet in depth and analyzed for PAHs and Target-Analyte-List (TAL) metals. At the sampling locations next to the seawall, the sampling depth will be less then 3.5 feet should the stone foundation for the seawall be encountered above the planned sampling depth. The suggested sampling locations are shown on the attached figure. TB-76 through TB-81 are distributed uniformly along the seawall.

Along with the existing locations, the new sampling sites provide a fairly uniform coverage of the 3.2-acre site, including the area along the seawall. The new locations should be reviewed and approved by the NPS. Alternative locations

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Baltimore, MD (410) 995-1246 FAX (410) 730-1785

will be acceptable as long as a fairly uniform distribution of sampling sites is obtained.

The analytical results at each location will be considered representative of average conditions at a depth of 0 to 3.5 feet, the zone of concern to the NPS. The analytical results from 0 to 2 and 2 to 4 feet at each of the four SB locations will be averaged, and the average concentrations used, along with the measurements at other locations, to calculate the 95% upper confidence limit for each chemical of potential concern (COPC).

Collection of data at 20 sampling sites will, for the purpose of risk assessment, sufficiently characterize exposure levels. The proposed density is one sample location per land area of approximately 7,600 square feet (sf).

Chemicals of Potential Concern

As agreed to by the NPS during the teleconference on April 23, 2001, the COPCs will be the same as determined for utility workers exposed on the entire East Station study area which includes the NPS property. It will also be assumed that the landscaping workers will be exposed to the same COPCs.

Calculation of Risks

It was reported to us in June 2001 that the 1995 guidance developed by Ms. Jennifer Hubbard and used to adjust slope factors and reference doses during the completion of the Additional Remedial Investigation and Feasibility Study (Phase IV) was the current guidance. That guidance will be used in assessing the risks to utility and landscaping workers working on the NPS property.

Presentation of Results

The current federal USEPA 1998 Risk Assessment Guidance for Superfund, Part D specifies that the results of a risk assessment be presented in another format from the one used in reporting the results of the Additional Remedial Investigation and Feasibility Study (Phase IV) (see attached letter). Given that nearly all of the supporting data in the Phase IV report relevant to the populations to be evaluated is still valid, it would be onerous to re-format that report. Instead, we will attach Section 8 and appropriate portions of Appendix D of the earlier report (Phase IV) as appendices to the new report and, in evaluating risk, refer the reader to appropriate sections of the appendices. All calculations and new assumptions used to determine risk levels will also be provided in the report.

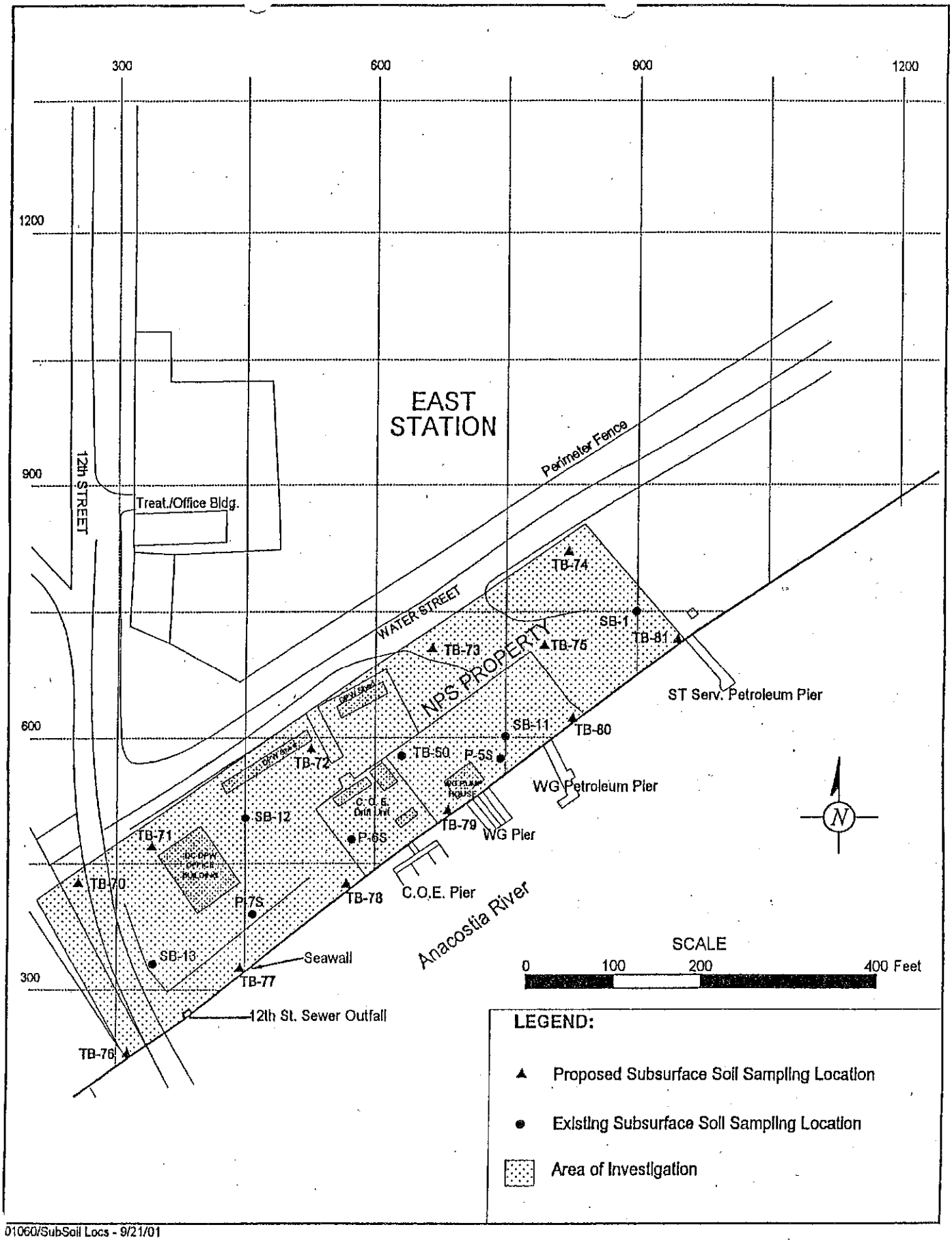
If you have any questions, please give me a call.

Very truly yours,

HYDRO-TERRA, INC.

Thomas R. Mills, P.E., P.G.
Principal Engineer & Geologist

trm/01060
cc: D. Logan, PBS&J
2 encl. HT01110



01060/SubSoil Locs - 9/21/01

Proposed Soil Sampling Locations on NPS Property
for Use in Assessing Human-Health Risks

AR 05157

PBS&J

An employee-owned company

June 5, 2001

Mr. Tom Mills
Hydo-Terra, Inc.
9192 Red Branch Road
Suite 290
Columbia, MD 21045

Dear Tom,

I have conducted a thorough investigation to determine current guidance applicable to dermal and associated risks for human populations using the National Park Service Property below East Station.

The current interim federal USEPA 1998 RAGS, Part D indicates in several places that regional guidance should be used in adjusting slope factors and RfDs. The current Region 3 guidance was developed by Jennifer Hubbard in 1995 and was the guidance used in completing the risk assessment found in Section 8 of the 1999 Phase IV report [Additional Remedial Investigation and Feasibility Study (Phase IV)]. The 1995 regional guidance should be used in evaluating the risks to utility and landscaping workers on the NPS property. The USEPA 2000 RAGS, Vol. 1: Human Health Evaluation Manual, Part E mentioned in the NPS's letter of March 28, 2001 has not been released and, thus, cannot be used.

The USEPA 1998 RAGS, Part D cited above was not used in completing the Phase IV assessment, since the guidance was not available when the evaluation was performed. The current guidance contains no substantive changes for performing the risk evaluation, but it does change the manner in which the results are to be presented.

If you have any questions, please give me a call.

Sincerely,

Dennis Logan, Ph.D.
Senior Scientist

RECEIVED
JUN 11 2001

12101 Indian Creek Court, Beltsville, Maryland 20705 • Telephone: 301.210.6800 • 800.697.7275 • www.pbsj.com

APPENDIX B

Laboratory Reports of
New Soil Samples TB-70 thru TB-81

PHASE SEPARATION SCIENCE, INC.

Analytical Chemistry Environmental Science

LABORATORY RESULTS

DATE RECEIVED: October 24, 2001

PROJECT: NPS Risk Assessment

PROJECT #: 01110

PREPARED FOR:

Hydro-Terra Inc.
9192 Red Branch Rd.
Suite 290
Columbia, MD 21045

November 5, 2001

6630 Baltimore National Pike Baltimore, Maryland 21228 (410) 747-8770 (800) 932-9047 fax (410) 788-8723

Phase Separation Science, Inc.
Analytical Chemistry - Environmental Science

TABLE OF CONTENTS

SECTION 1

CHAIN OF CUSTODY

SAMPLE CHAIN OF CUSTODY/AGREEMENT FORM

PHASE SEPARATION SCIENCE, INC.

www.phaseonline.com

(1)

CLIENT: HYDRO-TERRA PHONE NO: (410) 995 1224

PROJECT MGR: TOM MILLS FAX NO: (410) 730 1785

PROJECT NAME: NPS RISK ASSESSMENT

SITE LOCATION: EAST STATION I.C.

PROJECT NUMBER: ~~01110~~ 01110

P.O. NUMBER: 01110

PSS Project #: 01102419

PAGE 1 OF 2

(2)

LAB NO.	SAMPLE IDENTIFICATION	DATE	TIME	MATRIX	No. CONTAINERS	SAMPLE TYPE C=COMP G=GRAB	Preservatives Used: ICE →	Analysis Required (3): PAH	TAL METALS	REMARKS
	TB 70	10/24/01	1050	Soil	2	C		X	X	
	TB-71		1035							
	TB-72		1020							
	TB-73		1540							
	TB-74		1340							
	TB-75		1425							
	TB-76		1140							
	TB-77		1110							
	TB-78		1000							
	TB-79	↓	1520		↓	↓		↓	↓	

AR 05163

(5)

Collected / Relinquished By: (1)	Date	Time	Received By:
	10/24/01	1740	
Relinquished By: (2)	Date	Time	Received By:
Relinquished By: (3)	Date	Time	Received By:
Relinquished By: (4)	Date 10/24/01	Time 5:45pm	Received for Laboratory By:

(4)

Shipping Carrier: CLIENT

Shipping Ticket No:

Sample Condition Upon Receipt: Good

Data Deliverables Required

Level I Level II (Level III)

Chain of Custody Seal:

COOLER NA CONTAINER

Requested Turnaround Time and Special Instructions: ROUTINE

WE WANT DATA VALIDATION, TIGHT PQL's

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SAMPLE CHAIN OF CUSTODY/AGREEMENT FORM

PHASE SEPARATION SCIENCE, INC.

www.phaseonline.com

(1)

CLIENT: HYDRO-TERRA PHONE NO: ( )

PROJECT MGR: FAX NO: ( )

PROJECT NAME: NPS RISK ASSESSMENT

SITE LOCATION:

PROJECT NUMBER:

P.O. NUMBER: 01110

PSS Project #: 01102419

PAGE 2 OF 2

(2)

LAB NO.	SAMPLE IDENTIFICATION	DATE	TIME	MATRIX	No. CONTAINERS	SAMPLE TYPE C=COMP G=GRAB	Preservatives Used: Ice →	Analysis Required (3): PAH	TAL METALS	REMARKS
	TR-80	10/24/01	1445	SOIL	2	C	X	X		
	TR-81		1425							
	DUP-1		0900							
	DUP-2		0830							

AR 05164

(5)

Collected / Relinquished By: (1)	Date	Time	Received By:
Gary Kahn	10/24/01	1740	
Relinquished By: (2)	Date	Time	Received By:
Relinquished By: (3)	Date	Time	Received By:
Relinquished By: (4)	Date 10/25/01	Time 5:45	Received For Laboratory By: M. Walsh

(4)

Shipping Carrier: CLIENT

Shipping Ticket No:

Sample Condition Upon Receipt: Good

Data Deliverables Required: Level I Level II (Level III)

Chain of Custody Seal: COOLER NA CONTAINER

Requested Turnaround Time and Special Instructions: SEE PAGE 1

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SECTION 2

CASE NARRATIVE

PHASE SEPARATION SCIENCE, INC.

Analytical Chemistry Environmental Science

Case Narrative

Client: Hydro-Terra Inc.
Project: NPS Risk Assessment
Project #: 01110

Lab Number	Date Rec'vd	Lab Sample ID	Field Sample ID	Analysis	Method
102419	10/24/01				
		01102419-01	TB-70	Total Cyanide	EPA 9010B
				Polynuclear Aromatic Hydrocarbons	EPA 8270
				Target Analyte List - Metals	EPA 200 Series
		01102419-02	TB-71	Total Cyanide	EPA 9010B
				Polynuclear Aromatic Hydrocarbons	EPA 8270
				Target Analyte List - Metals	EPA 200 Series
		01102419-03	TB-72	Total Cyanide	EPA 9010B
				Polynuclear Aromatic Hydrocarbons	EPA 8270
				Target Analyte List - Metals	EPA 200 Series
		01102419-04	TB-73	Total Cyanide	EPA 9010B
				Polynuclear Aromatic Hydrocarbons	EPA 8270
				Target Analyte List - Metals	EPA 200 Series
		01102419-05	TB-74	Total Cyanide	EPA 9010B
				Polynuclear Aromatic Hydrocarbons	EPA 8270
				Target Analyte List - Metals	EPA 200 Series
		01102419-06	TB-75	Total Cyanide	EPA 9010B
				Polynuclear Aromatic Hydrocarbons	EPA 8270
				Target Analyte List - Metals	EPA 200 Series
		01102419-07	TB-76	Total Cyanide	EPA 9010B
				Polynuclear Aromatic Hydrocarbons	EPA 8270
				Target Analyte List - Metals	EPA 200 Series
		01102419-08	TB-77	Total Cyanide	EPA 9010B
				Polynuclear Aromatic Hydrocarbons	EPA 8270
				Target Analyte List - Metals	EPA 200 Series
		01102419-09	TB-78	Total Cyanide	EPA 9010B
				Polynuclear Aromatic Hydrocarbons	EPA 8270
				Target Analyte List - Metals	EPA 200 Series
		01102419-10	TB-79	Total Cyanide	EPA 9010B
				Polynuclear Aromatic Hydrocarbons	EPA 8270
				Percent Solids	Gravimetry
		01102419-11	TB-80	Total Cyanide	EPA 9010B
				Polynuclear Aromatic Hydrocarbons	EPA 8270
				Target Analyte List - Metals	EPA 200 Series
		01102419-12	TB-81	Total Cyanide	EPA 9010B
				Polynuclear Aromatic Hydrocarbons	EPA 8270
				Target Analyte List - Metals	EPA 200 Series
		01102419-13	Dup-1	Total Cyanide	EPA 9010B
				Polynuclear Aromatic Hydrocarbons	EPA 8270
				Target Analyte List - Metals	EPA 200 Series
		01102419-14	Dup-2	Total Cyanide	EPA 9010B
				Polynuclear Aromatic Hydrocarbons	EPA 8270
				Target Analyte List - Metals	EPA 200 Series

PHASE SEPARATION SCIENCE, INC.

Analytical Chemistry Environmental Science

Case Narrative

Client: Hydro-Terra Inc.
Project: NPS Risk Assessment
Project #: 01110

The above samples were analyzed in accordance with the referenced USEPA Methodologies, and the Quality Assurance Plan of hase Separation Science, Inc (PSS).

The samples were collected on October 24, 2001, between 8:30 AM and 3:40 PM and delivered intact to PSS via a client epresentative with Chain of Custody on October 24, 2001 @ 5:48 PM. The samples were received in a cooler, chilled with Ice. lease reference the Chain of Custody for specific container counts, collection time, and preservatives.

The samples were analyzed within the recommended holding time.

ll results are reported on an as received basis (wet weight). Percent solids data has been provided in this data set.

he following samples were reported with elevated practical quantitation limits (PQLs), due to sample dilutions:

Client Sample ID	Sample Number	Matrix	Test	Dilution
TB-70	01102419-01	Soil	PAH in Soil	30
TB-71	01102419-02	Soil	PAH in Soil	5
TB-72	01102419-03	Soil	PAH in Soil	5
TB-73	01102419-04	Soil	PAH in Soil	30
T	01102419-05	Soil	PAH in Soil	15
TB-75	01102419-06	Soil	PAH in Soil	5
TB-76	01102419-07	Soil	PAH in Soil	10
TB-77	01102419-08	Soil	PAH in Soil	5
TB-78	01102419-09	Soil	PAH in Soil	5
TB-79	01102419-10	Soil	PAH in Soil	5
TB-80	01102419-11	Soil	PAH in Soil	10
TB-81	01102419-12	Soil	PAH in Soil	5
Dup-1	01102419-13	Soil	PAH in Soil	20
Dup-2	01102419-14	Soil	PAH in Soil	5

Dilutions are performed for a variety of reasons, but primarily due to high level contamination of one or more target and/or non-target compound(s) resulting in matrix interference. Because of the dilutions done on these samples the PQLs for some target compounds may exceed the cleanup standards for soil and groundwater.

Samples TB-70, TB-71, TB-73, and TB-76 were re-analyzed for PAH's on November 10, 2001, in order to achieve lower PQL's. The results included in the attached Certificate of Analysis represent the data yielded by the re-analysis of these samples.

Quality Control:
PAH in Soil
All method quality control criteria was achieved, with the following exceptions:

- The surrogate compound, Nitrobenzene-d5, yielded a high recovery for sample TB-81, due to coelution with an interfering peak(s).
- The spike compound, Pyrene, yielded a high recovery for the matrix spike duplicate (MSD) performed on sample TB-80, more than likely, due to the non-homogenous nature of the sample.

Metals in Soil
All method quality control criteria was achieved, with the following exceptions:

- Aluminum appeared in the laboratory reagent blank (LRB) at a concentration greater than the PQL. All other run sequence blanks were acceptable for Aluminum. The level of Aluminum detected in each of the above samples deems this outlier insignificant.

PHASE SEPARATION SCIENCE, INC.

Analytical Chemistry Environmental Science

Case Narrative

Client: Hydro-Terra Inc.
Project: NPS Risk Assessment
Project #: 01110

The following Result Qualifier has been referenced for this project data:
e = estimated value, below reporting limit

Reviewed by: Matt Cohen Date: 30 Nov 01
Quality Assurance Officer

SECTION 3

CERTIFICATE OF ANALYSIS

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PHASE SEPARATION SCIENCE, INC.

ANALYTICAL CHEMISTRY • ENVIRONMENTAL SCIENCE

CERTIFICATE OF ANALYSIS
No. 01102419 Page 1 of 28
Hydro-Terra Inc.
November 21, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

ample ID: TB-70		Result	Unit	Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Acenaphthylene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Anthracene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Benzo (a) anthracene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Benzo (a) pyrene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Benzo (b) fluoranthene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Benzo (g,h,i) perylene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Benzo (k) fluoranthene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Chrysene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Dibenzo (a,h) anthracene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Fluoranthene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Fluorene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Indeno (1,2,3-cd) pyrene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
2-Methylnaphthalene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Naphthalene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Phenanthrene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Pyrene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Target Analyte List - Metals							
Aluminum		5200	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		9.3	mg/kg	EPA 200.8	0.5	10/25/01	11/01/01
Barium		110	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Calcium		9600	mg/kg	EPA 215.1	1.0	10/25/01	11/02/01
Chromium		20	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		3.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Copper		48	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Iron		7300	mg/kg	EPA 236.1	2.0	10/25/01	11/02/01
Lead		1100	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		2400	mg/kg	EPA 242.1	1.0	10/25/01	11/02/01
Manganese		960	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Mercury		0.8	mg/kg	EPA 200.8	0.2	10/25/01	11/01/01
Nickel		16	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		580	mg/kg	EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

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PHASE SEPARATION SCIENCE, INC.

ANALYTICAL CHEMISTRY • ENVIRONMENTAL SCIENCE •

CERTIFICATE OF ANALYSIS
No. 01102419 Page 2 of 28
Hydro-Terra Inc.
November 21, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

ample ID: TB-70		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		850	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		50	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		64	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: Matt Cohen
Quality Assurance Chemist

Not
QL ,actical Quantitation Limit
lesults reported on an as received basis
e - estimated value, less than quantitation limit

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 3 of 28
Hydro-Terra Inc.
November 21, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

ample ID: TB-71		Result	Unit	Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	<	1650	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Acenaphthylene	<	1650	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Anthracene	e	210	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Benzo (a) anthracene	e	620	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Benzo (a) pyrene	e	650	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Benzo (b) fluoranthene	e	320	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Ber 'g,h,i) perylene	<	1650	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Be. ,κ) fluoranthene	e	450	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Chrysene	e	730	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Dibenzo (a,h) anthracene	<	1650	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Fluoranthene	e	500	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Fluorene	<	1650	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Indeno (1,2,3-cd) pyrene	<	1650	ug/kg	EPA 8270	1650	10/26/01	11/10/01
2-Methylnaphthalene	<	1650	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Naphthalene	<	1650	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Phenanthrene	e	510	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Pyrene	e	830	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Target Analyte List - Metals							
Aluminum		7200	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		2.7	mg/kg	EPA 200.8	0.5	10/25/01	11/01/01
Barium		32	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Calcium		5300	mg/kg	EPA 215.1	1.0	10/25/01	11/02/01
Chromium		9.4	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		6.8	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Copper		18	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Iron		9300	mg/kg	EPA 236.1	2.0	10/25/01	11/02/01
Lead		28	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		1600	mg/kg	EPA 242.1	1.0	10/25/01	11/02/01
Manganese		180	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
M		0.1	mg/kg	EPA 200.8	0.1	10/25/01	11/01/01
Nickel		18	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		460	mg/kg	EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 4 of 28
Hydro-Terra Inc.
November 21, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

ample ID: TB-71		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		940	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		20	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		37	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: Matt Colin
Quality Assurance Chemist

ples:
QL - Practical Quantitation Limit
sults reported on an as received basis
- estimated value, less than quantitation limit

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 5 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-72		Result	Unit	Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Acenaphthylene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Anthracene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Benzo (a) anthracene	e	200	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Benzo (a) pyrene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Benzo (b) fluoranthene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
[illegible] (g,h,i) perylene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
[illegible]zo (k) fluoranthene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Chrysene	e	210	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Dibenzo (a,h) anthracene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Fluoranthene	e	450	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Fluorene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Indeno (1,2,3-cd) pyrene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
2-Methylnaphthalene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Naphthalene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Phenanthrene	e	270	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Pyrene	e	430	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Target Analyte List - Metals							
Aluminum		3600	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		2.9	mg/kg	EPA 200.8	0.5	10/25/01	11/01/01
Barium		28	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Calcium		1200	mg/kg	EPA 215.1	1.0	10/25/01	11/02/01
Chromium		9.2	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		3.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Copper		33	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Iron		9400	mg/kg	EPA 236.1	2.0	10/25/01	11/02/01
Lead		79	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		810	mg/kg	EPA 242.1	1.0	10/25/01	11/02/01
Manganese		120	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
[illegible]ury	<	0.1	mg/kg	EPA 200.8	0.1	10/25/01	11/01/01
Nickel		11	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		210	mg/kg	EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

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CERTIFICATE OF ANALYSIS
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Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-72		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		77	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		13	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		64	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: Matt Cohen
Quality Assurance Chemist

Notes:
PQL - Practical Quantitation Limit
Results reported on an as received basis
e - estimated value, less than quantitation limit

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CERTIFICATE OF ANALYSIS
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Hydro-Terra Inc.
November 21, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-73		Result	Unit	Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Acenaphthylene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Anthracene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Benzo (a) anthracene	e	7600	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Benzo (a) pyrene	e	6500	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Benzo (b) fluoranthene	e	5200	ug/kg	EPA 8270	9900	10/26/01	11/10/01
B (g,h,i) perylene	e	2300	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Be..o (k) fluoranthene	e	8900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Chrysene	e	8800	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Dibenzo (a,h) anthracene	e	3900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Fluoranthene		14000	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Fluorene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Indeno (1,2,3-cd) pyrene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
2-Methylnaphthalene		45000	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Naphthalene		39000	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Phenanthrene		12000	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Pyrene		14000	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Target Analyte List - Metals							
Aluminum		7200	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		2.1	mg/kg	EPA 200.8	0.5	10/25/01	11/01/01
Barium		78	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Calcium		240	mg/kg	EPA 215.1	1.0	10/25/01	11/02/01
Chromium		15	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		5.2	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Copper		50	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Iron		11000	mg/kg	EPA 236.1	2.0	10/25/01	11/02/01
Lead		200	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		1900	mg/kg	EPA 242.1	1.0	10/25/01	11/02/01
Manganese		400	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
M ry		0.9	mg/kg	EPA 200.8	0.1	10/25/01	11/01/01
Nickel		15	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		650	mg/kg	EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

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CERTIFICATE OF ANALYSIS
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Hydro-Terra Inc.
November 21, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-73		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		230	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		14	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		200	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: Matt Cohen
Quality Assurance Chemist

Notes:
PQL - Practical Quantitation Limit
Results reported on an as received basis
J - estimated value, less than quantitation limit

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CERTIFICATE OF ANALYSIS
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Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-74		Result	Unit	Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	<	4950	ug/kg	EPA 8270	4950	10/26/01	10/26/01
Acenaphthylene	<	4950	ug/kg	EPA 8270	4950	10/26/01	10/26/01
Anthracene	<	4950	ug/kg	EPA 8270	4950	10/26/01	10/26/01
Benzo (a) anthracene	e	940	ug/kg	EPA 8270	4950	10/26/01	10/26/01
Benzo (a) pyrene	<	4950	ug/kg	EPA 8270	4950	10/26/01	10/26/01
Benzo (b) fluoranthene	e	1200	ug/kg	EPA 8270	4950	10/26/01	10/26/01
B ...g,h,i) perylene	<	4950	ug/kg	EPA 8270	4950	10/26/01	10/26/01
Benzo (k) fluoranthene	e	1100	ug/kg	EPA 8270	4950	10/26/01	10/26/01
Chrysene	e	1400	ug/kg	EPA 8270	4950	10/26/01	10/26/01
Dibenzo (a,h) anthracene	<	4950	ug/kg	EPA 8270	4950	10/26/01	10/26/01
Fluoranthene	e	1500	ug/kg	EPA 8270	4950	10/26/01	10/26/01
Fluorene	<	4950	ug/kg	EPA 8270	4950	10/26/01	10/26/01
Indeno (1,2,3-cd) pyrene	<	4950	ug/kg	EPA 8270	4950	10/26/01	10/26/01
2-Methylnaphthalene	<	4950	ug/kg	EPA 8270	4950	10/26/01	10/26/01
Naphthalene	<	4950	ug/kg	EPA 8270	4950	10/26/01	10/26/01
Phenanthrene	e	1200	ug/kg	EPA 8270	4950	10/26/01	10/26/01
Pyrene	e	2300	ug/kg	EPA 8270	4950	10/26/01	10/26/01
Target Analyte List - Metals							
Aluminum		2600	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		12	mg/kg	EPA 200.8	0.5	10/25/01	11/01/01
Barium		130	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Calcium		210	mg/kg	EPA 215.1	1.0	10/25/01	11/02/01
Chromium		36	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		4.0	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Copper		58	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Iron		30000	mg/kg	EPA 236.1	2.0	10/25/01	11/02/01
Lead		750	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		350	mg/kg	EPA 242.1	1.0	10/25/01	11/02/01
M...anese		150	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
M...ry		0.4	mg/kg	EPA 200.8	0.1	10/25/01	11/01/01
Nickel		31	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		590	mg/kg	EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

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CERTIFICATE OF ANALYSIS
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Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-74		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		160	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		21	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		670	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: Matt Cohen
Quality Assurance Chemist

Notes:
PQL - Practical Quantitation Limit
Results reported on an as received basis
e - estimated value, less than quantitation limit

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Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-75		Result	Unit	Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Acenaphthylene	e	640	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Anthracene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Benzo (a) anthracene	e	980	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Benzo (a) pyrene		1900	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Benzo (b) fluoranthene	e	1600	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Benzo (g,h,i) perylene		1800	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Benzo (k) fluoranthene		1900	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Chrysene	e	1400	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Dibenzo (a,h) anthracene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Fluoranthene		1800	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Fluorene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Indeno (1,2,3-cd) pyrene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
2-Methylnaphthalene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Naphthalene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Phenanthrene	e	400	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Pyrene		3900	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Target Analyte List - Metals							
Aluminum		2500	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		3.4	mg/kg	EPA 200.8	0.5	10/25/01	11/01/01
Barium		420	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Calcium		6	mg/kg	EPA 215.1	1.0	10/25/01	11/02/01
Chromium		7.3	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		2.3	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Copper		190	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Iron		7100	mg/kg	EPA 236.1	2.0	10/25/01	11/02/01
Lead		40	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		370	mg/kg	EPA 242.1	1.0	10/25/01	11/02/01
Manganese		44	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Mercury		0.2	mg/kg	EPA 200.8	0.1	10/25/01	11/01/01
Nickel		8.8	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		130	mg/kg	EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

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Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-75		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		62	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		9.6	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		89	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: Matt Cohen
Quality Assurance Chemist

Notes:
PQL - Practical Quantitation Limit
Results reported on an as received basis

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CERTIFICATE OF ANALYSIS
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Hydro-Terra Inc.
November 21, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-76		Result	Unit	Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	<	3300	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Acenaphthylene	e	390	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Anthracene	<	3300	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Benzo (a) anthracene	e	1100	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Benzo (a) pyrene	e	530	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Benzo (b) fluoranthene	e	590	ug/kg	EPA 8270	3300	10/26/01	11/10/01
B[illegible]'g,h,i) perylene	<	3300	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Be[illegible] (k) fluoranthene	e	770	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Chrysene	e	1400	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Dibenzo (a,h) anthracene	<	3300	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Fluoranthene	e	1800	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Fluorene	<	3300	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Indeno (1,2,3-cd) pyrene	<	3300	ug/kg	EPA 8270	3300	10/26/01	11/10/01
2-Methylnaphthalene	<	3300	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Naphthalene	<	3300	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Phenanthrene	e	1700	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Pyrene	e	2400	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Target Analyte List - Metals							
Aluminum		4200	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		17	mg/kg	EPA 200.8	0.5	10/25/01	11/01/01
Barium		68	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Calcium		69	mg/kg	EPA 215.1	1.0	10/25/01	11/02/01
Chromium		33	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		14	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Copper		270	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Iron		65000	mg/kg	EPA 236.1	2.0	10/25/01	11/02/01
Lead		1300	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		380	mg/kg	EPA 242.1	1.0	10/25/01	11/02/01
Manganese		450	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
M[illegible]y		0.2	mg/kg	EPA 200.8	0.1	10/25/01	11/01/01
Nickel		28	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		220	mg/kg	EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

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ANALYTICAL CHEMISTRY • ENVIRONMENTAL SCIENCE •

CERTIFICATE OF ANALYSIS
No. 01102419 Page 14 of 28
Hydro-Terra Inc.
November 21, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

ample ID: TB-76		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		78	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		33	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		370	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: Matt Cohen
Quality Assurance Chemist

oles:
)L - Practical Quantitation Limit
esults reported on an as received basis
- estimated value, less than quantitation limit

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 15 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-77		Result	Unit	Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Acenaphthylene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Anthracene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Benzo (a) anthracene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Benzo (a) pyrene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Benzo (b) fluoranthene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
o (g,h,i) perylene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Benzo (k) fluoranthene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Chrysene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Dibenzo (a,h) anthracene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Fluoranthene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Fluorene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Indeno (1,2,3-cd) pyrene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
2-Methylnaphthalene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Naphthalene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Phenanthrene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Pyrene	e	450	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Target Analyte List - Metals							
Aluminum		3300	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		16	mg/kg	EPA 200.8	0.5	10/25/01	11/01/01
Barium		61	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Calcium		12000	mg/kg	EPA 215.1	1.0	10/25/01	11/02/01
Chromium		41	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		4.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Copper		120	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Iron		38000	mg/kg	EPA 236.1	2.0	10/25/01	11/02/01
Lead		50	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		3400	mg/kg	EPA 242.1	1.0	10/25/01	11/02/01
Manganese		380	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
ury		0.4	mg/kg	EPA 200.8	0.1	10/25/01	11/01/01
Nickel		38	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		580	mg/kg	EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 16 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-77		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		1000	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		50	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		56	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: Matt Colvin
Quality Assurance Chemist

Notes:
PQL - Practical Quantitation Limit
Results reported on an as received basis
B - estimated value, less than quantitation limit

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 18 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-78		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		930	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		14	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		130	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: Matt Cole
Quality Assurance Chemist

No
PQL .actical Quantitation Limit
Results reported on an as received basis
e - estimated value, less than quantitation limit

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 19 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-79		Result	Unit	Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Acenaphthylene	e	210	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Anthracene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Benzo (a) anthracene	e	320	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Benzo (a) pyrene	e	330	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Benzo (b) fluoranthene	e	330	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Benzo (g,h,i) perylene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Benzo (k) fluoranthene	e	310	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Chrysene	e	400	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Dibenzo (a,h) anthracene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Fluoranthene	e	440	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Fluorene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Indeno (1,2,3-cd) pyrene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
2-Methylnaphthalene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Naphthalene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Phenanthrene	e	240	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Pyrene	e	680	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Target Analyte List - Metals							
Aluminum		2800	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		2.9	mg/kg	EPA 200.8	0.5	10/25/01	11/01/01
Barium		42	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Calcium		6200	mg/kg	EPA 215.1	1.0	10/25/01	11/02/01
Chromium		12	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Copper		19	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Iron		7800	mg/kg	EPA 236.1	2.0	10/25/01	11/02/01
Lead		43	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		2900	mg/kg	EPA 242.1	1.0	10/25/01	11/02/01
Manganese		93	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Mercury	<	0.1	mg/kg	EPA 200.8	0.1	10/25/01	11/01/01
Nickel		8.6	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		170	mg/kg	EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

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ANALYTICAL CHEMISTRY • ENVIRONMENTAL SCIENCE

CERTIFICATE OF ANALYSIS
No. 01102419 Page 20 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-79		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		78	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		12	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		24	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: Matt Colvin
Quality Assurance Chemist

Notes
L - [illegible]ical Quantitation Limit
sults reported on an as received basis
- estimated value, less than quantitation limit

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 21 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-80		Result	Unit	Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	<	3300	ug/kg	EPA 8270	3300	10/29/01	10/29/01
Acenaphthylene	e	770	ug/kg	EPA 8270	3300	10/29/01	10/29/01
Anthracene	<	3300	ug/kg	EPA 8270	3300	10/29/01	10/29/01
Benzo (a) anthracene	e	920	ug/kg	EPA 8270	3300	10/29/01	10/29/01
Benzo (a) pyrene	e	1300	ug/kg	EPA 8270	3300	10/29/01	10/29/01
Benzo (b) fluoranthene	e	1100	ug/kg	EPA 8270	3300	10/29/01	10/29/01
Benzo (g,h,i) perylene	e	1300	ug/kg	EPA 8270	3300	10/29/01	10/29/01
Benzo (k) fluoranthene	e	1300	ug/kg	EPA 8270	3300	10/29/01	10/29/01
Chrysene	e	1100	ug/kg	EPA 8270	3300	10/29/01	10/29/01
Dibenzo (a,h) anthracene	<	3300	ug/kg	EPA 8270	3300	10/29/01	10/29/01
Fluoranthene	e	1700	ug/kg	EPA 8270	3300	10/29/01	10/29/01
Fluorene	<	3300	ug/kg	EPA 8270	3300	10/29/01	10/29/01
Indeno (1,2,3-cd) pyrene	<	3300	ug/kg	EPA 8270	3300	10/29/01	10/29/01
2-Methylnaphthalene	<	3300	ug/kg	EPA 8270	3300	10/29/01	10/29/01
Naphthalene	<	3300	ug/kg	EPA 8270	3300	10/29/01	10/29/01
Phenanthrene	e	610	ug/kg	EPA 8270	3300	10/29/01	10/29/01
Pyrene		3300	ug/kg	EPA 8270	3300	10/29/01	10/29/01
Target Analyte List - Metals							
Aluminum		2900	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		5.3	mg/kg	EPA 200.8	0.5	10/25/01	11/01/01
Barium		36	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Calcium		16000	mg/kg	EPA 215.1	1.0	10/25/01	11/02/01
Chromium		12	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		3.7	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Copper		34	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Iron		11000	mg/kg	EPA 236.1	2.0	10/25/01	11/02/01
Lead		100	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		9200	mg/kg	EPA 242.1	1.0	10/25/01	11/02/01
Manganese		120	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Mercury		0.2	mg/kg	EPA 200.8	0.1	10/25/01	11/01/01
Nickel		19	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		210	mg/kg	EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 22 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil
Date Sampled: 10/24/01
Date Received: 10/24/01

mple ID: TB-80		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		100	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
hallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		16	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		65	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: _____
Quality Assurance Chemist

otes:
L - cal Quantitation Limit
sults orted on an as received basis
estimated value, less than quantitation limit

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 23 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-81		Result	Unit	Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	<	1650	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Acenaphthylene	<	1650	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Anthracene	<	1650	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Benzo (a) anthracene	e	690	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Benzo (a) pyrene	e	650	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Benzo (b) fluoranthene	e	610	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Benzo (g,h,i) perylene	e	360	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Benzo (k) fluoranthene	e	700	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Chrysene	e	820	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Dibenzo (a,h) anthracene	<	1650	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Fluoranthene	e	1000	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Fluorene	e	530	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Indeno (1,2,3-cd) pyrene	<	1650	ug/kg	EPA 8270	1650	10/29/01	10/29/01
2-Methylnaphthalene	<	1650	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Naphthalene	<	1650	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Phenanthrene	<	1650	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Pyrene	e	1800	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Target Analyte List - Metals							
Aluminum		200	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		12	mg/kg	EPA 200.8	0.5	10/25/01	11/01/01
Barium		210	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Calcium		36	mg/kg	EPA 215.1	1.0	10/25/01	11/02/01
Chromium		17	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		4.8	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Copper		60	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Iron		16000	mg/kg	EPA 236.1	2.0	10/25/01	11/02/01
Lead		1600	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		1200	mg/kg	EPA 242.1	1.0	10/25/01	11/02/01
Manganese		82	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Mercury		0.3	mg/kg	EPA 200.8	0.1	10/25/01	11/01/01
Nickel		24	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		120	mg/kg	EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 24 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

ample ID: TB-81	Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals						
Sodium	84	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	2.8	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium	34	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc	79	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: Matt Cohen
Quality Assurance Chemist

Not
QL ...ctical Quantitation Limit
...esults reported on an as received basis
e - estimated value, less than quantitation limit

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 25 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: Dup-1		Result	Unit	Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	e	5000	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Acenaphthylene	e	1900	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Anthracene	e	3600	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Benzo (a) anthracene	e	4800	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Benzo (a) pyrene	e	3700	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Benzo (b) fluoranthene	e	2600	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Benzo (g,h,i) perylene	<	6600	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Benzo (k) fluoranthene	e	3100	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Chrysene	e	5000	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Dibenzo (a,h) anthracene	<	6600	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Fluoranthene		6700	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Fluorene	e	4000	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Indeno (1,2,3-cd) pyrene	<	6600	ug/kg	EPA 8270	6600	10/29/01	10/29/01
2-Methylnaphthalene	e	5200	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Naphthalene	<	6600	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Phenanthrene		7500	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Pyrene		12000	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Target Analyte List - Metals							
Aluminum		4800	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		11	mg/kg	EPA 200.8	0.5	10/25/01	11/01/01
Barium		54	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Calcium		140	mg/kg	EPA 215.1	1.0	10/25/01	11/02/01
Chromium		18	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		13	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Copper		89	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Iron		18000	mg/kg	EPA 236.1	2.0	10/25/01	11/02/01
Lead		520	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		1200	mg/kg	EPA 242.1	1.0	10/25/01	11/02/01
Manganese		190	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Mercury		0.2	mg/kg	EPA 200.8	0.1	10/25/01	11/01/01
Nickel		18	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		580	mg/kg	EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 26 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: Dup-1		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		1400	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		18	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		140	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: Matt Cohen
Quality Assurance Chemist

N
PQL - Practical Quantitation Limit
Results reported on an as received basis
e - estimated value, less than quantitation limit

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 27 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: Dup-2		Result	Unit	Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	<	1650	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Acenaphthylene	e	900	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Anthracene	e	230	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Benzo (a) anthracene	e	1300	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Benzo (a) pyrene	e	890	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Benzo (b) fluoranthene		2000	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Benzo (g,h,i) perylene		2200	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Benzo (k) fluoranthene		1900	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Chrysene		1700	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Dibenzo (a,h) anthracene	<	1650	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Fluoranthene		2600	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Fluorene	<	1650	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Indeno (1,2,3-cd) pyrene	<	1650	ug/kg	EPA 8270	1650	10/29/01	10/29/01
2-Methylnaphthalene	<	1650	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Naphthalene	<	1650	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Phenanthrene	e	500	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Pyrene		5300	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Target Analyte List - Metals							
Aluminum		1600	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		5.4	mg/kg	EPA 200.8	0.5	10/25/01	11/01/01
Barium		280	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Calcium		8	mg/kg	EPA 215.1	1.0	10/25/01	11/02/01
Chromium		6.8	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		2.2	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Copper		200	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Iron		7300	mg/kg	EPA 236.1	2.0	10/25/01	11/02/01
Lead		39	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		510	mg/kg	EPA 242.1	1.0	10/25/01	11/02/01
Manganese		31	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Mercury	<	0.1	mg/kg	EPA 200.8	0.1	10/25/01	11/01/01
Nickel		10	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		160	mg/kg	EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 28 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: Dup-2		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		110	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		8.7	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		80	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: _____
Quality Assurance Chemist

No
PQL ,actical Quantitation Limit
Results reported on an as received basis
e - estimated value, less than quantitation limit

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 1 of 2
Hydro-Terra Inc.
December 4, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

	Result	Unit	Method	Date Analyzed
Sample ID: TB-70				
Percent Solids	88	%	Gravimetry	10/29/0
mple ID: TB-71				
Percent Solids	88	%	Gravimetry	10/29/0
Sample ID: TB-72				
Percent Solids	85	%	Gravimetry	10/29/0
Sample ID: TB-73				
Percent Solids	74	%	Gravimetry	10/29/0
Sample ID: TB-74				
Percent Solids	91	%	Gravimetry	10/29/0
Sample ID: TB-75				
Percent Solids	92	%	Gravimetry	10/29/0
Sample ID: TB-76				
Percent Solids	88	%	Gravimetry	10/29/0
Sample ID: TB-77				
Percent Solids	84	%	Gravimetry	10/29/0
Sample ID: TB-78				
Percent Solids	76	%	Gravimetry	10/29/0
Sample ID: TB-79				
Percent Solids	91	%	Gravimetry	10/29/0

Notes:
PQL - Practical Quantitation Limit

Reviewed by: Matt Colue
Quality Assurance Chemist

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 2 of 2
Hydro-Terra Inc.
December 4, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil
Date Sampled: 10/24/01
Date Received: 10/24/01

	Result	Unit	Method	Date Analyzed
Sample ID: TB-80				
Percent Solids	90	%	Gravimetry	10/29/0
Sample ID: TB-81				
Percent Solids	79	%	Gravimetry	10/29/0
Sample ID: Dup-1				
Percent Solids	78	%	Gravimetry	10/29/0
Sample ID: Dup-2				
Percent Solids	91	%	Gravimetry	10/29/0

Notes:
PQL - Practical Quantitation Limit

Reviewed by: _____
Quality Assurance Chemist

AR 05198

APPENDIX C

Boring Logs of Subsurface-Soil Sampling Sites on NPS Property

BORING LOG	HYDRO-TERRA, INCORPORATED	PAGE: 1

BORING NO.: TB-50 | PROJECT: EAST STATION | DATE: 4-17-96

PROJECT NO:	96010	DRILLER:	PSI	DRILLING BIT:	3.25" I.D.
LOCATION:	EAST STATION	RIG TYPE:	ATV	GROUND ELEVATION:	6.13
INSPECTOR:	B. WHIPPLE	METHOD:	ROTARY, H.S.	SAMPLING METHOD:	SPLIT SPOON
WELL TYPE:		SCREEN LENGTH:		PROTOP WIDTH/TYPE	
WELL DEPTH:		GROUT LENGTH/TYPE:		PAD ELEVATION:	
SCREEN:		SEAL LENGTH/TYPE:		TOC ELEVATION	
SLOT SIZE:		FILTER LENGTH/TYPE:		STICK UP/DOWN:	

DEPTH	SAMPLE COLLECTION DATA: SAMPLE NUMBER	HNU (PPM)	STP TEST BLOWS/6"	REC (in.)	DESCRIPTION	DEPTH
		0.4	4435	10"	BROWN SILTY SAND AND GRAVEL, SOME CLAY (FILL) MOIST	
4	S-1	0.4	2-2-1-2	10"	BROWN SILTY SAND & GRAVEL, SOME CLAY, WET (FILL) ~~4-4.1' BLACK SILTY SAND AND COAL CINDERS, SATURATED~~ PW	
		14	2-8-6-5	13"	4.5-5' SAME, SATURATED	
					5-6' BLACK SILTY SAND AND COAL CINDERS, SATURATED (FILL)	
8		14	6-6-7-3	11"	BLACK SILTY SAND AND COAL CINDERS; SATURATED (FILL) TAR VOL. ODOR PRESENT	
	S-2	20	2-1-2-8	11"	BLACK SILTY SAND AND GRAVEL AND COAL CINDERS, TRACE COAL TAR, SATURATED, C.T. ODOR PRESENT (FILL)	
12		6.0	2-2-3-3	12"	10-10.5' SAME AS B-10 (FILL) 10.5-12' DARK GRAY SILTY CLAY, TRACE WOOD FRAGMENTS (SILT) COAL TAR PRESENT (MAY BE SLOUGH)	
		6.0	1-1-1-1	19"	GRAYISH BROWN SILTY CLAY, TRACE WOOD FRAGMENTS (SILT) COAL TAR PRESENT ALONG INSIDE OF SPOON NOT IN SAMPLE. WET	
		4.5	1-2-1-2	19"	SAME AS 12-14' (SILT)	
16					* NO UV SCAN WAS PERFORMED AT THIS LOCATION.	
20						

PROPORTIONS USED: TRACE = 0-10%, LITTLE = 10-20%, SOME 20-35%, AND = 35-50%

TEST BORING LOG

Boring Number: TB-70
Date: 24 Oct. 2001
Inspectors: S. Myers / G. Parks
Location: Immediately soutwest of entrance gate to DPW compound.
Driller: Tidewater Engineering
Type of rig: Geoprobe on pickup truck

Description of Recovered Sample

0" - 7" Dark brown to medium gray, medium Sand, little/some gravel

7" - 11" Orange/brown, silty Clay

11" - 20" Dark gray to brown, silty Sand with gravel

20"- 22" Red, silty Clay

22" - 25" Sand & Gravel

25" - 41" Dark gray, Cinders & medium Sand & Gravel

41" - 42" Brown, Sand, medium moist

Notes:

Pushed sample tube to 42" and obtained 42" of recovery.
No tar odors. PID scan = 0.0 ppm on all.

TEST BORING LOG

Boring Number: TB-71
Date: 24 Oct. 2001
Inspectors: S. Myers / G. Parks
Location: Near northwest corner of DPW office building
Driller: Tidewater Engineering
Type of rig: Geoprobe on pickup truck

Desrciption of Recovered Sample

0" - 8" Dark brown, poorly sorted Sand, trace gravel

8' - 13" Tan, medium Sand, some coarse sand & gravel

13" - 37" Reddish brown, silty Sand

37" - 42" Reddish brown, sandy Clay

Notes:

Pushed sample tube to 42", obtained 42" of sample recovery.
Possible trace odor.
PID scan = 0.0 ppm for whole sample

TEST BORING LOG

Boring Number: TB-72
Date: 24 Oct. 2001
Inspectors: S. Myers / G. Parks
Location: 60 feet north-northwest of Corps of Engineers office
Driller: Tidewater Engineering
Type of rig: Geoprobe on pickup truck

Description of Recovered Sample

0" -2" Dark brown, top Soil

2" - 15" Orange-brown, medium Sand with silt & gravel

15" - 20" Dark gray, Sand with gravel & silt

20" - 29" Medium brown, fine/medium Sand, little gravel, trace silt,

29" - 42" Brown, sandy Clay with gravel, chunks of black wood

Notes:

Pushed sample tube to 42", obtained 42" of recovery.
No tar odor.
PID scan = 0.0 ppm for whole sample.

TEST BORING LOG

Boring Number: TB-73
Date: 24 Oct. 2001
Inspectors: S. Myers / G. Parks
Location: 60 feet northeast of DPW compound, near Water Street
Date: 24 Oct. 2001
Type of rig: Geoprobe on pickup truck

Description of Recovered Sample

0" - 5" Brown, fine Sand & Gravel (crushed stone)

5" - 7" Pink/tan, fine Sand, some gravel

7" - 16" Black/medium brown, fine Sand & Gravel, some silt

16" - 27" Black, sand-sized Cinders, moist

27" - 45" Red/tan mottled, Clay, moist

45" - 48" Olive/brown, silty Sand, little gravel
Odor towards bottom - coke?

Notes:

Pushed sample tube to 42", obtained 48"of recovery
Maximum PID reading = 1.1 ppm at 22".
PID reading at 36" = 0.0 ppm.

TEST BORING LOG

Boring Number: TB-74
Date: 24 Oct. 2001
Inspectors: S. Myers / G. Parks
Location: In woods 150 feet northwest of ST services pier
Driller: Tidewater Engineering
Type of rig: Geoprobe on pickup truck

Description of Recovered Sample

0" - 1.5" Plant debris & glass

1.5" - 6" Dark brown, sandy Silt, some slag, little gravel

6" - 13" Dark/medium brown, Cinders & Sand

13" - 22" Light brown,.silty fine Sand

22" - 28" Light brown/gray, Cinders, loose, dry

Notes:

Pushed sample tube to 42" on fifth drilling attempt, obtained 28" of recovery.

TEST BORING LOG

Boring Number: TB-75
Date: .24 Oct. 2001
Inspectors: S. Myers / G. Parks
Location: 110 feet north of Washington Gas pier
Driller: Tidewater Engineering
Type of rig: Geoprobe on pickup truck

Description of Recovered Sample

0" - 2" Rock fragments

2" - 4" Sand & Gravel

4" - 7" Black/dark brown, silty Sand and large Coke (Processed Coal)

7" - 12" Light brown, fine sandy Clay

12" - 38" Black, fine Cinders, some coke

Notes:

Pushed sample tube to 42", obtained 38" of recovery.
No PID reading above 0.0 ppm.
No coal tar odors.
Took duplicate sample here - called it "Dup-2".

TEST BORING LOG

Boring Number: TB-76
Date: 24 Oct. 2001
Inspectors: S. Myers / G. Parks
Location: Along seawall, below western edge of 11th Street bridge
Driller: Tidewater Engineering
Type of rig: Geoprobe on pickup truck

Description of Recovered Sample

0" - 3" Brown, Silt with grass roots

3" - 6" Light brown, Silt, trace gravel

6" - 22" Dark/medium brown, mixed Sand & Gravel, little silt
Fresh tree root at 18"

22" - 29" Dark brown/black, Cinders

29" - 36" Red, Clay, wet (fill material)

Notes:

Pushed sample tube to 42" on two attempts, obtained 36" recovery max.
No coal tar odor.
Maximum PID reading = 1.9 ppm at 26".
No ground water in hole at time 1148.

TEST BORING LOG

Boring Number: TB-77
Completion Date: 24 Oct. 2001
Inspectors: S. Myers / G. Parks
Location: Along seawall, south/southeast of DPW office
Type of sampling rig: Geoprobe on pickup truck
Geoprobe Operator: Tidewater Engineering

Description of Recovered Sample

0" - 2" Brown, Silt (topsoil), with grass roots and fine sand

2" - 12" Light/Dark brown, Sand & Gravel

12" - 14" Dark brown, sandy Silt

14" - 23" Light brown, silty fine Sand, micaceous, trace gravel

23" - 36" Dark gray, Sand & Gravel, some sil & wood chunks

36" - 38" Silty Sand, micaceous, (Weathered Schist, non-native material)

Notes:
Pushed sample tube to 42", obtained 38" of recovery.
No water in hole at time 1116, immediately after sampling.

TEST BORING LOG

Boring Number: TB-78
Completion Date: 24 Oct. 2001
Inspectors: S. Myers / G. Parks
Location: Along seawall southwest of Corps of Engineers docks
Type of sampling rig: Geoprobe on pickup truck
Geoprobe Operator: Tidewater Engineering

Description of Recovered Sample

0" - 3" Brown, sandy Silt (topsoil), plant roots present

3" - 12" Dark gray to black, Cinders, some wood & plant roots little 1/2" gravel, wet at 12"

12" - 18" Black, silty Cinders, wet

18" - 20" Concrete chunk, black woody Silt, oily odor. Bottom 6" of sample is oily.

Notes:
Pushed sample tube to 42", obtained 27" of sample recovery.
PID reading maximum = 4.6 ppm in oily zone of sample.
Took duplicate sample - called it "Dup-1".

TEST BORING LOG

Boring Number: TB-79
Completion Date: 24 Oct. 2001
Inspectors: S. Myers / G. Parks
Location: Near seawall about 10 feet south of Wash. Gas pump house.
Type of sampling rig: Geoprobe on pickup truck
Geoprobe Operator: Tidewater Engineering

Description of Recovered Sample

0" - 2" Brown, silty Sand, little gravel & roots

2" - 6" Brown, medium Sand & Gravel, some silt

6" - 12" Light brown/tan, poorly sorted Sand & Gravel

12" - 14" Tan, fine Sand, crushed quartzite

14" - 18" Red, fine Sand & Gravel, little silt

18" - 22" Brown, sandy Silt, little clay & gravel

22" - 23" Red, Brick (Crushed)

Notes:
Pushed sample tube to 48" on four attempts - obtained maximum of 23" recovery on fourth attempt - sampled it.
No PID readings above 0.0 ppm in sample.
Water at 1.84 feet below ground immediately after sampling.
No oil on water, but petroleum odor from hole.

TEST BORING LOG

Boring Number: TB-80
Completion Date: 24 Oct. 2001
Inspectors: S. Myers / G. Parks
Location: Near seawall 35 feet northeast of Wash. Gas pier in river
Type of sampling rig: Geoprobe on pickup truck
Geoprobe Operator: Tidewater Engineering

Description of Recovered Sample

0" - 2" Loose dry vegetation, Light brown, Sand, Gravel, & Silt

2" - 6" Brown/light gray, fine Sand & Gravel

6" - 12" Gray, crushed Stone and brown silty Sand

12" - 15" Red, Clay and Gravel mix

15" - 25" Brown/black, mix of Cinders, Gravel, and Slag

Notes:
Pushed sample tube to 42" on two attempts, and obtained 25" of sample recovery on both attempts.
The tip of the sample spoon was wet at 42".
No PID readings were above 0.0 ppm.

TEST BORING LOG

Boring Number: TB-81
Completion Date: 24 Oct. 2001
Inspectors: S. Myers / G. Parks
Location: Near seawall, 15 feet southwest of ST Service pier
Type of sampling rig: Geoprobe on pickup truck
Geoprobe Operator: Tidewater Engineering

Description of Recovered Sample

0" - 1" Surface debris

1" - 6" Brown, sandy Silt, some wood, little gravel

6" - 11" Crushed rock(?), little Sand

11" - 28" Black/dark brown, Sand & Cinders,some gravel
Saturated below 18". Strong oily odor. Very coarse cinders in lower portion.

Notes:
Pushed sample tube to 42", obtained 28" of sample recovery.
Water at 2.8 feet below ground immediately after sampling.
Maximum PID reading = 91.6 ppm in oily zone.

TEST BORING LOG	HYDRO–TERRA, INCORPORATED	PAGE 1

BORING NO.: SB-1	PROJECT: East Station	DATE: 5-8-91

PROJECT NO:	95190	DRILLER:	PSI	DRILLING BIT:	3.25" H.S.
LOCATION:	East Station	RIG TYPE:	ATV	GROUND ELEVATION:	
INSPECTOR:	T. Mills	METHOD:	Rotary, H.S.	SAMPLING METHOD:	Split Spoon
WELL TYPE:		SCREEN LENGTH:		PROTOP WIDTH/TYPE	
WELL DEPTH:		GROUT LENGTH/TYPE:		PAD ELEVATION:	
SCREEN:		SEAL LENGTH/TYPE:		TOC ELEVATION	
SLOT SIZE:		FILTER LENGTH/TYPE:		STICK UP/DOWN:	

DEPTH	SAMPLE COLLECTION DATA: SAMPLE NUMBER	HNU (PPM)	STP TEST BLOWS / 6"	REC (in.)	DESCRIPTION	DEPTH
		1.0	4-8-14-10	18"	Brown to Black Mixed Cinder, Sand/Gravel, and Clay Fill No Fluorescence detected	
2						
		34.0	3-7-4	18"	Black Cinder Fill, 5 inches of silty clay at top, lower 6 inches wet, oil odor Fluorescence detected	
		20.0	3-6-4-4	11"	Black cinder fill, oil odor, saturated Fluorescence detected	
6						

HNU Background → 0.8 ppm

PROPORTIONS USED: TRACE = 0–10%, LITTLE = 10–20%, SOME 20–35%, AND = 35–50%

TEST BORING LOG	HYDRO–TERRA, INCORPORATED	PAGE 1

BORING NO.: SB-11 | PROJECT: | DATE: 5-9-96

PROJECT NO:		DRILLER:		DRILLING BIT:	
LOCATION:		RIG TYPE:		GROUND ELEVATION:	
INSPECTOR:		METHOD:		SAMPLING METHOD:	
WELL TYPE:		SCREEN LENGTH:		PROTOP WIDTH/TYPE:	
WELL DEPTH:		GROUT LENGTH/TYPE:		PAD ELEVATION:	
SCREEN:		SEAL LENGTH/TYPE:		TOC ELEVATION:	
SLOT SIZE:		FILTER LENGTH/TYPE:		STICK UP/DOWN:	

DEPTH	SAMPLE COLLECTION DATA: SAMPLE NUMBER	HNU (PPM)	STP TEST BLOWS / 6"	REC (in.)	DESCRIPTION	DEPTH
		2.0	3-3-2-5	18"	0-6" Topsoil, Trace Cinders (FILL), Moist 6"-24" Black Cinders, Trace Silty Clay (FILL), Moist	
		0.8	3-2-2-3	12"	Red & Brown Silty Clay FILL, Trace Sand & Gravel, Moist	
		1.4	2-3-4-3	12"	Same as S-2, Wet lower 6"	
					No Fluoresence detected	

HNu Background = 0.8

PROPORTIONS USED: TRACE = 0–10%, LITTLE = 10–20%, SOME 20–35%, AND = 35–50%

TEST BORING LOG	HYDRO-TERRA, INCORPORATED	PAGE 1

BORING NO.: SB-12	PROJECT: 25190	DATE: 5-9-26

PROJECT NO:		DRILLER:	PSI	DRILLING BIT:	
LOCATION:		RIG TYPE:		GROUND ELEVATION:	
INSPECTOR:		METHOD:		SAMPLING METHOD:	
WELL TYPE:		SCREEN LENGTH:		PROTOP WIDTH/TYPE	
WELL DEPTH:		GROUT LENGTH/TYPE:		PAD ELEVATION:	
SCREEN:		SEAL LENGTH/TYPE:		TOC ELEVATION	
SLOT SIZE:		FILTER LENGTH/TYPE:		STICK UP/DOWN:	

DEPTH	SAMPLE COLLECTION DATA				DESCRIPTION	DEPTH
	SAMPLE NUMBER	HNU (PPM)	STP TEST BLOWS / 6"	REC (in.)		
0-2		1.4	11-16-15-13	9"	Black & Gray Cinders, Moist (Fill)	
2-4		12.2	9-8-6-9	14"	Black & Brown Silty Clay, Trace Cinder, Some Purifer Sponge, Moist (Fill)	
4-6		4.5	3-3-4-5	16"	Brown to Black Silty Clay, Some Purifer Sponge, Trace Cinders, Moist, wet at Bottom (Fill) *Trace Fluoresence detected	

HNU background → 0.6 ppm

PROPORTIONS USED: TRACE = 0–10%, LITTLE = 10–20%, SOME 20–35%, AND = 35–50%

TEST BORING LOG	HYDRO–TERRA, INCORPORATED	PAGE 1

BORING NO.: SB-13 PROJECT: 95190 East Station DATE: 5-9-96

PROJECT NO:		DRILLER:		DRILLING BIT:	
LOCATION:		RIG TYPE:		GROUND ELEVATION:	
INSPECTOR:		METHOD:		SAMPLING METHOD:	
WELL TYPE:		SCREEN LENGTH:		PROTOP WIDTH/TYPE:	
WELL DEPTH:		GROUT LENGTH/TYPE:		PAD ELEVATION:	
SCREEN:		SEAL LENGTH/TYPE:		TOC ELEVATION:	
SLOT SIZE:		FILTER LENGTH/TYPE:		STICK UP/DOWN:	

DEPTH	SAMPLE COLLECTION DATA				DESCRIPTION	DEPTH
	SAMPLE NUMBER	HNU (PPM)	STP TEST BLOWS / 6"	REC (in.)		
		1.5	5-4-5-3	18"	Dark Brown to Tan Sand & Gravel, Trace Cinder & Silt, Moist	
		1.0	2-3-4-4	17"	Same as ~~S-2~~ S-1	
		68		10"	Same as S-1, Very Moist Trace Fluorescence detected.	

HNu background 0.6 ppm

PROPORTIONS USED: TRACE = 0–10%, LITTLE = 10–20%, SOME 20–35%, AND = 35–50%

TEST BORING LOG	HYDRO–TERRA, INCORPORATED	PAGE 1

BORING NO.: P-5S (2nd Attempt) PROJECT: East Station DATE: 5-1-96

PROJECT NO:	96010	DRILLER:	PSI	DRILLING BIT:	3.25" I.D.
LOCATION:	East Station	RIG TYPE:	ATV	GROUND ELEVATION:	5.12 ±
INSPECTOR:	B. Whipple	METHOD:	Rotary H.S.	SAMPLING METHOD:	Split Spoon
WELL TYPE:	1" Piezometer	SCREEN LENGTH:	5'	PROTOP WIDTH/TYPE	—
WELL DEPTH:		GROUT LENGTH/TYPE:	0	PAD ELEVATION:	—
SCREEN:	1" Stainless Steel	SEAL LENGTH/TYPE:	3.5 Bentonite	TOC ELEVATION	4.47'
SLOT SIZE:	0.01	FILTER LENGTH/TYPE:	6.0 No.1 Sand	STICK UP/DOWN:	-0.65

DEPTH	SAMPLE COLLECTION DATA: SAMPLE NUMBER	HNU (PPM)	STP TEST BLOWS / 6"	REC (in.)	DESCRIPTION	DEPTH
						3.5
5						4.5
		11.0	S-2-2-2 F	13"	Grayish-Brown and Black Clayey Silt, Trace Coal Tar and Cinder Material, Moist Coal Tar odor present (Fill)	
		14.0	2-2-2-4 F	14"	Grayish-Brown Silt, Trace Coal Tar, Wet Slight Coal Tar odor (Fill?)	9.5
	S-2	12.0	Weight of Hammer F	12"	10-11.8' Very Soft Black Silt, Trace Coal Tar and Gravel, C.T. odor present (Silt) 11.8-12' Grayish-Brown Clayey Silt, Trace Gravel	
		1.0	Weight of Hammer	14"	Grayish-Brown Clayey Silt (Silt?)	
15						

Screen set at 9'

F → Fluoresence detectected during UV scan.

PROPORTIONS USED: TRACE = 0–10%, LITTLE = 10–20%, SOME 20–35%, AND = 35–50%

BORING LOG — HYDRO-TERRA, INCORPORATED

PAGE: 1

BORING NO.:	P-6S	PROJECT:	EAST STATION	DATE:	4-23-96
PROJECT NO.:	96010	DRILLER:	PSI	DRILLING BIT:	3.25" I.D.
LOCATION:	EAST STATION	RIG TYPE:	ATV	GROUND ELEVATION:	4.37'
INSPECTOR:	B. WHIPPLE	METHOD:	ROTARY, H.S.	SAMPLING METHOD:	SPLIT SPOON
WELL TYPE:	1" PIEZOMETER	SCREEN LENGTH:	5'	PROTOP WIDTH/TYPE	—
WELL DEPTH:	10'	GROUT LENGTH/TYPE:	0	PAD ELEVATION:	—
SCREEN:	1" STAINLESS-STEEL	SEAL LENGTH/TYPE:	3'/BENTONITE	TOC ELEVATION	4.11
SLOT SIZE:	0.01	FILTER LENGTH/TYPE:	6'/No.1 SAND	STICK UP/DOWN:	-0.26'

DEPTH	SAMPLE NUMBER	HNU (PPM)	STP TEST BLOWS/6"	REC (in.)	DESCRIPTION	DEPTH
		8.4	[illegible]	—	DK. BROWN SILTY SAND + GRAVEL, SOME SILT (FILL)	
		4.5	2-33-30-14	14"	BROWN CLAYEY SILT, SOME GRAVEL + SAND (FILL) Bentonite	
4	S-1				CONCRETE FILL AT ~3'. SLIGHT PETROLEUM ODOR, MOIST	
		20.0	9/8-16-15 F*	12"	4-4.5' CONCRETE FILL (FILL)	
	S-2				4.5-6' BLACK CINDERS + GRAVEL, SOME PURIFIER SPONGE, TRACE	
		12.0	4-4-4-1 F	16"	6-7' BLACK CINDER FILL, TRACE COAL TAR (FILL)	
8					7-8' DK. GRAY CLAYEY SILT, TRACE ROOTS (SILT)	
		1.8	2-1-1-1 F*	13"	GRAYISH BROWN CLAYEY SILT, TRACE SAND (SILT)	
	J	0.4	1/12, 1, 2	12"	GRAYISH BROWN CLAYEY SILT, TRACE SAND (SILT)	
12						
16						
20						

F - FLUORESENCE DETECTED

F* - SMALL AMOUNT OF FLUORESENCE DETE.

PROPORTIONS USED: TRACE = 0-10%, LITTLE = 10-20%, SOME 20-35%, AND = 35-50%

BORING LOG	HYDRO-TERRA, INCORPORATED	PAGE: 1

BORING NO.: P-75 | PROJECT: EAST STATION | DATE: 4-25-96

PROJECT NO.:	96010	DRILLER:	PSI	DRILLING BIT:	3.25" I.D.
LOCATION:	EAST STATION	RIG TYPE:	ATV	GROUND ELEVATION:	7.24'
INSPECTOR:	B. WHIPPLE	METHOD:	ROTARY, H-S,	SAMPLING METHOD:	SPLIT SPOON
WELL TYPE:	1" PIEZOMETER	SCREEN LENGTH:	5'	PROTOP WIDTH/TYPE	—
WELL DEPTH:	13'	GROUT LENGTH/TYPE:	0	PAD ELEVATION:	—
SCREEN:	1" STAINLESS-STEEL	SEAL LENGTH/TYPE:	5'/BENTONITE	TOC ELEVATION	6.74'
SLOT SIZE:	0.01	FILTER LENGTH/TYPE:	7'/No. 1 SAND	STICK UP/DOWN:	0.50'

DEPTH	SAMPLE COLLECTION DATA: SAMPLE NUMBER	HNU (PPM)	STP TEST BLOWS/6"	REC (in.)	DESCRIPTION	DEPTH
		0.2	3-6-4-5	10"	BROWN SILTY SAND + GRAVEL, MOIST (FILL)	
4	S-1	0.2	13-18-13-14	20"	BROWNISH-BLACK ~~DARK BROWN~~ SILT AND MULTI-COLORED CRUSHED GLASS, VERY MOIST (FILL)	BENTONITE
		0.2	2-8-6-7	17"	4-5' BLACK SILTY SAND, SOME CINDERS, WET (FILL) 5-6' TIGHT BROWN CLAYEY SILT, TRACE SAND, WET	
8		8.0	3-6-7-7 F*	20"	6-6.5' SAME AS 5-6' (FILL) 6.5-8' PURIFIER SPONGE/CINDER FILL, STRONG ODOR WET.	S.A.Z.O.
	S-2	19.0	2-2-3-5 F	14"	CINDER FILL, TRACE COAL TAR AND PURIFIER SPONGE, WET VERY STRONG ODOR (FILL)	
12		25.0	2-2-2-1 F*	16"	10-11' SAME AS 8-10 (FILL) 11-12 GRAYISH-BROWN CLAYEY SILT (SILT)	
		0.6	1-2-1-1	13"	SAME AS 11-12' (SILT)	
16						
20						

F - FLUORESENCE DETECTED

F* - SMALL AMOUNT OF FLUORESENCE DETECTED.

PROPORTIONS USED: TRACE = 0-10%, LITTLE = 10-20%, SOME 20-35%, AND = 35-50%

APPENDIX D

Selection of Chemicals of Potential Concern

Source: Appendix D, Volume 2, "Additional Remedial Investigation and Feasibility Study (Phase IV)" for East Station, Dated August 31, 1998

APPENDIX D

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APPENDIX D
HUMAN HEALTH RISK ASSESSMENT

PART I SELECTION OF CHEMICALS OF POTENTIAL CONCERN

D.1 Introduction

The purpose of this Appendix is to provide the numerical basis for the selection of contaminants of potential concern and to show in quantitative detail how the hazards and risks posed by these compounds were estimated. Tables referenced in the text are found at the back of Part I, starting on Page D-6. All data tables and caluculations, HIF tables, and figures for Part II are located at the back of that section after the scenario calculations.

D.2 Selection of Chemicals of Potential Concern

As discussed in Section 8.2.1 of the main text, not all the chemicals analyzed for were considered of potential concern. A process was chosen to eliminate those of least significance. Undetected chemicals were eliminated from all media. The maximum concentrations of organic noncarcinogens were divided by the oral Reference Doses to provide concentration-toxicity scores; separately, the maximum concentrations of organic carcinogens were multiplied by their oral Cancer Potency Slopes to provide similar scores. Those compounds contributing less than 2% of a score were eliminated from further consideration. The maximum concentrations of noncarcinogenic inorganic contaminants were compared to the adjusted values of the USEPA's oral Risk-Based [screening] Concentrations (RBCs); contaminants lower than these concentrations were eliminated. All of the carcinogenic inorganic contaminants were included in the risk calculations. The remaining contaminants were evaluated under scenarios in which exposure to the particular contaminants was likely to occur.

D.2.1 Selection of Inorganics of Potential Concern

The source of information on Anacostia River fish contamination was the report by Versar, Inc. (Pinkney et al.,1993) concerning consequences of the oil spill of January 1992. The only inorganic elements analyzed were cadmium, mercury and lead. Versar evaluated only mercury, since this was the only one of the three elements with FDA action levels. There was no significant difference between the concentration of mercury in fish collected in the spill area and those from combined

reference areas. Therefore, it was decided to do no further human-health evaluation for inorganic elements in fish.

Solutes in Anacostia River water exceeding the USEPA Maximum Concentration Limits (MCLs), the Drinking Water Equivalent Level (DWEL) derived from RfD for manganese, the lifetime Health Advisory (zinc), or action level at the tap (lead) would have been evaluated for human health effects. However, no such inorganic solutes were found in exceedance of these levels.

For screening purposes, if the highest concentration of an inorganic contaminant was less than 1/10 the ingestion RBC for that contaminant (Smith, 1996), the contaminant was eliminated from further consideration for the data group of interest (see Tables D-1 and D-2). The elements calcium, magnesium, potassium and sodium have no associated RfDs, CPSs or RBCs -- doubtless because they are not considered toxic; they were dropped from further consideration. Lead also has no associated RfD, CPS or RBC, and is not subjected to the screening process -- because no agreement has been reached as to what the values should be; instead, as explained in the text of Chapter 8, an action level of 400 mg/kg has been adopted for soil.

The carcinogenic effects of arsenic, beryllium, cadmium and chromium are evaluated for all data groups in which they occur. Table D-9 provides information on RfD and CPS values of inorganics.

D.2.2 Selection of Organic Chemicals of Potential Concern

Only semi-volatiles, in particular polynuclear aromatic hydrocarbons (PAHs), were reported in fish samples analyzed by Versar, Inc. (Pinkney et al.,1993) in connection with the oil spill of January 1992. The seven identified carcinogenic PAHs were all selected for risk evaluation. The totality of PAHs (including the carcinogens), as reported by Versar, were evaluated with respect to the toxic hazard.

Since no organics (semivolatile or volatile) were detected in the Anacostia River water, no human-health evaluation is required for this river water.

The only soil-gas volatile organic constituents of concern were benzene, toluene, ethylbenzene, and xylenes (BTEX).

In the soil (surface and subsurface) and river sediment, the concentration-toxicity screen was used to define the noncarcinogenic organic chemicals (Tables D-3 through D-5) and the carcinogenic organic chemicals (Tables D-6, through D-8).

D.2.3 Concentration Toxicity Screen

After dropping undetected chemicals or those otherwise barred from consideration, the concentration-toxicity screen (USEPA 1989, 5-23 to 5-24) determines which of the chemicals remaining have the potential to contribute significantly to site risks. Those that contribute significantly are identified as chemicals of potential concern.

The following algorithm is used to calculate the concentration-toxicity score for a given compound in a given medium, with separate summaries for noncarcinogens and for carcinogens (organics only):

$R_i = C_i \times T_i$, and

$R = \Sigma R_i$ (total risk factor for the medium), where

R_i = risk factor for contaminant "i" in the medium,

C_i = maximum concentration of contaminant "i" found in the medium, and

T_i = toxicity value for contaminant "i" (1/oral reference dose) for a noncarcinogen and slope factor for a carcinogen.

In this document, R_i is equal to the Cancer Potency Slope (CPS) for each chemical treated as a carcinogen, and the inverse chronic Reference Dose (1/RfD) for each chemical that is treated as a noncarcinogen. For several of the chemicals, there is a difference between oral and inhalation CPS or RfD; in other cases only an oral or an inhalation value has been presented by the USEPA (Smith, R.L., 1996, EPA Region III Risk-Based Concentration Table, United States Environmental Protection Agency, Philadelphia, PA). Where possible, oral CPS (CPS_o) or RfD (RfD_o) values were used for fish, sediment, surface soil, and subsurface soil samples. It would have been preferable to use inhalation values (with subscript "i") of surface soil samples for the screening exercise, but such values were only available for three of the chemicals in this medium (as noncarcinogens). In the evaluation of carcinogens, inhalation CPS values were found for nine out of the ten contaminants evaluated. Oral values were used to fill in for missing inhalation values, and vice versa, except that cadmium was considered carcinogenic only by inhalation. In some instances there was no RfD value for a particular compound, and a surrogate value from a closely related chemical was assumed. The surrogates and their values are listed below.

1. Use the RfD_o, 0.04 mg/(kg·day), of naphthalene for 2-methylnaphthalene.

2. Use the RfD_o, 0.06 mg/(kg·day), of acenaphthene for acenaphthylene.

3. Use the RfD_o, 0.3 mg/(kg·day), of anthracene for phenanthrene.

4. Use the RfD_o, 0.03 mg/(kg·day), of pyrene for all other PAHs for which there is no other RfD_o.

5. Use the RfD_o [0.080 mg/(kg·day)] or the RfD_i [0.023 mg/(kg·day)] of methyl isobutyl ketone for 2-pentanone and 2-hexanone.

6. Use the RfD_o, 0.005 mg/(kg·day), of 2-chlorophenol for 4-chloro-3-methylphenol.

Those chemicals contributing less than 2 percent to one of the total risk factors (carcinogenic or noncarcinogenic) have been eliminated as chemicals of potential concern.

D.2.4 Chemicals of Potential Concern in Fish

As indicated earlier, only semivolatile organics are included in the human health evaluation. With no additional screening, all seven carcinogenic chemicals listed below were identified as chemicals of potential concern, as shown in Table D-2, Data Group 12.

Also, the PAHs were lumped together (Pinkney et al., 1993) for treatment as a single noncarcinogenic toxic entity.

D.2.5 Chemicals of Potential Concern in River Sediment

The results of the screening process for identifying chemicals of potential concern in river sediment are shown in Tables D-1 (Data Group 7), D-2 (Data Group 7), D-3 and D-6.

D.2.6 Chemicals of Potential Concern in Surface Soil

The results of the screening process for identifying chemicals of potential concern in surface soil are shown in Tables D-1 (Data Groups 3, 4, and 5), D-2 (Data Groups 3, 4, and 5), D-4, and D-7.

D.2.7 Chemicals of Potential Concern in Subsurface Soil (0 to 6 feet)

The results of the screening process for identifying chemicals of potential concern in subsurface soil borings are shown in Tables D-1 (Data Group 11), D-2 (Data Group 11), D-5 and D-8.

D.2.8 Chemicals of Potential Concern in Soil Gas

The volatile organic compounds listed below and in Table D-2 (Data Groups 8-10) were the only volatile chemicals detected and are all of potential concern.

1. Benzene[a]
2. Toluene
3. Ethylbenzene
4. Xylenes

Note: [a] Carcinogen

D.3 REFERENCES

1. Pinkney, A.E., W.H. Burton, L.C. Scott, and J.B. Frithsen, January 1993, An Assessment of Potential Residual Effects of the January 1992 Oil Spill in the Anacostia River, Versar Inc., ESM Operations, Columbia, MD.

2. U.S. EPA, December, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Office of Emergency and Remedial Response, Washington, DC.

3. Smith, R.L., 1996, EPA Region III Risk-Based Concentration Table, United States Environmental Protection Agency, Philadelphia, PA.

TABLE D-1
Screening of Soils for Noncarcinogenic Inorganics

Analytes	Maximum Concentrations of Noncarcinogenic Inorganic Analytes in Each Data Group							Screening Value 0.1 x RBC²
	Group 1 (mg/kg)	Group 2 (mg/kg)	Group 3 (mg/kg)	Group 4 (mg/kg)	Group 5 (mg/kg)	Group 7 (mg/kg)	Group 11 (mg/kg)	(mg/kg)
Aluminum	13,200	19,800	7,110	19,800	13,100	22,900	59,900	7,800
Antimony	1.4	6.8	0.44	0.73	1.4	0.77	71.1	3.1
Arsenic*	9.2	38.2	1.7	9.2	6.1	12.2	38.2	0.043
Barium	90	172	26.8	172	90	170	149	550
Beryllium*	1.4	1.4	0.12	1.4	0.74	1.6	1.3	0.015
Cadmium**	1.3	3.1	0.73	3.1	1.4	2.7	4.4	3.9
Chromium**	95.9	136	39.7	136	40.3	66	41.2	39
Cobalt	11.9	17.2	10.2	17.2	11.9	21.8	9.5	470
Copper	199	279	44.9	54.3	199	324	401	310
Iron	46,300	77,000	17,000	46,300	27,600	39,400	77,000	2,300
Lead	ND	ND	ND	ND	ND	502	1,160	400***
Manganese	423	469	203	469	423	678	481	180
Mercury	0.73	4.3	ND	4.3	0.73	0.87	1.1	2.3
Nickel	58.7	296	58.7	296	58.7	53	80.8	160
Selenium	ND	2.8	ND	ND	ND	ND	2.9	39
Silver	ND	ND	ND	ND	0.43	3.1	6.7	39
Thallium	ND	19.4	ND	ND	ND	ND	39.4	0.63
Vanadium	95.5	93.8	70	93.8	95.5	68.1	89.7	55
Zinc	348	326	51.4	326	348	400	717	2,300
Total Cyanides	29.0	252	2.6	29	9	48.8	252	160

Group 1: Surface Soil Samples SR-16 thru SR-22, SR-24 & SR-25 (SW Cnr of Site)
Group 2: Soil Boring Samples SB-2 thru SB-10 (0-2') and Surface Soil Samples SR-1 thru SR-20 & SR-23 (Bulldozer Scenarios)
Group 3: Surface Soil Sample SR-25
Group 4: Surface Soil Samples SR-1 thru SR-20, & SR-23 (SR North of Water St)
Group 5: Surface Soil Samples SR-21, SR-22, SR-24, SR-25, & SR-26 (SR South of Water St)
Group 7: Sediment Samples 96SD02 - 96SD05 & 96SD07
Group 11: Soil Boring Samples SB-1 through SB-13 (all three intervals)

* Ingestion Carcinogen, will be used in all risk calculations.
** Inhalation Carcinogen, will be used in risk calculations for particulate inhalation scenarios.
*** EPA Region III Screening Level (Revised Interim Soil Lead Guidance Memorandum, OSWER Directive #9355.4-12,1994)
² RBC: Region III Risk Based Concentrations (RBC) for resdiential soil ingestion (January 1997)

Shaded analytes indicate an exceedance of the screening value and require risk evaluation.

TABLE D-2
Chemicals of Potential Concern for Each Data Group

Chemicals of Potential Concern	Data Groups*											
	1	2	3	4	5	6	7	8	9	10	11	12
Inorganics												
Aluminum	X	X		X	X		X				X	
Antimony		X									X	
Arsenic	X	X	X	X	X		X				X	
Beryllium	X	X	X	X	X		X				X	
Cadmium											X	
Chromium	X	X	X	X	X		X				X	
Copper							X				X	
Iron	X	X	X	X	X		X				X	
Lead**							X				X	
Manganese	X	X	X	X	X		X				X	
Mercury		X		X								
Nickel		X		X								
Thallium		X									X	
Vanadium	X	X	X	X	X		X				X	
Total Cyanides		X									X	
Organics												
Total PAHs***	X	X	X	X	X		X				X	X
Acenaphthene							X					
Benzene						X		X	X	X		
Ethylbenzene						X		X	X	X		
Benzo[a]anthracene	X	X	X	X	X		X				X	X
Benzo[a]pyrene	X	X	X	X	X		X				X	X
Benzo[b]fluoranthene	X	X	X	X	X		X				X	X
Benzo[g,h,i]perylene	X	X	X	X	X		X				X	
Benzo[k]fluoranthene	X	X	X	X	X		X				X	X
Bis(2-ethylhexyl) Phthalate	X		X	X	X		X					
Chrysene	X	X	X	X	X		X				X	X
Dibenzo[a,h]anthracene	X	X	X	X	X		X				X	X
Dibenzofuran		X					X				X	
Fluoranthene	X	X	X	X	X		X				X	
Fluorene							X					
Indeno[1,2,3-cd]pyrene	X	X	X	X	X		X				X	X
2-Methylnaphthalene							X					
Naphthalene	X	X	X	X	X		X				X	
Pyrene	X	X	X	X	X		X				X	
Toluene						X		X	X	X		
Xylenes						X		X	X	X		

* Data Groups:

1. Surface Soil Samples Southwest Crnr. of Site (SR16 - SR22, SR24 & SR25)
2. Soil Borings & Surface Soil North of Water Street (SB2 - SB10, 0-2' in depth; SR1 - SR20 & SR23)
3. Surface Soil Sample SR-25
4. Surface Soil Samples North of Water Street (SR-1 through SR-20 and SR-23)
5. Surface Soil Samples South of Water Street (SR-21, SR-22, SR-24, SR-25 and SR-26)
6. Soil Gas Samples Southwest Crnr. of Site (SG20 - SG23, SG25 - SG34 & SG38 - SG42)
7. Sediment Samples Downstream of East Station (96SD02 - 96SD05 & 96SD07)
8. Soil Borings North of 900-North Grid Line (SB2 - SB8, 0-2' & 2-4' in depth)
9. Soil Gas Sample SG-12
10. All Soil Gas Samples (SG-1 through SG-45)
11. All Soil Borings (SB-1 through SB-13; all three intervals)
12. Fish Samples Collected by Versar (1993)

** Risk/Hazard was not evaluated for Lead because no RfD or CPS values are available.

*** Total PAH's are the sum of the chemicals listed in Section 8.1.1.2.

TABLE D-3
Noncarcinogenic Toxicity Screen of Organics in River Sediment

Analyte	Concentration (mg/kg)	RfD_o (mg/[kg·day])	Conc./RfD_o (day)	Percent of Total
Methylene chloride[a]	0.084	6.0e-02	1.4	<1
Acetone[a]	0.290	1.0e-01	2.9	<1
Butanone[a]	0.072	6.0e-01	0.12	<1
Benzene[a]	0.005	1.7e-03	2.9	<1
4-Methyl-2-pentanone	0.018	8.0e-02	0.23	<1
2-Hexanone[a]	0.0028	8.0e-02	0.04	<1
Ethylbenzene[a]	0.0092	1.0e-01	0.09	<1
o-Xylene[a]	0.014	2.0e+00	0.01	<1
Styrene[a]	0.0048	2.0e-01	0.02	<1
Toluene[a]	0.011	2.0e-01	0.06	<1
Naphthalene	6.9	4.0e-02	172.5	2.2
2-Methyl-naphthalene	18.0	4.0e-02	450	5.8
Acenaphthylene[a]	2.9	6.0e-02	48.3	<1
Acenaphthene	22.0	6.0e-02	367	4.7
Dibenzofuran	1.6	4.0e-03	400	5.1
Fluorene	14.0	4.0e-02	350	4.5
Phenanthrene[a]	42.0	3.0e-01	140	1.8
Anthracene[a]	4.7	3.0e-01	15.7	<1
Di-n-butyl Phthalate[a]	0.85	1.0e-01	8.5	<1
Fluoranthene	32.0	4.0e-02	800	10.3
Pyrene	36.0	3.0e-02	1,200	15.4
Benzo[a]anthracene	16.0	3.0e-02	533	6.8
Chrysene	16.0	3.0e-02	533	6.8
Bis(2-ethylhexyl)phthalate	7.2	2.0e-02	360	4.6
Benzo[b]fluoranthene	9.2	3.0e-02	307	3.9
Benzo[k-fluoranthene	9.5	3.0e-02	317	4.1
Benzo[a]pyrene	27.0	3.0e-02	900	11.6
Indeno[1,2,3-cd]-pyrene	6.3	3.0e-02	210	2.7
Dibenzo[a,h]-anthracene	6.9	3.0e-02	230	3.0
Benzo[g,h,i]-perylene	13.0	3.0e-02	433	5.6
		Conc./RfD_o Total =	7,783	

[a] <2% of total, hence eliminated from further consideration unless included because of carcinogenicity.

TABLE D.4
Noncarcinogenic Toxicity Screen of Organics in Surface Soil

Analyte	Concentration (mg/kg)	RfD_o (mg/[kg·day])	Conc./RfD_o (day)	Percent of Total
Methylene chloride[a]	0.060	8.57e-01[b]	0.07	<1
Acetone[a]	0.034	1.0e-01	0.34	<1
Butanone[a]	0.016	2.86e-01[b]	0.06	<1
Toluene[a]	0.011	1.14e-01[b]	0.06	<1
Benzoic Acid[a]	0.58	4.0	0.15	<1
Naphthalene	8.8	4.0e-02	220.0	3.5
2-Methyl-naphthalene	3.2	4.0e-02	80.0	1.3
Acenaphthylene[a]	4.1	6.0e-02	68.3	1.1
Acenaphthene	0.58	6.0e-02	9.7	<1
Dibenzofuran	0.49	4.0e-03	122.5	1.9
Fluorene	1.9	4.0e-02	47.5	<1
Phenanthrene[a]	11.0	3.0e-01	36.7	<1
Anthracene[a]	3.0	3.0e-01	10.0	<1
Di-n-butyl Phthalate[a]	0.62	1.0e-01	6.2	<1
Fluoranthene	15.0	4.0e-02	375.0	5.9
Pyrene	27.0	3.0e-02	900.0	14.1
Butyl Benzyl Phthalate[a]	0.82	2.0e-01	4.1	<1
Benzo[a]anthracene	11.0	3.0e-02	366.7	5.8
Chrysene	15.0	3.0e-02	500.0	7.8
Bis(2-ethylhexyl)phthalate	33.0	2.0e-02	1,650.0	25.9
Benzo[b]fluoranthene	12.0	3.0e-02	400.0	6.3
Benzo[k-fluoranthene	6.3	3.0e-02	210.0	3.3
Benzo[a]pyrene	12.0	3.0e-02	400.0	6.3
Indeno[1,2,3-cd]-pyrene	9.5	3.0e-02	316.7	5.0
Dibenzo[a,h]-anthracene[a,c]	3.4	3.0e-02	113.3	1.8
Benzo[g,h,i]-perylene	16.0	3.0e-02	533.3	8.4
		Conc./RfD_o Total =	6,371	

[a] <2% of total, hence eliminated from further consideration unless included because of carcinogenicity.

[b] RfD_i value.

[c] Retained by virtue of carcinogenicity.

TABLE D-5
Noncarcinogenic Toxicity Screen of Organics in Subsurface Soil

Analyte	Concentration (mg/kg)	RfD_o (mg/[kg·day])	Conc./RfD_o (day)	Percent of Total
Methylene chloride[b]	0.20	6.0e-02	3.3	< 1
Acetone[b]	10.0	1.0e-01	100.0	< 1
Carbon Disulfide[b]	1.1	1.0e-01	11.0	< 1
Butanone[b]	0.38	6.0e-01	0.6	< 1
Benzene[b]	1.0	1.71e-03	584.8	< 1
Toluene[b]	51.0	2.0e-01	255.0	< 1
Chlorobenzene[b]	0.094	1.0e-01	0.9	< 1
Ethylbenzene[b]	28.0	1.0e-01	280.0	< 1
m + p-Xylene[b]	260.0	2.0e+00	130.0	< 1
o-Xylene[a]	170.0	2.0e+00	85.0	< 1
Styrene[b]	7.9	2.0e-01	39.5	< 1
Tetrachloroethene[b]	0.022	1.0e-02	2.2	< 1
Naphthalene	1,900.0	4.0e-02	47,500.0	11.6
'4-Chloro-3-methylphenol[b]	12.0	5.0e-03	2,400.0	< 1
2-Methyl-naphthalene	710.0	4.0e-02	17,750.0	4.3
'2-Chloro-naphthalene[b]	17.0	8.0e-02	212.5	< 1
Acenaphthylene[b]	25.0	6.0e-02	416.6	< 1
Acenaphthene[b]	40.0	6.0e-02	666.7	< 1
Dibenzofuran	490.0	4.0e-03	122,500.0	29.9
Fluorene[b]	95.0	4.0e-02	2,375.0	< 1
Phenanthrene[b]	1,800.0	3.0e-01	6,000.0	1.5
Anthracene[b]	290.0	3.0e-01	966.7	< 1
Fluoranthene	1,900.0	4.0e-02	47,500.0	11.6
Pyrene	930.0	3.0e-02	31,000.0	7.6
Butyl Benzyl Phthalate[b]	450.0	2.0e-01	2,250.0	< 1
Benzo[a]anthracene	740.0	3.0e-02	24,666.7	6
Chrysene	740.0	3.0e-02	24,666.7	6
Bis(2-ethylhexyl)phthalate[b]	0.43	2.0e-02	21.5	< 1
Benzo[b]fluoranthene	570.0	3.0e-02	19,000.0	4.6
Benzo[k-fluoranthene	440.0	3.0e-02	14,666.7	3.6
Benzo[a]pyrene	410.0	3.0e-02	13,666.7	3.3
Indeno[1,2,3-cd]-pyrene	430.0	3.0e-02	14,333.3	3.5
Dibenzo[a,h]-anthracene[b,c]	200.0	3.0e-02	6,666.7	1.6
Benzo[g,h,i]-perylene	370.0	3.0e-02	12,333.3	3.0
		Conc./RfD Total =	413,051	

[a] 3,3'-Dichlorobenzidine was omitted for lack of an RfD.
[b] <2% of total, hence eliminated from further consideration unless included because of carcinogenicity.
[c] Retained by virtue of carcinogenicity.

TABLE D-6
Carcinogenic Toxicity Screen of Organics in River Sediment

Analyte	Concentration (mg/kg)	CPS_o (kg·day/mg)	CPS_o • Conc. (day)	Percent of Total
Methylene chloride[a]	0.084	7.5e-3	0.00063	< 1
Benzene[a]	0.005	2.9e-2	0.00015	< 1
Benzo[a]-anthracene	16.0	0.73	11.68	4.3
Chrysene[a,b]	16.0	7.3e-3	0.1168	< 1
Bis(2-ethylhexyl) Phthalate[a,b]	7.2	1.4e-2	0.1008	< 1
Benzo[b]-fluoranthene	9.2	0.73	6.719	2.5
Benzo[k]-fluoranthene[a,b]	9.5	7.3e-2	0.694	< 1
Benzo[a]pyrene	27.0	7.3	197.1	72.6
Indeno[1,2,3-cd]-pyrene[a,b]	6.3	0.73	4.60	1.7
Dibenzo[a,h]-anthracene	6.9	7.3	50.37	18.6
		CPS_o • Conc. Total =	271	

[a] < 2% of total, hence eliminated from further consideration unless included because of noncarcinogenic toxicity.

[b] Included because of noncarcinogenic toxicity.

TABLE D-7
Carcinogenic Screen for Organics in Surface Soil

Analyte	Concentration (mg/kg)	CPS_o (kg·day/mg)	CPS_o •Conc. (day)	Percent of Total
Methylene chloride[a]	0.06	1.64e-03	0.000098	< 1
Benzo[a]anthracene	11.0	0.61	6.71	5.9
Chrysene[a,b]	15.0	6.10e-03	0.09	< 1
Bis(2-ethylhexyl) Phthalate[a,b]	33.0	0.014	0.46	< 1
Benzo[b]-fluoranthene	12.0	0.61	7.32	6.4
Benzo[k]-fluoranthene[a,b]	6.3	0.061	0.38	< 1
Benzo[a]pyrene	12.0	6.1	73.2	63.8
Indeno[1,2,3-cd]-pyrene	9.5	0.61	5.8	5.1
Dibenzo[a,h]-anthracene	3.4	6.1	20.74	18.1
		CPS_o •Conc. Total =	114.7	

[a] < 2% of total, hence eliminated from further consideration unless included because of noncarcinogenic toxicity.

[b] Included because of noncarcinogenic toxicity.

[c] CPS_o is used in lieu of CPS_i.

TABLE D-8
Carcinogenic Toxicity Screen for Organics in Subsurface Soil

Analyte	Concentration (mg/kg)	CPS_o (kg·day/mg)	CPS_o •Conc. (day)	Percent of Total
Tetrachloroethene[a]	0.022	5.2e-02	0.001	< 1
Methylene chloride[a]	0.20	7.5e-03	0.002	< 1
Benzene[a]	1	2.9e-02	0.029	< 1
3,3-Dichloro-benzidene[a]	1.1	4.5e-01	0.495	< 1
Benzo[a]-anthracene	740	7.3e-01	540.2	9.4
Chrysene[a,b]	740	7.3e-03	5.402	< 1
Bis(2-ethylhexyl) Phthalate[a]	0.43	1.4e-02	0.006	< 1
Benzo[b]-fluoranthene	570	7.3e-01	416.1	7.2
Benzo[k]-fluoranthene[a,b]	440	7.3e-02	32.1	< 1
Benzo[a]pyrene	410	7.3	2,993.0	52
Indeno[1,2,3-cd]-pyrene	430	7.3e-01	313.9	5.4
Dibenzo[a,h]-anthracene	200	7.3	1,460.0	25.3
		CPS_o •Conc. Total =	5,761	

[a] < 2% of total, hence eliminated from further consideration unless included because of noncarcinogenic toxicity.

[b] Included because of noncarcinogenic toxicity.

APPENDIX E

Data Validation Report

DATA VALIDATION REPORT

ORGANIC AND INORGANIC ANALYSES

SOIL SAMPLES

National Park Service Risk Assessment Project

Laboratory ID Number: 01110

Sampling Date of October 24, 2001

PREPARED FOR:

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March 2002

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Appendices

DATA VALIDATION SUMMARY: ORGANIC AND INORGANIC ANALYSES SOIL SAMPLES

NPS Risk Assessment Project

Laboratory ID Number: 01110

Sampling Date of October 24, 2001

INTRODUCTION

This Data Validation Summary Report for Organic and Inorganic analyses was generated for 14 soil samples and the associated quality control samples for the Laboratory ID No. 01110. Sampling activities were conducted in support of the field investigation for the National Park Service (NPS) Risk Assessment Project. The analytical laboratory work was performed by Phase Separation Science, Inc. of Baltimore, Maryland. It should be noted that the analytical results were reported on an 'as received' basis and were not moisture corrected. However, percent solids were analyzed for the samples and were included in the data package and again in this data validation report.

Analytical testing was performed for selected Polynuclear Aromatic Hydrocarbon (PAH) compounds utilizing United States Environmental Protection Agency (USEPA) Method 8270 for Semi-Volatile Organic analyses by Gas Chromatography/Mass Spectroscopy (GC/MS). Inorganics were analyzed by Inductively Coupled Plasma (ICP) with Mercury by Cold Vapor and Cyanide by Spectrophotometry. The analytical work was performed utilizing **Test Methods for Evaluating Solid Waste, Physical / Chemical Methods (SW-846), Third Edition, Update III, December 1996, USEPA Office of Solid Waste and USEPA Methods for Determination of Metals in Environmental Samples – Supplement I-EPA/600/ R-94-111, May 1994.**

This report provides a summary of data acceptability and deviations in accordance with the **USEPA Contract Laboratory Program (CLP) National Functional Guidelines For Organic and Inorganic Data Review, February 1994**; and the appropriate USEPA methods, where applicable and relevant. The validation report pertains to the following samples:

Laboratory ID Number: 01110

TB-70
TB-71
TB-72
TB-73
TB-74
TB-75
TB-76
TB-77
TB-78
TB-79
TB-80
TB-81
DUP-1 (Field Duplicate of TB-78)
DUP-2 (Field Duplicate of TB-75)

1.0 SEMI-VOLATILE ORGANICS BY GC/MS (PAH Analyses)

The following items/criteria were reviewed, as method appropriate:

* Holding Times
* System Monitoring (Surrogate) Compound Recovery
* Matrix Spikes (MS) and Matrix Spike Duplicates (MSD)
* Initial and Continuing Calibration
* Blanks (Method and Field)
* GC/MS Instrument Performance Check
* Internal Standards
* Field Duplicates
* Compound Identification
* Compound Quantitation and Reported Detection Limits
* System Performance

All items above were generated within acceptable Quality Control (QC) specifications with deviations detailed as follows. All data reviewed is considered to be valid and usable with the appropriate qualifiers, as noted on the data summary forms in Appendix A and within the following text.

1.1 Holding Times

All holding times were met for extraction and analysis of the soil samples. Samples are required to be extracted within 14 days of collection and analyzed within 40 days of extraction.

1.2 System Monitoring (Surrogate) Compound Recovery

All system monitoring compound percent recovery (%R) was found to be generated within acceptable limits for the three surrogate compounds.

1.3 Matrix Spike/Matrix Spike Duplicates (MS/MSD)

One site-specific MS/MSD sample set was analyzed for the Lab ID No. noted. Acceptable accuracy (percent recovery) and precision (relative percent difference) were generated for the QC samples, with the following exception.

Pyrene generated high recovery for the MSD, only, at 183% (Limit 35-142). The project samples were not qualified in relation to the MS/MSD.

1.4 Calibration

All initial and continuing calibrations were performed within acceptable limits for the GC/MS analyses. Review items included average Relative Response Factors (avgRRF), Percent Relative Standard Deviation (% RSD), Relative Response Factors (RRF), and Percent Difference (% D).

1.5 Blanks

1.5.1 Field Blanks

Field blanks were not collected for the 14 soil samples analyzed for PAH's.

1.5.2 **Method Blanks**

Four method blanks were analyzed for PAH soils analyses for the Lab ID No. noted. Positive results were not detected in the method blanks.

1.6 **GC/MS Instrument Performance Check**

Instrument performance was generated within acceptable limits and frequency for Decafluorotriphenylphosphine (DFTPP).

1.7 **Internal Standards**

All internal standards were generated within acceptable specifications for area counts and retention time variation, with the following exceptions.

Sample TB-74 generated a low area count for perylene-d12 and sample TB-77 generated low area counts for chrysene-d12 and perylene-d12. These samples were qualified as 'J', estimated, for the positive results and 'UJ', estimated, for the non-detectable results for the compounds associated with the chrysene-d12 and perylene-d12 internal standards.

Samples TB-73 and TB-76 generated high area counts for chrysene-d12. These samples were qualified as 'J', estimated, for the positive results, only, for the compounds associated with the chrysene-d12 internal standard.

1.8 **Field Duplicates**

Samples DUP-1/TB-78 and DUP-2/TB-75 were collected as the field duplicate soil samples and analyzed for PAH's. In general, acceptable precision was generated for the duplicate samples, with the following exceptions.

Poor precision was generated for benzo(a)pyrene at 72% relative percent difference for samples DUP-2 and TB-75. Slightly elevated relative percent difference was generated for DUP-1 and TB-78 for acenaphthene, acenaphthylene, benzo(a)anthracene and benzo(k)fluoranthene. This relative percent difference ranged from 38% to 43% (Limit 35%).

1.9 **Compound Identification**

GC/MS qualitative analyses are considered to be acceptable for the data set. Retention times and mass spectra were generated within appropriate quality control specifications.

1.10 **Compound Quantitation and Reported Detection Limits**

GC/MS quantitative analyses are considered to be acceptable. Sample dilutions, internal standards, and response factors were found to be within acceptable limits.

1.11 **System Performance**

Acceptable system performance was maintained throughout the analyses of the soil samples. This was exhibited through good resolution and consistent chromatographic performance.

2.0 INORGANIC ANALYSES BY ICP
(Mercury by Cold Vapor and Cyanide by Spectrophotometry)

The following items/criteria were reviewed:

* Holding Times
* Initial and Continuing Calibration
* CRDL Standards for ICP
* Blanks (Initial, Continuing Calibration, and Preparation)
* Field Blanks
* ICP Interference Check Sample
* Matrix Spike Sample Recovery
* Laboratory Duplicates
* Field Duplicates
* Laboratory Control Sample (LCS)
* ICP Serial Dilution
* Sample Result Verification

All items above were generated within acceptable QC specifications, with deviations detailed as follows. All data reviewed is considered to be valid and usable with the appropriate qualifiers, as noted on the data summary forms in Appendix A and within the following text.

2.1 Holding Times

All holding times were met within the acceptable time frame from collection for total metals (180 days), mercury (28 days) and cyanide (14 days), with the following exceptions.

All 14 soil samples were analyzed 6-7 days beyond the acceptable holding time of 14 days from collection for cyanide. The samples were qualified as 'J', estimated, for the positive results and 'UJ', estimated, for the non-detectable results for cyanide.

2.2 Calibration

The initial and continuing calibrations were performed within acceptable limits for percent recovery (%R).

2.3 Contract Required Detection Limit (CRDL) Standards for ICP

CRDL standards were not included in the data package reviewed.

2.4 Blanks

2.4.1 Laboratory (Method) Blanks

All initial calibration, continuing calibration, and preparation blanks were generated in accordance with acceptable limits.

2.4.2 Field Blanks

Field blanks were not collected for the soil samples analyzed for inorganics.

2.5 ICP Interference Check

ICP Interference Check samples were not included in the data package reviewed.

2.6 **Matrix Spike Sample Recovery**

Acceptable matrix spike recovery was generated for the site-specific sample, with the exception of low recovery for zinc (29.1%) and high recovery for copper (146.2%), silver (160.1%) and barium (157.8%). The acceptable limit for spike recovery is 75-125%. The soil samples were qualified as 'J', estimated, for the positive results for copper, zinc and barium. Positive results were not detected for silver, therefore, qualification was not required for this inorganic.

In addition, the Lab Fortified Blank generated high spike recovery at 123% for nickel (Limit 80-120%). The positive results, only, for nickel were qualified as 'J', estimated, for the soil samples.

2.7 **Laboratory Duplicates**

A Lab Duplicate sample was included for mercury and cyanide, only. Acceptable precision was generated for these lab duplicate samples.

2.8 **Field Duplicates**

Samples DUP-1/TB-78 and DUP-2/TB-75 were collected as the field duplicate soil samples and analyzed for Inorganics. Poor precision was generated for cobalt at 83% relative percent difference for samples DUP-1 and TB-78. Slightly elevated relative percent difference was generated for DUP-1 and TB-78 for aluminum, magnesium and sodium. This relative percent difference ranged from 40% to 56% (Limit 35%). In addition, slightly elevated relative percent difference was generated for DUP-2 and TB-75 for aluminum, arsenic, barium and sodium. This relative percent difference also ranged from 40% to 56%.

2.9 **Laboratory Control Sample (LCS)**

The laboratory control samples were generated within the acceptable limit of 80-120% for recovery, with the following exception.

Antimony generated low recovery at 78.3% for the LCS. The soil samples were qualified as 'UJ', estimated, for the non-detectable results for antimony. Positive results were not detected for this inorganic.

2.10 **ICP Serial Dilution**

An ICP Serial Dilution sample was not included in the data package reviewed.

2.11 **Sample Result Verification**

Quantitative analyses are considered to be acceptable for the samples reviewed. Analyte quantitation was generated in accordance with protocols.

APPENDIX A

DATA SUMMARY FORMS

PAH's, Inorganics and Cyanide
Percent Moisture

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 1 of 28
Hydro-Terra Inc.
November 21, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-70		Result	Unit	Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Acenaphthylene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Anthracene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Benzo (a) anthracene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Benzo (a) pyrene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Benzo (b) fluoranthene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
.o (g,h,i) perylene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Benzo (k) fluoranthene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Chrysene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Dibenzo (a,h) anthracene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Fluoranthene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Fluorene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Indeno (1,2,3-cd) pyrene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
2-Methylnaphthalene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Naphthalene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Phenanthrene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Pyrene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Target Analyte List - Metals							
Aluminum		5200	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg UJ	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		9.3	mg/kg	EPA 200.8	0.5	10/25/01	11/01/01
Barium		110 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Calcium		9600	mg/kg	EPA 215.1	1.0	10/25/01	11/02/01
Chromium		20	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		3.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Copper		48 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Iron		7300	mg/kg	EPA 236.1	2.0	10/25/01	11/02/01
Lead		1100	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		2400	mg/kg	EPA 242.1	1.0	10/25/01	11/02/01
ıganese		960	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
. .,cury		0.8	mg/kg	EPA 200.8	0.2	10/25/01	11/01/01
Nickel		16 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		580	mg/kg	EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

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No. 01102419 Page 2 of 28
Hydro-Terra Inc.
November 21, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-70		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		850	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		50	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		64 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: Matt Ochee
Quality Assurance Chemist

Notes:
PQL - Practical Quantitation Limit
Results reported on an as received basis
e - estimated value, less than quantitation limit

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Hydro-Terra Inc.
November 21, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-71		Result	Unit	Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	<	1650	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Acenaphthylene	<	1650	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Anthracene	e	210	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Benzo (a) anthracene	e	620	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Benzo (a) pyrene	e	650	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Benzo (b) fluoranthene	e	320	ug/kg	EPA 8270	1650	10/26/01	11/10/01
zo (g,h,i) perylene	<	1650	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Benzo (k) fluoranthene	e	450	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Chrysene	e	730	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Dibenzo (a,h) anthracene	<	1650	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Fluoranthene	e	500	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Fluorene	<	1650	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Indeno (1,2,3-cd) pyrene	<	1650	ug/kg	EPA 8270	1650	10/26/01	11/10/01
2-Methylnaphthalene	<	1650	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Naphthalene	<	1650	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Phenanthrene	e	510	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Pyrene	e	830	ug/kg	EPA 8270	1650	10/26/01	11/10/01
Target Analyte List - Metals							
Aluminum		7200	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg UJ	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		2.7	mg/kg	EPA 200.8	0.5	10/25/01	11/01/01
Barium		32 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Calcium		5300	mg/kg	EPA 215.1	1.0	10/25/01	11/02/01
Chromium		9.4	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		6.8	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Copper		18 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Iron		9300	mg/kg	EPA 236.1	2.0	10/25/01	11/02/01
Lead		28	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		1600	mg/kg	EPA 242.1	1.0	10/25/01	11/02/01
nganese		180	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
rcury		0.1	mg/kg	EPA 200.8	0.1	10/25/01	11/01/01
Nickel		18 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		460	mg/kg	EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

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Hydro-Terra Inc.
November 21, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-71		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		940	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		20	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		37 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: Matt Collier
Quality Assurance Chemist

Notes:
PQL - Practical Quantitation Limit
Results reported on an as received basis
e - estimated value, less than quantitation limit

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Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-72		Result	Unit		Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons								
Acenaphthene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Acenaphthylene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Anthracene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Benzo (a) anthracene	e	200	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Benzo (a) pyrene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Benzo (b) fluoranthene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Benzo (g,h,i) perylene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Benzo (k) fluoranthene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Chrysene	e	210	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Dibenzo (a,h) anthracene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Fluoranthene	e	450	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Fluorene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Indeno (1,2,3-cd) pyrene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
2-Methylnaphthalene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Naphthalene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Phenanthrene	e	270	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Pyrene	e	430	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Target Analyte List - Metals								
Aluminum		3600	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg	UJ	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		2.9	mg/kg		EPA 200.8	0.5	10/25/01	11/01/01
Barium		28	J mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Calcium		1200	mg/kg		EPA 215.1	1.0	10/25/01	11/02/01
Chromium		9.2	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		3.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Copper		33	J mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Iron		9400	mg/kg		EPA 236.1	2.0	10/25/01	11/02/01
Lead		79	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		810	mg/kg		EPA 242.1	1.0	10/25/01	11/02/01
Manganese		120	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Mercury	<	0.1	mg/kg		EPA 200.8	0.1	10/25/01	11/01/01
Nickel		11	J mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Potassium		210	mg/kg		EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 6 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-72		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		77	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		13	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		64 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: Matt Cohen
Quality Assurance Chemist

Notes:
PQL - Practical Quantitation Limit
Results reported on an as received basis
e - estimated value, less than quantitation limit

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 7 of 28
Hydro-Terra Inc.
November 21, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-73		Result	Unit	Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Acenaphthylene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Anthracene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Benzo (a) anthracene	e	7600 J	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Benzo (a) pyrene	e	5500	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Benzo (b) fluoranthene	e	5200	ug/kg	EPA 8270	9900	10/26/01	11/10/01
o (g,h,i) perylene	e	2300	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Benzo (k) fluoranthene	e	8900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Chrysene	e	8800 J	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Dibenzo (a,h) anthracene	e	3900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Fluoranthene		14000	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Fluorene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Indeno (1,2,3-cd) pyrene	<	9900	ug/kg	EPA 8270	9900	10/26/01	11/10/01
2-Methylnaphthalene		45000	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Naphthalene		39000	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Phenanthrene		12000	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Pyrene		14000 J	ug/kg	EPA 8270	9900	10/26/01	11/10/01
Target Analyte List - Metals							
Aluminum		7200	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg UJ	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		2.1	mg/kg	EPA 200.8	0.5	10/25/01	11/01/01
Barium		78 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Calcium		240	mg/kg	EPA 215.1	1.0	10/25/01	11/02/01
Chromium		15	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		5.2	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Copper		50 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Iron		11000	mg/kg	EPA 236.1	2.0	10/25/01	11/02/01
Lead		200	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		1900	mg/kg	EPA 242.1	1.0	10/25/01	11/02/01
Manganese		400	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
cury		0.9	mg/kg	EPA 200.8	0.1	10/25/01	11/01/01
Nickel		15 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		650	mg/kg	EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

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Hydro-Terra Inc.
November 21, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-73		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		230	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		14	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		200 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: Matt Cohen
Quality Assurance Chemist

Notes:
PQL - Practical Quantitation Limit
Results reported on an as received basis
e - estimated value, less than quantitation limit

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Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-74		Result	Unit		Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons								
Acenaphthene	<	4950	ug/kg		EPA 8270	4950	10/26/01	10/26/01
Acenaphthylene	<	4950	ug/kg		EPA 8270	4950	10/26/01	10/26/01
Anthracene	<	4950	ug/kg		EPA 8270	4950	10/26/01	10/26/01
Benzo (a) anthracene	e	940	ug/kg		EPA 8270	4950	10/26/01	10/26/01
Benzo (a) pyrene	<	4950	ug/kg	UJ	EPA 8270	4950	10/26/01	10/26/01
Benzo (b) fluoranthene	e	1200	J ug/kg		EPA 8270	4950	10/26/01	10/26/01
zo (g,h,i) perylene	<	4950	ug/kg	UJ	EPA 8270	4950	10/26/01	10/26/01
Benzo (k) fluoranthene	e	1100	J ug/kg		EPA 8270	4950	10/26/01	10/26/01
Chrysene	e	1400	ug/kg		EPA 8270	4950	10/26/01	10/26/01
Dibenzo (a,h) anthracene	<	4950	ug/kg	UJ	EPA 8270	4950	10/26/01	10/26/01
Fluoranthene	e	1500	ug/kg		EPA 8270	4950	10/26/01	10/26/01
Fluorene	<	4950	ug/kg		EPA 8270	4950	10/26/01	10/26/01
Indeno (1,2,3-cd) pyrene	<	4950	ug/kg	UJ	EPA 8270	4950	10/26/01	10/26/01
2-Methylnaphthalene	<	4950	ug/kg		EPA 8270	4950	10/26/01	10/26/01
Naphthalene	<	4950	ug/kg		EPA 8270	4950	10/26/01	10/26/01
Phenanthrene	e	1200	ug/kg		EPA 8270	4950	10/26/01	10/26/01
Pyrene	e	2300	ug/kg		EPA 8270	4950	10/26/01	10/26/01
Target Analyte List - Metals								
Aluminum		2600	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg	UJ	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		12	mg/kg		EPA 200.8	0.5	10/25/01	11/01/01
Barium		130	J mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Calcium		210	mg/kg		EPA 215.1	1.0	10/25/01	11/02/01
Chromium		36	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		4.0	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Copper		58	J mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Iron		30000	mg/kg		EPA 236.1	2.0	10/25/01	11/02/01
Lead		750	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		350	mg/kg		EPA 242.1	1.0	10/25/01	11/02/01
nganese		150	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
ercury		0.4	mg/kg		EPA 200.8	0.1	10/25/01	11/01/01
Nickel		31	J mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Potassium		590	mg/kg		EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01

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Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-74		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		160	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		21	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		670	J mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: Matt Colvin
Quality Assurance Chemist

Notes:
PQL - Practical Quantitation Limit
Results reported on an as received basis
e - estimated value, less than quantitation limit

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Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-75		Result	Unit		Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons								
Acenaphthene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Acenaphthylene	e	640	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Anthracene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Benzo (a) anthracene	e	980	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Benzo (a) pyrene		1900	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Benzo (b) fluoranthene	e	1600	ug/kg		EPA 8270	1650	10/26/01	10/26/01
:o (g,h,i) perylene		1800	ug/kg		EPA 8270	1650	10/26/01	10/26/01
benzo (k) fluoranthene		1900	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Chrysene	e	1400	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Dibenzo (a,h) anthracene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Fluoranthene		1800	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Fluorene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Indeno (1,2,3-cd) pyrene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
2-Methylnaphthalene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Naphthalene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Phenanthrene	e	400	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Pyrene		3900	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Target Analyte List - Metals								
Aluminum		2500	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg	UJ	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		3.4	mg/kg		EPA 200.8	0.5	10/25/01	11/01/01
Barium		420	mg/kg	J	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Calcium		6	mg/kg		EPA 215.1	1.0	10/25/01	11/02/01
Chromium		7.3	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		2.3	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Copper		190	mg/kg	J	EPA 200.8	2.5	10/25/01	11/01/01
Iron		7100	mg/kg		EPA 236.1	2.0	10/25/01	11/02/01
Lead		40	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		370	mg/kg		EPA 242.1	1.0	10/25/01	11/02/01
·nganese		44	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
:cury		0.2	mg/kg		EPA 200.8	0.1	10/25/01	11/01/01
Nickel		8.8	mg/kg	J	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		130	mg/kg		EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01

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Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-75		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		62	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		9.6	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		89 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: Matt Colvin
Quality Assurance Chemist

Notes:
PQL - Practical Quantitation Limit
Results reported on an as received basis

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Hydro-Terra Inc.
November 21, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-76		Result	Unit	Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	<	3300	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Acenaphthylene	e	390	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Anthracene	<	3300	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Benzo (a) anthracene	e	1100 J	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Benzo (a) pyrene	e	530	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Benzo (b) fluoranthene	e	590	ug/kg	EPA 8270	3300	10/26/01	11/10/01
:o (g,h,i) perylene	<	3300	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Benzo (k) fluoranthene	e	770	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Chrysene	e	1400 J	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Dibenzo (a,h) anthracene	<	3300	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Fluoranthene	e	1800	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Fluorene	<	3300	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Indeno (1,2,3-cd) pyrene	<	3300	ug/kg	EPA 8270	3300	10/26/01	11/10/01
2-Methylnaphthalene	<	3300	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Naphthalene	<	3300	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Phenanthrene	e	1700	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Pyrene	e	2400 J	ug/kg	EPA 8270	3300	10/26/01	11/10/01
Target Analyte List - Metals							
Aluminum		4200	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg UJ	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		17	mg/kg	EPA 200.8	0.5	10/25/01	11/01/01
Barium		68 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Calcium		69	mg/kg	EPA 215.1	1.0	10/25/01	11/02/01
Chromium		33	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		14	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Copper		270 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Iron		65000	mg/kg	EPA 236.1	2.0	10/25/01	11/02/01
Lead		1300	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		380	mg/kg	EPA 242.1	1.0	10/25/01	11/02/01
·nganese		450	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
rcury		0.2	mg/kg	EPA 200.8	0.1	10/25/01	11/01/01
Nickel		28 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		220	mg/kg	EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

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Hydro-Terra Inc.
November 21, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-76		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		78	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		33	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		370 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: Matt Collier
Quality Assurance Chemist

Notes:
PQL - Practical Quantitation Limit
Results reported on an as received basis
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Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-77		Result	Unit	Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Acenaphthylene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Anthracene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Benzo (a) anthracene	<	1650	ug/kg UJ	EPA 8270	1650	10/26/01	10/26/01
Benzo (a) pyrene	<	1650	ug/kg UJ	EPA 8270	1650	10/26/01	10/26/01
Benzo (b) fluoranthene	<	1650	ug/kg UJ	EPA 8270	1650	10/26/01	10/26/01
zo (g,h,i) perylene	<	1650	ug/kg UJ	EPA 8270	1650	10/26/01	10/26/01
Benzo (k) fluoranthene	<	1650	ug/kg UJ	EPA 8270	1650	10/26/01	10/26/01
Chrysene	<	1650	ug/kg UJ	EPA 8270	1650	10/26/01	10/26/01
Dibenzo (a,h) anthracene	<	1650	ug/kg UJ	EPA 8270	1650	10/26/01	10/26/01
Fluoranthene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Fluorene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Indeno (1,2,3-cd) pyrene	<	1650	ug/kg UJ	EPA 8270	1650	10/26/01	10/26/01
2-Methylnaphthalene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Naphthalene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Phenanthrene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Pyrene	e	450 J	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Target Analyte List - Metals							
Aluminum		3300	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg UJ	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		16	mg/kg	EPA 200.8	0.5	10/25/01	11/01/01
Barium		61 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Calcium		12000	mg/kg	EPA 215.1	1.0	10/25/01	11/02/01
Chromium		41	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		4.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Copper		120 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Iron		38000	mg/kg	EPA 236.1	2.0	10/25/01	11/02/01
Lead		50	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		3400	mg/kg	EPA 242.1	1.0	10/25/01	11/02/01
anganese		380	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
ercury		0.4	mg/kg	EPA 200.8	0.1	10/25/01	11/01/01
Nickel		38 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		580	mg/kg	EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

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Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-77		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		1000	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		50	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		55 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: Matt Colvin
Quality Assurance Chemist

Notes:
PQL - Practical Quantitation Limit
Results reported on an as received basis
e - estimated value, less than quantitation limit

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 17 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-78		Result	Unit	Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons							
Acenaphthene		3300	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Acenaphthylene	e	1300	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Anthracene		2700	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Benzo (a) anthracene		3100	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Benzo (a) pyrene		2700	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Benzo (b) fluoranthene		1900	ug/kg	EPA 8270	1650	10/26/01	10/26/01
o (g,h,l) perylene	e	1100	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Benzo (k) fluoranthene		2100	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Chrysene		3600	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Dibenzo (a,h) anthracene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Fluoranthene		4700	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Fluorene		2800	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Indeno (1,2,3-cd) pyrene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
2-Methylnaphthalene		4000	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Naphthalene	<	1650	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Phenanthrene		5400	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Pyrene		8800	ug/kg	EPA 8270	1650	10/26/01	10/26/01
Target Analyte List - Metals							
Aluminum		2700	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg UJ	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		13	mg/kg	EPA 200.8	0.5	10/25/01	11/01/01
Barium		56 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Calcium		180	mg/kg	EPA 215.1	1.0	10/25/01	11/02/01
Chromium		19	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		5.4	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Copper		110 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Iron		21000	mg/kg	EPA 236.1	2.0	10/25/01	11/02/01
Lead		450	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		690	mg/kg	EPA 242.1	1.0	10/25/01	11/02/01
nganese		180	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
rcury		0.2	mg/kg	EPA 200.8	0.1	10/25/01	11/01/01
Nickel		16 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		440	mg/kg	EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 18 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-78		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		930	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		14	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		130 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: _____
Quality Assurance Chemist

Notes:
PQL - Practical Quantitation Limit
Results reported on an as received basis
e - estimated value, less than quantitation limit

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CERTIFICATE OF ANALYSIS
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Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-79		Result	Unit		Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons								
Acenaphthene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Acenaphthylene	e	210	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Anthracene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Benzo (a) anthracene	e	320	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Benzo (a) pyrene	e	330	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Benzo (b) fluoranthene	e	330	ug/kg		EPA 8270	1650	10/26/01	10/26/01
zo (g,h,i) perylene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
nzo (k) fluoranthene	e	310	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Chrysene	e	400	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Dibenzo (a,h) anthracene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Fluoranthene	e	440	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Fluorene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Indeno (1,2,3-cd) pyrene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
2-Methylnaphthalene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Naphthalene	<	1650	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Phenanthrene	e	240	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Pyrene	e	680	ug/kg		EPA 8270	1650	10/26/01	10/26/01
Target Analyte List - Metals								
Aluminum		2800	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg	UJ	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		2.9	mg/kg		EPA 200.8	0.5	10/25/01	11/01/01
Barium		42	mg/kg	J	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Calcium		6200	mg/kg		EPA 215.1	1.0	10/25/01	11/02/01
Chromium		12	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Copper		19	mg/kg	J	EPA 200.8	2.5	10/25/01	11/01/01
Iron		7800	mg/kg		EPA 236.1	2.0	10/25/01	11/02/01
Lead		43	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		2900	mg/kg		EPA 242.1	1.0	10/25/01	11/02/01
nganese		93	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
rcury	<	0.1	mg/kg		EPA 200.8	0.1	10/25/01	11/01/01
Nickel		8.6	mg/kg	J	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		170	mg/kg		EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 20 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-79		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		78	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		12	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		24 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: Matt Colvin
Quality Assurance Chemist

Notes:
PQL - Practical Quantitation Limit
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CERTIFICATE OF ANALYSIS
No. 01102419 Page 21 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-80		Result	Unit		Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons								
Acenaphthene	<	3300	ug/kg		EPA 8270	3300	10/29/01	10/29/01
Acenaphthylene	e	770	ug/kg		EPA 8270	3300	10/29/01	10/29/01
Anthracene	<	3300	ug/kg		EPA 8270	3300	10/29/01	10/29/01
Benzo (a) anthracene	e	920	ug/kg		EPA 8270	3300	10/29/01	10/29/01
Benzo (a) pyrene	e	1300	ug/kg		EPA 8270	3300	10/29/01	10/29/01
Benzo (b) fluoranthene	e	1100	ug/kg		EPA 8270	3300	10/29/01	10/29/01
zo (g,h,i) perylene	e	1300	ug/kg		EPA 8270	3300	10/29/01	10/29/01
nzo (k) fluoranthene	e	1300	ug/kg		EPA 8270	3300	10/29/01	10/29/01
Chrysene	e	1100	ug/kg		EPA 8270	3300	10/29/01	10/29/01
Dibenzo (a,h) anthracene	<	3300	ug/kg		EPA 8270	3300	10/29/01	10/29/01
Fluoranthene	e	1700	ug/kg		EPA 8270	3300	10/29/01	10/29/01
Fluorene	<	3300	ug/kg		EPA 8270	3300	10/29/01	10/29/01
Indeno (1,2,3-cd) pyrene	<	3300	ug/kg		EPA 8270	3300	10/29/01	10/29/01
2-Methylnaphthalene	<	3300	ug/kg		EPA 8270	3300	10/29/01	10/29/01
Naphthalene	<	3300	ug/kg		EPA 8270	3300	10/29/01	10/29/01
Phenanthrene	e	610	ug/kg		EPA 8270	3300	10/29/01	10/29/01
Pyrene		3300	ug/kg		EPA 8270	3300	10/29/01	10/29/01
Target Analyte List - Metals								
Aluminum		2900	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg	UJ	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		5.3	mg/kg		EPA 200.8	0.5	10/25/01	11/01/01
Barium		36	mg/kg	J	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Calcium		16000	mg/kg		EPA 215.1	1.0	10/25/01	11/02/01
Chromium		12	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		3.7	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Copper		34	mg/kg	J	EPA 200.8	2.5	10/25/01	11/01/01
Iron		11000	mg/kg		EPA 236.1	2.0	10/25/01	11/02/01
Lead		100	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		9200	mg/kg		EPA 242.1	1.0	10/25/01	11/02/01
anganese		120	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
rcury		0.2	mg/kg		EPA 200.8	0.1	10/25/01	11/01/01
Nickel		19	mg/kg	J	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		210	mg/kg		EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 22 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-80		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		100	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		16	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		65 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: _____
Quality Assurance Chemist

Notes:
PQL - Practical Quantitation Limit
Results reported on an as received basis
e - estimated value, less than quantitation limit

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 23 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-81		Result	Unit	Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	<	1650	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Acenaphthylene	<	1650	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Anthracene	<	1650	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Benzo (a) anthracene	e	690	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Benzo (a) pyrene	e	650	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Benzo (b) fluoranthene	e	610	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Benzo (g,h,i) perylene	e	360	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Benzo (k) fluoranthene	e	700	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Chrysene	e	820	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Dibenzo (a,h) anthracene	<	1650	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Fluoranthene	e	1000	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Fluorene	e	530	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Indeno (1,2,3-cd) pyrene	<	1650	ug/kg	EPA 8270	1650	10/29/01	10/29/01
2-Methylnaphthalene	<	1650	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Naphthalene	<	1650	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Phenanthrene	<	1650	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Pyrene	e	1800	ug/kg	EPA 8270	1650	10/29/01	10/29/01
Target Analyte List - Metals							
Aluminum		200	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg UJ	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		12	mg/kg	EPA 200.8	0.5	10/25/01	11/01/01
Barium		210 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Calcium		36	mg/kg	EPA 215.1	1.0	10/25/01	11/02/01
Chromium		17	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		4.8	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Copper		60 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Iron		16000	mg/kg	EPA 236.1	2.0	10/25/01	11/02/01
Lead		1600	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		1200	mg/kg	EPA 242.1	1.0	10/25/01	11/02/01
Manganese		82	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Mercury		0.3	mg/kg	EPA 200.8	0.1	10/25/01	11/01/01
Nickel		24 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		120	mg/kg	EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

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ANALYTICAL CHEMISTRY • ENVIRONMENTAL SCIENCE

CERTIFICATE OF ANALYSIS
No. 01102419 Page 24 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: TB-81	Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals						
Sodium	84	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	2.8	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium	34	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc	79 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: Matt Cohee
Quality Assurance Chemist

Notes:
PQL - Practical Quantitation Limit
Results reported on an as received basis
e - estimated value, less than quantitation limit

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ANALYTICAL CHEMISTRY • ENVIRONMENTAL SCIENCE

CERTIFICATE OF ANALYSIS
No. 01102419 Page 25 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: Dup-1		Result	Unit	Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	e	5000	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Acenaphthylene	e	1900	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Anthracene	e	3600	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Benzo (a) anthracene	e	4800	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Benzo (a) pyrene	e	3700	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Benzo (b) fluoranthene	e	2600	ug/kg	EPA 8270	6600	10/29/01	10/29/01
zo (g,h,i) perylene	<	6600	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Benzo (k) fluoranthene	e	3100	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Chrysene	e	5000	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Dibenzo (a,h) anthracene	<	6600	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Fluoranthene		6700	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Fluorene	e	4000	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Indeno (1,2,3-cd) pyrene	<	6600	ug/kg	EPA 8270	6600	10/29/01	10/29/01
2-Methylnaphthalene	e	5200	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Naphthalene	<	6600	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Phenanthrene		7500	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Pyrene		12000	ug/kg	EPA 8270	6600	10/29/01	10/29/01
Target Analyte List - Metals							
Aluminum		4800	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg UJ	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		11	mg/kg	EPA 200.8	0.5	10/25/01	11/01/01
Barium		54 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Calcium		140	mg/kg	EPA 215.1	1.0	10/25/01	11/02/01
Chromium		18	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		13	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Copper		89 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Iron		18000	mg/kg	EPA 236.1	2.0	10/25/01	11/02/01
Lead		520	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		1200	mg/kg	EPA 242.1	1.0	10/25/01	11/02/01
anganese		190	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
rcury		0.2	mg/kg	EPA 200.8	0.1	10/25/01	11/01/01
Nickel		18 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		580	mg/kg	EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 26 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: Dup-1		Result	Unit	Method	PQL	Prepared	Analyzed
Target Analyte List - Metals							
Sodium		1400	mg/kg	EPA 273.1	1.0	10/25/01	11/02/01
Thallium	<	2.0	mg/kg	EPA 200.8	2.0	10/25/01	11/01/01
Vanadium		18	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01
Zinc		140 J	mg/kg	EPA 200.8	2.5	10/25/01	11/01/01

Reviewed By: Matt Cohen
Quality Assurance Chemist

Notes:
PQL - Practical Quantitation Limit
Results reported on an as received basis
e - estimated value, less than quantitation limit

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 27 of 28
Hydro-Terra Inc.
November 5, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

Sample ID: Dup-2		Result	Unit		Method	PQL	Prepared	Analyzed
Polynuclear Aromatic Hydrocarbons								
Acenaphthene	<	1650	ug/kg		EPA 8270	1650	10/29/01	10/29/01
Acenaphthylene	e	900	ug/kg		EPA 8270	1650	10/29/01	10/29/01
Anthracene	e	230	ug/kg		EPA 8270	1650	10/29/01	10/29/01
Benzo (a) anthracene	e	1300	ug/kg		EPA 8270	1650	10/29/01	10/29/01
Benzo (a) pyrene	e	890	ug/kg		EPA 8270	1650	10/29/01	10/29/01
Benzo (b) fluoranthene		2000	ug/kg		EPA 8270	1650	10/29/01	10/29/01
zo (g,h,i) perylene		2200	ug/kg		EPA 8270	1650	10/29/01	10/29/01
Benzo (k) fluoranthene		1900	ug/kg		EPA 8270	1650	10/29/01	10/29/01
Chrysene		1700	ug/kg		EPA 8270	1650	10/29/01	10/29/01
Dibenzo (a,h) anthracene	<	1650	ug/kg		EPA 8270	1650	10/29/01	10/29/01
Fluoranthene		2600	ug/kg		EPA 8270	1650	10/29/01	10/29/01
Fluorene	<	1650	ug/kg		EPA 8270	1650	10/29/01	10/29/01
Indeno (1,2,3-cd) pyrene	<	1650	ug/kg		EPA 8270	1650	10/29/01	10/29/01
2-Methylnaphthalene	<	1650	ug/kg		EPA 8270	1650	10/29/01	10/29/01
Naphthalene	<	1650	ug/kg		EPA 8270	1650	10/29/01	10/29/01
Phenanthrene	e	500	ug/kg		EPA 8270	1650	10/29/01	10/29/01
Pyrene		5300	ug/kg		EPA 8270	1650	10/29/01	10/29/01
Target Analyte List - Metals								
Aluminum		1600	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Antimony	<	2.5	mg/kg	UJ	EPA 200.8	2.5	10/25/01	11/01/01
Arsenic		5.4	mg/kg		EPA 200.8	0.5	10/25/01	11/01/01
Barium		280	mg/kg	J	EPA 200.8	2.5	10/25/01	11/01/01
Beryllium	<	2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Cadmium	<	2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Calcium		8	mg/kg		EPA 215.1	1.0	10/25/01	11/02/01
Chromium		6.8	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Cobalt		2.2	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Copper		200	mg/kg	J	EPA 200.8	2.5	10/25/01	11/01/01
Iron		7300	mg/kg		EPA 236.1	2.0	10/25/01	11/02/01
Lead		39	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Magnesium		510	mg/kg		EPA 242.1	1.0	10/25/01	11/02/01
anganese		31	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
rcury	<	0.1	mg/kg		EPA 200.8	0.1	10/25/01	11/01/01
Nickel		10	mg/kg	J	EPA 200.8	2.5	10/25/01	11/01/01
Potassium		160	mg/kg		EPA 258.1	1.0	10/25/01	11/02/01
Selenium	<	2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01
Silver	<	2.5	mg/kg		EPA 200.8	2.5	10/25/01	11/01/01

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 1 of 2
Hydro-Terra Inc.
November 16, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

	Result	Unit	Method	PQL	Date Analyzed
Sample ID: TB-70					
Total Cyanide					
Cyanide	< 5	mg/kg UJ	EPA 9010B	5	11/13/01
Sample ID: TB-71					
Total Cyanide					
Cyanide	< 5	mg/kg UJ	EPA 9010B	5	11/13/01
Sample ID: TB-72					
Total Cyanide					
Cyanide	< 5	mg/kg UJ	EPA 9010B	5	11/13/01
Sample ID: TB-73					
Total Cyanide					
Cyanide	21 J	mg/kg	EPA 9010B	5	11/13/01
Sample ID: TB-74					
Total Cyanide					
Cyanide	26 J	mg/kg	EPA 9010B	5	11/13/01
Sample ID: TB-75					
Total Cyanide					
Cyanide	< 5	mg/kg UJ	EPA 9010B	5	11/13/01
Sample ID: TB-76					
Total Cyanide					
Cyanide	< 5	mg/kg UJ	EPA 9010B	5	11/13/01
Sample ID: TB-77					
Total Cyanide					
Cyanide	< 5	mg/kg UJ	EPA 9010B	5	11/13/01

Notes/Comments:
PQL - Practical Quantitation Limit
Results reported on an as received basis.

Reviewed by: Matt Cohn
Quality Assurance Chemist

AR 05271

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 2 of 2
Hydro-Terra Inc.
November 16, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

	Result		Unit	Method	PQL	Date Analyzed
Sample ID: TB-78						
Total Cyanide						
Cyanide	<	5	mg/kg UJ	EPA 9010B	5	11/14/01
Sample ID: TB-79						
Total Cyanide						
Cyanide	<	5	mg/kg UJ	EPA 9010B	5	11/14/01
Sample ID: TB-80						
Total Cyanide						
Cyanide	<	5	mg/kg UJ	EPA 9010B	5	11/14/01
Sample ID: TB-81						
Total Cyanide						
Cyanide	<	5	mg/kg UJ	EPA 9010B	5	11/14/01
Sample ID: Dup-1						
Total Cyanide						
Cyanide	<	5	mg/kg UJ	EPA 9010B	5	11/14/01
Sample ID: Dup-2						
Total Cyanide						
Cyanide	<	5	mg/kg UJ	EPA 9010B	5	11/14/01

Notes/Comments:
PQL - Practical Quantitation Limit
Results reported on an as received basis

Reviewed by: Matt Cohn
Quality Assurance Chemist

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 1 of 2
Hydro-Terra Inc.
December 4, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil

Date Sampled: 10/24/01
Date Received: 10/24/01

	Result	Unit	Method	Date Analyzed
Sample ID: TB-70				
Percent Solids	88	%	Gravimetry	10/29/0
Sample ID: TB-71				
Percent Solids	88	%	Gravimetry	10/29/0
Sample ID: TB-72				
Percent Solids	85	%	Gravimetry	10/29/0
Sample ID: TB-73				
Percent Solids	74	%	Gravimetry	10/29/0
Sample ID: TB-74				
Percent Solids	91	%	Gravimetry	10/29/0
Sample ID: TB-75				
Percent Solids	92	%	Gravimetry	10/29/0
Sample ID: TB-76				
Percent Solids	88	%	Gravimetry	10/29/0
Sample ID: TB-77				
Percent Solids	84	%	Gravimetry	10/29/0
Sample ID: TB-78				
Percent Solids	76	%	Gravimetry	10/29/0
Sample ID: TB-79				
Percent Solids	91	%	Gravimetry	10/29/0

Notes:
PQL - Practical Quantitation Limit

Reviewed by: Matt Colee
Quality Assurance Chemist

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CERTIFICATE OF ANALYSIS
No. 01102419 Page 2 of 2
Hydro-Terra Inc.
December 4, 2001

Project: NPS Risk Assessment
Site Location: East Station / D.C.
Project Number: 01110
Matrix: Soil
Date Sampled: 10/24/01
Date Received: 10/24/01

	Result	Unit	Method	Date Analyzed
Sample ID: TB-80				
Percent Solids	90	%	Gravimetry	10/29/0
Sample ID: TB-81				
Percent Solids	79	%	Gravimetry	10/29/0
Sample ID: Dup-1				
Percent Solids	78	%	Gravimetry	10/29/0
Sample ID: Dup-2				
Percent Solids	91	%	Gravimetry	10/29/0

Notes:
PQL - Practical Quantitation Limit

Reviewed by: _____
Quality Assurance Chemist

APPENDIX B

DATA QUALIFIERS

ORGANIC DATA QUALIFIERS

U - Indicates that the compound was analyzed for, but not detected at or above the Contract Required Quantitation Limit (CRQL), or the compound is not detected due to qualification through the method or field blank.

J - The associated numerical value is an estimated quantity.

JN - Tentatively identified with approximated concentrations (Volatile and Semi-Volatile Organics). Presumptively present at an approximated quantity (Pesticides/PCBs).

UJ - The compound was analyzed for, but not detected. The sample quantitation limit is an estimated quantity due to variance from quality control limits.

C - Applies to Pesticide results where the identification has been confirmed by GC/MS.

E - Reported value is estimated due to quantitation above the calibration range.

D - Reported result taken from diluted sample analysis.

A - Aldol condensation product.

R - Reported value is unusable and rejected due to variance from quality control limits.

NA - Not Analyzed.

INORGANIC DATA QUALIFIERS

U - Indicates analyte not detected at or above the Contract Required Detection Limit (CRDL), or the compound is not detected due to qualification through the method or field blank.

B - Indicates analyte result is between Instrument Detection Limit (IDL) and CRDL.

J - The reported value is estimated due to variance from quality control limits.

UJ - The element was analyzed for, but not detected. The sample quantitation limit is an estimate due to variance from quality control limits.

E - Reported value is estimated because of the presence of interference.

R - Reported value is unusable and rejected due to variance from quality control limits.

NA - Not analyzed.

APPENDIX C

CASE NARRATIVES

PHASE SEPARATION SCIENCE, INC.

Analytical Chemistry Environmental Science

Case Narrative

Client: Hydro-Terra Inc.
Project: NPS Risk Assessment
Project #: 01110

The following Result Qualifier has been referenced for this project data:
e = estimated value, below reporting limit

Reviewed by: _____ Date: 30 Nov 01
Quality Assurance Officer

APPENDIX D

CHAIN-OF-CUSTODY FORMS

SAMPLE CHAIN OF CUSTODY/AGREEMENT FORM

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(1)

CLIENT: HYDRO-TERRA PHONE NO: (410) 995 1224

PROJECT MGR: TOM MILLS FAX NO: (410) 730 1785

PROJECT NAME: NPS RISK ASSESSMENT

SITE LOCATION: EAST STATION 10 CC.

PROJECT NUMBER: ~~0110~~ 01110

P.O. NUMBER: 01110

PSS Project #: 01102419

PAGE 1 OF 2

(2)

LAB NO.	SAMPLE IDENTIFICATION	DATE	TIME	MATRIX	No. CONTAINERS	SAMPLE TYPE C=COMP G=GRAB	Preservatives Used: ICE →	Analysis Required (3): PAH	TAL METALS	REMARKS
	TB-70	10/24/01	1050	Soil	2	C		X	X	
	TB-71		1035							
	TB-72		1020							
	TB-73		1540							
	TB-74		1340							
	TB-75		1425							
	TB-76		1140							
	TB-77		1110							
	TB-78		1000							
	TB-79	↓	1520							

(5)

Collected / Relinquished By: (1)	Date	Time	Received By:
	10/24/01	1740	
Relinquished By: (2)	Date	Time	Received By:
Relinquished By: (3)	Date	Time	Received By:
Relinquished By: (4)	Date 10/24/01	Time 5:15pm	Received for Laboratory By:

(4)

Shipping Carrier: CLIENT

Shipping Ticket No:

Sample Condition Upon Receipt: Good

Data Deliverables Required

Level I Level II (Level III)

Chain of Custody Seal:

COOLER NA CONTAINER

Requested Turnaround Time and Special Instructions: ROUTINE

WE WANT DATA VALIDATION, TIGHT PQL's

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SAMPLE CHAIN OF CUSTODY/AGREEMENT FORM

PHASE SEPARATION SCIENCE, INC.

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(1)

CLIENT: Hydro-Terra PHONE NO: ( )

PROJECT MGR: FAX NO: ( )

PROJECT NAME: NPS Risk Assessment

SITE LOCATION:

PROJECT NUMBER:

P.O. NUMBER: 01110

PSS Project #: 01102419

PAGE 2 OF 2

(2)

LAB NO.	SAMPLE IDENTIFICATION	DATE	TIME	MATRIX	No. CONTAINERS	SAMPLE TYPE C= COMP G= GRAB	Preservatives Used: Ice →	Analysis Required (3): PAH	TAL Metals	REMARKS
	TB-80	10/24/01	1445	Soil	2	C	ice	X	X	
	TB-81	↓	1425	↓	↓	↓	↓	↓	↓	
	DUP-1		0900							
	DUP-2	↓	0830	↓	↓	↓	↓	↓	↓	

(5)

Collected / Relinquished By: (1)	Date	Time	Received By:
Dan Kade	10/24/01	1740	
Relinquished By: (2)	Date	Time	Received By:
Relinquished By: (3)	Date	Time	Received By:
Relinquished By: (4)	Date 10/25/01	Time 545	Received For Laboratory By: M. Wall

(4)

Shipping Carrier: CLIENT

Shipping Ticket No:

Sample Condition Upon Receipt: Good

Data Deliverables Required: Level I Level II (Level III)

Chain of Custody Seal: COOLER NA CONTAINER

Requested Turnaround Time and Special Instructions: SEE PAGE 1

AR 05282

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APPENDIX F

Section 8 from Report of "Additional Remedial Investigation and Feasibility Study (Phase IV)" for East Station, Dated August 31, 1998

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SECTION 8 HUMAN-HEALTH RISK

SECTION 8 FIGURE

SECTION 8 TABLES

8. HUMAN-HEALTH RISK

The purpose of this risk assessment is to evaluate potential adverse effects to present and future human receptors on or near the study area (including the East Station property, NPS property, and public streets on the south and west side of the East Station property) as the result of exposure to hazardous substances. The evaluation considers potential effects under (1) present uses on the East Station and NPS properties; (2) a transitional use of the properties when activities to prepare the land for beneficial use, including grading and building construction, might cause exposures to or releases of toxic substances; and (3) future uses of the properties which might or might not permit completely unrestricted use of the properties. In essence, study of the first of these conditions constitutes a baseline risk assessment. Preparing the site for beneficial use may require actions, such as paving, which may have remedial effects. The third of these conditions entails some additional remediation - not as mandated remediation, but as a means of preparing the site for beneficial uses. It is assumed that the future use of NPS property is to be a park similar to the Anacostia Park across the river. Two future uses of the East Station property were assessed: (1) commercial/industrial use, and (2) residential use.

The assessment considers the possibility that detected contamination, which arose from activities at the MGP on the East Station property, might affect the health of present onsite or nearby populations, as well as of those populations that might work in, reside on, or visit the property in the future (Figure 8-1). The assessment consists of three steps.

- Selection of Chemicals of Potential Concern
- Exposure Assessment
- Risk/Hazard Assessment

First, recent sampling/analysis results are used to choose chemicals of potential concern (COPC), or "indicator chemicals." Second, decisions are made as to how much of those chemicals are present and whether they could migrate to places where people are likely to come in contact with them. This is termed the exposure assessment, wherein the frequencies and degrees of exposure at typical locations are

quantified. The exposure assessment results are used in the third step (risk/hazard assessment), wherein information regarding contaminant toxicities is assembled and used to estimate risks or degrees of hazard to exposed populations. Once these estimates are generated, a number of statements are made as to the significance of the findings and the certainty/uncertainty of the assumptions used in deriving the estimates. These permit the reader to better understand where non-conservative or conservative assumptions have been made, and their influence on the estimated measures of risk or hazard.

The procedures used in this risk assessment are consistent with USEPA guidance where such guidance is available. Additional technical information and guidance are also used and referenced where appropriate.

Attention is focused on the potential effects of human exposure to compounds, such as PAHs, that are reasonably traceable to the residual products of gas manufacturing. Since ground water discharging from the site is not believed to influence the quality of any drinking water supply (see Section 4.4.4), no attempt is made to evaluate ground water from the standpoint of conformance to drinking-water quality standards or potability.

Figures and tables referenced in the text are found at the back of this section.

8.1 Chemicals of Potential Concern

Environmental sampling data collected on the study area, found in Appendix A and described in Section 5, were evaluated to determine which chemicals should be retained for use in the human-health risk assessment. They were evaluated in accordance with the USEPA's Risk Assessment Guidance for Superfund (RAGS) (USEPA, 1989a), as applied to organic compounds, or USEPA Region III guidance, especially Smith (1996), as applied to inorganic analytes.

The site-related COPCs (i.e, posing a possible risk of adverse health effects to exposed humans) that would most appropriately serve as the focus of the risk assessment were selected from among all those found. The chemicals found in river

sediment, subsurface soil, and surface soil were those identified and quantified during this investigation. No chemicals exceeding drinking-water maximum concentration limits (MCLs) were found in river water. The chemicals in fish were from a 1992 study by Versar, Inc. (Pinkney et al., 1993). Versar analyzed Anacostia River water, sediment, and biota at segments of the river near the study area to assess the impact of an oil spill, not associated with study-area contamination, on the river. The Versar data on concentrations of selected organics in fish were used in this risk assessment.

Air samples were not taken during the present study; however, recent occupational-exposure air sampling within the East Station office/treatment building on four occasions (August 1993, July 1994, October 1995, and October 1996) revealed that the indoor air quality did not exceed any acceptable limits. Air sampling within the D.C. Public Works building on the NPS property occurred in October 1996. The indoor air-quality was not above acceptable limits at that location. Chemicals detected in samples collected from the study area include those present as a result of releases related to industrial activities at the site, some that may have been introduced from offsite sources and some that may be naturally occurring chemicals.

8.1.1 Selection of Chemicals of Potential Concern

The selection process is detailed in Part II of Appendix D and summarized herein. The screening methodology was approved by USEPA, Region III.

8.1.1.1 Elimination of Chemicals

Initially, consideration was given to all detected and identified chemicals found in each medium. The less significant chemicals were then screened out. There are several reasons for eliminating target compound list (TCL) and target analyte list (TAL) chemicals from consideration in a risk assessment. At the study area, four elimination criteria were used.

- Step 1. Chemicals Not Detected
- Step 2. Concentrations below USEPA Criteria
- Step 3. Toxicity Screening - Organics Only
- Step 4. Risk Based Concentration Screening - Inorganics Only

Step 1: Any chemical that was not detected in a given medium was eliminated for that medium as a COPC because there was no evidence that the chemical was present in the medium.

Step 2: Water solutes in Anacostia River water were eliminated from consideration because they all fell below USEPA MCLs, below lifetime health advisory levels (e.g., zinc), below drinking water equivalent levels (DWELs) calculated from USEPA reference doses (e.g., manganese), or below action levels at the tap (e.g., lead).

Step 3: The toxicity screen (USEPA, 1989a) determines which of the remaining chemicals have the potential to contribute significantly to site risks. The following algorithm is used to calculate the concentration-toxicity score for a given chemical in a given medium for carcinogens and non-carcinogens separately.

$$R_i = C_i \times T_i$$

Where:

R_i = toxicity score for chemical "i" in the media
C_i = maximum concentration of chemical "i" found in the medium
T_i = toxicity value for chemical "i" (1/oral reference dose) for a noncarcinogen or slope factor for a carcinogen.

The total concentration-toxicity score (R) for all carcinogens or non-carcinogens in a given medium is the sum of the scores for the individual chemicals, expressed by the equation, $R = \Sigma R_i$. This screen was applied to the organic chemicals in sediment, surface soil, and subsurface soil. Chemicals contributing less than 2 percent to one of the total risk scores for any of these media (noncarcinogenic or carcinogenic) were eliminated from further consideration as potential chemicals of concern.

Step 4: Risk-Based Concentration (RBC) Screening for noncarcinogenic effects of inorganic chemicals was applied individually, to each of seven pertinent

chemical data groups (Groups 1 through 5, 7, and 11). The data groups are composed of chemical data, specific to different parts of the study area, used in the analysis of risks associated with specific exposure scenarios. For example, in order to calculate potential risk to a construction worker, data from soil samples collected in the construction area were used. The data groups are summarized in Table 8-1.

The RBC screening consisted of a comparison of the highest concentration of a noncarcinogenic inorganic chemical in the sediment or soil medium data group with 1/10 the soil ingestion RBC (Risk-Based Concentration) promulgated by US EPA Region III (Smith, 1996). Use of the factor 1/10 addresses the possibility that a hazard index of greater than 1.0 might result from grouping several target hazard quotients, each one less than 1.0 (Smith, 1993). When the highest concentration of a chemical was greater than 0.1 RBC, the chemical was retained for consideration for the sample group in question. There are no reference doses, hence no RBCs, for calcium, magnesium, potassium, sodium or lead; the first four of these are considered non-toxic and are essential nutrients. Lead is toxic and has an action level of 400 mg/kg (Section 8.3.4), a value exceeded in four samples from the East Station property (one subsurface-soil sample and three sediment samples); thus, lead was retained for further consideration.

Detected inorganic chemicals with carcinogenic effects for which slope factors were available were all retained, specifically, arsenic (oral and inhalation), beryllium (oral and inhalation), cadmium (inhalation), and chromium (inhalation).

8.1.1.2 Chemicals of Potential Concern

Those chemicals remaining after completing the four-step elimination process are the COPCs for the various media and are shown on Table 8-2. The selection process is described in more detail in Appendix D. In addition to the individual chemicals, the group concentrations of polynuclear aromatic hydrocarbons (PAHs) in fish were reported as such by Versar (Pinkney et al., 1993) with no breakdown by

individual constituents. All other total PAH values in this report represent the total of values for the following 17 noncarcinogenic and carcinogenic PAHs.

- naphthalene
- 2-methylnaphthalene
- acenaphthylene
- acenaphthene
- fluorene
- phenanthrene
- anthracene
- fluoranthene
- benzo[ghi]perylene
- pyrene
- benzo[a]anthracene
- chrysene
- benzo[b]fluoranthene
- benzo[k]fluoranthene
- benzo[a]pyrene
- indeno(1,2,3-cd)pyrene
- dibenzo[a,h]anthracene

8.2 Exposure Assessment

Exposure to a chemical is the contact between an individual and a COPC. The magnitude of this contact is determined by estimating how much of the chemical is available for absorption at one of the body's exchange boundaries (i.e., the intestinal tract, the lungs, or the skin) during a specified period of time. The objective of an exposure assessment is to determine the type and magnitude of such exposure to COPCs. Figure 8-1 is a conceptual exposure diagram. Details of exposure assessment are to be found in the individual scenarios in Appendix D, Part II. Each scenario summarizes one of the possible exposure situations with a specific target population, route of exposure, and source.

8.2.1 Exposure Setting

8.2.1.1 Physical Setting

The area affected by the release of tar, oil, and solid residuals of gas manufacturing includes portions of the East Station property, 12th Street adjacent to East Station, Water Street below East Station, southwest of the former above-ground oil tanks, and the portion of the NPS property extending from the 12th Street Sewer

to the vicinity of monitoring well MW-4 near the upstream boat yard (Figure 4-12, Section 4).

The climate in the District of Columbia (DC), including the study site, is influenced by three factors. First, its latitude places it in a zone of prevailing west-to-east atmospheric flow of both polar and tropical air masses. Second, DC is situated on or near several paths that are frequently followed by low-pressure storm systems. The third factor is its riverine location. The Anacostia River influences the local climate by moderating temperature extremes.

Meteorological information is based on data collected at the Washington National Airport, three miles southwest of the study area. On average, temperatures at the airport dip to or below the freezing point 71 days per year. The coldest temperatures occur in January and February. Temperatures exhibit an annual mean of 14°C (57.5°F). The warmest temperatures occur in July and August. Low pressure systems regularly pass through the region, producing precipitation approximately one day in every three. Data from 1965 through 1974 indicate a mean annual precipitation for DC of 99 centimeters (38.9 inches). The average annual surface wind speed at a height of 10 meters (m) is 3.4 m/sec (GRI, 1988).

The vegetative cover on portions of the East Station and NPS properties is sparse, reflecting the current use of the properties. This condition favors release of fugitive dust from the soil through wind erosion.

The Anacostia River is tidally influenced, so that no simple statements can be made about its flow rate or pattern. Overall, the 10-year average 7-day low flow is about 8.1 cubic feet per second. The water is not capable of sustaining a year-round cold water or seasonal cold water fishery; however, there is a brief shad spawning run in the springtime. Carp, brown bullhead, and channel catfish are found in the river. Sunfish are a territorial species common to the vicinity.

WG currently pumps from its property and the NPS property a significant portion (approximately 19,000 gallons per day) of the impacted ground water that flows towards the Anacostia River and effectively removes volatiles, semi-volatiles,

suspended solids, and immiscible chemicals from the water in a treatment facility constructed on its property. The water treatment steps include sedimentation, oil/water separation, and air stripping. The treated water is discharged to the sanitary sewer system under a discharge permit. The volatiles-laden air from the air-strippers is passed through activated carbon adsorbers before being released to the atmosphere under an air-discharge permit.

The East Station property and the portions of the NPS property used by the DC Department of Public Works (DCDPW), Corps of Engineers (COE), and formerly used by WG are fenced, and access is controlled.

8.2.1.2 Potentially Exposed Populations Under Present Land Use

WG maintains offices and a water treatment plant in a two-story building on its property. An average of approximately nine people work in the building and could be exposed to volatile chemicals and contaminated dust particles in the air. The same exposure routes apply to two permanent office workers in the DCDPW's and COE's buildings and equipment operators employed by the DCDPW and COE who use these facilities less frequently.

Periodically, rowing club members and anglers using the narrow strip of NPS land and adjoining river extending from beneath the 11th Street Bridge to the vicinity of the COE site could be exposed to chemicals in the river, including, but not limited to, those from the study area, either dermally or by fish ingestion.

Utility workers digging into contaminated soil while maintaining gas, sewer, and water lines on the East Station and NPS properties and on land under and along 12th Street and Water Street could also be exposed to chemicals via dermal contact with and ingestion of affected soil and through inhalation of gaseous chemicals.

Another population that could be exposed to airborne chemicals from the site is the indeterminate, but large, number of people working or living in areas west of the study area beyond 11th Street in the Washington Navy Yard and on residential and commercial properties north of the area, beyond "M" Street.

The following five types of populations are identified for the current-use or baseline situation.

- Offsite anglers
- Swimmer/waders
- Onsite and offsite office workers
- Offsite residents
- Onsite utility repair personnel

8.2.1.3 Potentially Exposed Population During Transitional Period

The transitional period is the time during which the East Station property is undergoing development for commercial/industrial or residential use, and/or when the NPS property is conditioned for use as a park. Any remediation necessary to achieve these end uses is also included in this phase.

An indeterminate number of construction workers (approximately 50) are expected to be exposed to vapor emissions and to direct contact with tar-associated chemicals in soil over a brief period. Office workers and offsite residents could be exposed to slightly increased levels of airborne chemicals due to grading and excavation activities. Workers maintaining underground utilities could be exposed in the same manner as described for the present-use condition, but over a much shorter period of time while the East Station property is undergoing construction for re-development.

The following six types of populations are identified for the transitional phase.

- Offsite anglers
- Swimmer/waders
- Onsite and offsite office workers
- Offsite residents
- Onsite utility repair personnel
- Construction workers

8.2.1.4 Potentially Exposed Populations During Future Land Use

Two uses of the East Station property are considered in this risk assessment: (1) office or industrial use and (2) residential use (high-rise apartment or condominium). The considered future use of the NPS property is as a public park.

Under these conditions, adults and children living on the East Station property or workers in offices or industrial facilities developed on the site would be exposed to a low level of vapor-phase chemicals emitted by the soil. On the NPS property, part-time populations of adults and children would use the park for recreation and would be exposed to vapor-phase chemicals emitted by the soil. Unauthorized wading or swimming in the river by recreational users of the property could result in dermal exposure to chemicals of mixed origin in the sediment and ingestion of water also containing chemicals of mixed origin. Utility workers would continue to be exposed in the manner described for the baseline condition. Offsite residents and office workers would also continue to be exposed to vapor-phase chemicals emitted from the subsurface of the site.

The following six types of populations are identified for the future-use condition.

- Offsite anglers
- Recreational users of the NPS area
- Offsite swimmers/waders
- Onsite and offsite office workers
- Onsite and offsite residents
- Utility repair personnel

8.2.2 Exposure Pathways

An exposure pathway describes the movement of a chemical from a source to the point where an individual (the "receptor") comes in contact with that chemical. A complete exposure pathway consists of some or all of the following:

- A source and mechanism of chemical release

- A transport medium
- A point of potential contact with the contaminated medium
- An exposure route at the contact point
- A potentially exposed population.

In general, a complete pathway contains all these elements. In some instances, the source is also an exposure point and there is no release or transport involved. If a pathway is not complete, there is no exposure and risk need not be characterized. Identifying complete exposure pathways involves not only characterizing site features but also taking into consideration which compounds would be present in the vapor phase. Thirty-five (35) chemicals have been selected as COPCs at the study area (Table 8-2). Certain assumptions regarding fate and transport processes and exposure factors are made in the analyses. These are discussed in the section on uncertainties (Section 8.4).

8.2.2.1 Identification of Exposure Pathways

8.2.2.1.1 Sources, Release Mechanisms and Transport Media

Gas manufacturing started on the East Station property in 1888 and continued on a full-time basis until 1948 when WG converted to natural gas. From 1948 until 1983, the plant was operated on an intermittent basis during periods of peak gas demand. During a portion of its operating history, tar and solid wastes consisting of coal-burning cinders, ash, coke, and small amounts of contaminated wood chips were apparently placed in fill on the former wetland along 12th Street and from the south side of the WG property down onto the NPS property. Also, oil was released in the fill on the west side of the study area. Its source is thought to have been the buried spent-oil tanks previously existing at the south end of the East Station property, below the office/treatment building. Oil was also found in fill on the east side of the study area and is thought to have been released from buried oil lines extending from the ST Services (formerly Steuart Petroleum) and WG piers on the river up to the former location of the above-ground oil tanks on the east side of the WG property and the adjoining ST Services fuel storage facility.

Tar and oil migrated into subsurface soil and ground water. In the ground water, excess tar, a dense non-aqueous phase liquid (DNAPL), that was not retained in the soil at residual concentration, sank to the bottom of the water-bearing units and accumulated on the underlying aquitards. Oil, a light non-aqueous phase liquid (LNAPL), came to rest on top of the water table. The heavier accumulations of DNAPL tar in the fill unit appear to lie at or near the source area. A depression in the poorly-permeable silt underlying the fill under and below Water Street physically prevents the tar from migrating to the river (Figure 6-8, Section 6). DNAPL is found near the edge of the depression in a well (WGL-01S) located near the 12th Street Sewer outfall and also in the Trench Well on the NPS property. Movement of DNAPL to the river from these areas is unlikely, but cannot at this time be completely ruled out. In the deeper sand/gravel unit the forward edge of DNAPL contamination appears to have reached a state of static equilibrium on the NPS property. Constituents of tar and oil dissolved in the ground water within the fill unit can migrate into the river and may be partitioned into the organic-rich river sediment.

Volatile hydrocarbons in the soil and ground water migrate upwards through the soil and into the atmosphere. Exposed surface soil containing MGP-related chemicals is found on the study area, and particles of the soil can be carried into the atmosphere due to wind erosion (fugitive dust emission) and into the river sediment via water erosion.

New construction on the study area must be anticipated and will result in soil excavation. If the soil is temporarily stockpiled on adjacent surfaces, the excavated soil will rapidly emit volatile chemicals as vapors, quickly exhausting this source over a construction period assumed to be one year. The movement of vehicles such as bulldozers will emit suspended soil particles as dust.

Impacted ground water on the study area is not utilized in any way, nor is it likely to be in the future, in view of the availability of the upstream Potomac River water for potable use.

The Anacostia River is not considered fit for swimming and swimming is prohibited. Users of the marina along the river might occasionally enter the water, but not for extended periods or to swim regularly.

Waterborne chemicals in the Anacostia River water and sediment coming from the study area and other sources could bioaccumulate in aquatic biota (e.g., fish), which in turn might become part of the human diet. The chances are remote, however, that the river would be a habitat for enough food fish to contribute more than a small fraction to anyone's diet, especially since consumption of fish from this source is prohibited by regulation. A 1997 fishery survey by the D.C. Department of Consumer & Regulatory Affairs (DCRA) included a sampling of anglers at one location on the Anacostia River above the study area and four locations on the Potomac River and C&O Canal. The researcher concluded that "the D.C. fishery is predominantly a catch-and-release shoreline fishery" (Byers, Jr., 1997).

8.2.2.1.2 Exposure Points

An exposure point is defined as that point where a human can come in contact with a contaminated medium. This includes the contaminated source, transport medium or release point itself, which can also be an exposure point (e.g., contaminated surface soil). Current and future exposure points identified for the study area include:

- Site surface soil
- Site subsurface soil
- Outdoor and indoor fugitive dust from wind- and vehicle-eroded soil
- Outdoor and indoor volatile chemicals emitted from soil and ground water
- Anacostia River water
- Anacostia River sediment
- Anacostia River fish.

8.2.2.1.3 Exposure Routes

Human populations may be exposed to chemicals by the following three routes: (1) ingestion of contaminated media, (2) inhalation of contaminated media and (3) dermal contact with contaminated media. Based on the nature of contamination and the anticipated activities at the exposure points, exposure routes identified for the study area include the following:

- Ingestion of and dermal contact with soils, sediment, and surface water
- Inhalation of volatile emissions from soils
- Ingestion of contaminated fish
- Inhalation of windblown particulates.

8.2.2.1.4 Exposure Pathway Analysis

Potential pathways that were judged to be incomplete (e.g., no exposure point and/or route by which contact could occur) were not quantified. An analysis of the more plausible exposures under current and future conditions was conducted to determine complete exposure pathways that would be quantified. This led to the selection of the following scenarios, populations and pathways.

- Present Use Scenarios

1. Population: Offsite anglers
   Pathway: Ingestion of fish

2. Population: Swimmer/Wader
   Pathway: Ingestion of sediment and dermal absorption

3. Population: Onsite and offsite office workers
   Pathways: Inhalation of airborne vapors and particulates

4. Population: Offsite residents
   Pathways: Inhalation of airborne vapors and particulates

5. Population: Utility repair personnel
   Pathways: Inhalation of airborne vapors, ingestion of soil, dermal absorption

- Transitional Use Scenarios

1. Population: Offsite anglers
   Pathway: Ingestion of fish

2. Population: Swimmer/Wader
   Pathway: Ingestion of sediment and dermal absorption

3. Population: Onsite and offsite office workers
   Pathways: Inhalation of airborne vapors and particulates

4. Population: Offsite residents
   Pathways: Inhalation of airborne vapors and particulates

5. Population: Utility repair personnel
   Pathways: Inhalation of airborne vapors, ingestion of soil, dermal absorption

6. Population: Construction workers
   Pathways: Inhalation of airborne vapors and particulates, ingestion of soil, dermal absorption

- Future Use Scenarios

1. Population: Offsite anglers
   Pathway: Ingestion of fish

2. Population: Youth using the NPS property for recreation
   Pathways: Inhalation of airborne vapors

3 Population: Swimmer/Wader
Pathways: Ingestion of sediment and dermal absorption

4. Population: Onsite and offsite office workers
Pathways: Inhalation of airborne vapors

5. Population: Onsite and offsite residents
Pathways: Inhalation of airborne vapors

6. Population: Utility repair personnel
Pathways: Inhalation of airborne vapors, ingestion of soil, dermal absorption

8.2.3 Quantification of Exposure

The last step in the exposure assessment process is the calculation of an average daily intake of the COPCs. The intake is an approximation of the exposure expressed in terms of the chemical mass at the body exchange boundary per unit body weight per day (mg/[kg·day]).

The exposure levels are not directly expressed in the scenario-related hazard or risk estimates in Part II of Appendix D, but are implicit in them and can easily be calculated from the information provided. The exposure levels are folded into the risk or hazard calculations found in Appendix D.

8.2.3.1 Human Intake Factor

To calculate Human Intake Factors (HIF), the following equation is used.

$DI = C \cdot HIF$

$HIF = (CR \cdot EFD/BW)(1/AT)$

$DI = C \cdot (CR \cdot EFD/BW)(1/AT)$

where:

DI = Daily intake: the average amount of the chemical at the body's exchange boundary, in units of mg/(kg·day).

C = Chemical concentration: the concentration that comes in contact with the body during the exposure period (e.g., mg/kg in soil or mg/L in water).

CR = Contact rate: the amount of contaminated medium contacted per unit time or event (e.g., liter/day for drinking water).

EFD = Exposure frequency and duration: how long and how often exposure occurs. The EFD term is usually calculated from two terms, the exposure frequency, EF (usually expressed in days/year) and the exposure duration, ED (usually expressed in years).

BW = Body weight: the average body weight over the exposure period (kg).

AT = Averaging time: the period over which exposure is averaged (days).

Values for the variables in the equation are selected so that an estimate of the reasonable maximum exposure for each pathway is achieved (USEPA, 1991, 1989a). The reasonable maximum exposure is defined as the maximum exposure that is

reasonably expected to occur (USEPA, 1989a). This step is undertaken in two stages: (1) estimation of exposure concentrations (the "C" term in the equation) and (2) calculation of human intake factors (HIFs) which are the combined "CR," "EFD," "BW" and "AT" terms in the equation.

8.2.3.1.1 Calculation of HIFs

In the general equation for calculating human DI, the HIF incorporates the terms that describe exposure as related to human activity. The value of the HIF term in calculating chemical intakes depends on the specific exposure scenario being evaluated. An HIF value is calculated individually for each exposed population, for each medium, for each exposure route and for each exposure duration. In general, an HIF value is comprised of the following three terms.

- A contact rate term that describes the quantitative intake of a medium (e.g., mg of soil or L of water) by a person on a day when exposure occurs.
- A body weight term.
- A series of time correction factors that account for the fact that exposure may not occur every day during the time period of interest. These variables include exposure time (hours/day), exposure frequency (days/year), and exposure duration (years). These factors are divided by the period (in days) over which exposure is averaged.

The HIF tables are found in Appendix D.

8.2.3.1.2 Activity Patterns of Potentially Exposed Populations

Human intake factors are derived for a total of 19 assumed configurations (Tables HIF-1 through HIF-19 in Part II of Appendix D). A brief description of the assumed activity patterns of these populations is presented below.

- Offsite residents. These present and future offsite housing residents would have no direct contact with soil but might inhale windborne vapors or suspended particles.

- Offsite office workers. Present and future offsite office workers would have no direct contact with soil but might inhale windborne vapors or soil particles.

- Children (6-18 years). Children might occasionally wade or swim in the Anacostia River, swallowing and dermally contacting water and sediment. They might also (in the future) use the NPS property as a play area. It is highly doubtful that children below age 6 will be swimming in the river.

- Utility repair personnel. These current and future workers sporadically repair utilities, especially in the vicinity of Water Street and 12th Street. This may involve limited periods of hard labor to excavate sewers, electric conduits, water and gas mains, and telephone lines.

- Construction workers. For the relatively brief land preparation periods anticipated for the East Station and NPS sites, construction workers would be involved in direct contact with soil through excavation and grading of soils and covering over the surface soil. Later they would be exposed only to vapors.

- Site residents. The future residents of onsite multistory buildings would have little direct contact with contaminated soil, but might be exposed to vapors by the inhalation route.

- Site office or industrial workers. This adult population would be exposed to the same concentrations of chemicals as site residents, but for briefer time intervals. (Scenario No. 14, discussed in Part II of Appendix D, is an exception, meant to represent the very localized situation of contaminated dust suspended by vehicular activity in a parking lot on the NPS property adjoining an office building in which people could be exposed.)

- Offsite anglers. It is assumed that sport anglers share their catches with their families at the dinner table, even though Anacostia River fish do not seem to be of the most desirable types for human consumption. Although sport fishery does not appear to be flourishing and fish from the river are not supposed to be eaten based on an advisory from the DCRA, it is possible that a few avid enthusiasts would fish the Anacostia River and consume some of their catch. Adult and child populations are treated separately because they differ in their ratios of consumption to body weight. There is no difference between current and future consumer populations, which are considered completely different from other study area populations.

8.2.3.1.3 Quantitative Assumptions

The following values are used in the pathway-specific exposure calculations unless otherwise specified in the individual exposure scenarios described in Part II of Appendix D. Some values were the result of professional judgement and are selected to be conservative.

- Body Weights. The following human age ranges versus body weights (USEPA, 1989b) were assumed: 0-6 yr, 15 kg; 6-18 yr, 43 kg; adults, 70 kg.

- Exposure Frequencies

  Residential: Residential exposure frequency is based on full-time residence, with 15 days per year spent away from home, resulting in a residential exposure frequency of 350 days per year (USEPA, 1991). However, dermal exposure frequencies are assumed to be 200 days per year, based on professional judgement.

  Office/Industrial Worker: Office and site industrial workers are estimated to work 250 days per year.

Children: Children are expected to use the park 200 days per year (maximum), and to wade or swim in the Anacostia River 10 times a year. These assumptions are based on professional judgement since no guidance is available.

Utility Repair Personnel: Utility repair crews are expected to operate in the area five days per year, based on information provided by WG.

Construction Workers: Construction workers would be exposed by direct contact (dermal, ingestion and inhalation of work-generated particulates) 60 days, and indirectly (vapor inhalation) for 250 days (in a single year). These assumptions are based on professional judgement since no guidance exists.

Consumers of Fish: To the degree that local populations may engage in fishing in the Anacostia River near the WG East Station site, this activity would have to be considered recreational. There is no evidence that the river supports subsistence fishing. As a very conservative estimate, it is assumed that an angler obtains one meal for the family for each day of fishing, and fishes the river 10 days per year. These assumptions are based on professional judgement since no guidance exists that is applicable to this site.

- Exposure Durations: Residential, office worker and industrial worker exposures are assumed to occur over 30 years; in the case of residential populations, this includes six childhood years. Utility repair crew exposures are assumed to occur to adults over 20-year periods. Juveniles wading, swimming, or using the park for recreation are assumed to do so over a period of 12 years. Construction worker exposures are assumed to occur over one year. These are based on professional judgement since no guidance exists.

- Exposure Times: Residential days are 24 hours and worker days are 8 hours. Child recreational days are 4 hours and child swimming/wading days

are 2 hours in duration. These are based on professional judgement since no guidance exists.

- Averaging Times: The averaging time was assumed equal to the exposure duration for subchronic and chronic (noncarcinogenic) hazards and 70 years for lifetime (carcinogenic) risks (USEPA 1991).

- Ingestion of Soil: Most soil ingestion is believed to occur by hand-to-mouth activity (cigarette smoking, nail-biting, finger wetting, etc.) and during meals (Hawley, 1985). A daily intake of 100 mg (10^{-4} kg) is conservatively assumed for utility repair crews and construction workers. This is the value assumed by USEPA Region III (Smith, 1996).

- Ingestion of Sediment During Swimming: Swimmers are assumed to ingest 50 mg (0.00005 kg) of resuspended sediment per event. This assumption is based on professional judgement since no guidance exists.

- Dermal Contact with Soil: One parameter needed to calculate dermal contact with soil is the soil-to-skin adherence factor (AF). Consideration of a number of sources led the USEPA to adopt the factor AF = 1 mg/cm^2 as a reasonable upper value (USEPA 1992a). Another parameter needed to calculate dermal intake is the fraction of the chemical (ABS) that is absorbed from soil. This is a chemical-specific value. In general, metals have low dermal absorption; USEPA Region III has recommended 0.01 as a default value of ABS (except 0.032 for arsenic) for metals (Hubbard, 1995). An ABS default value of 0.1 was used, as recommended by Hubbard (1995). The third parameter needed to calculate dermal intake is the exposed skin surface area per contact event. For the child wader/swimmer, the area exposed to adhering sediment, namely legs and feet, is 37 percent of the total body surface, i.e. 4,900 cm^2 (USEPA, 1989b). For utility repair and construction workers and adult residents, the skin areas exposed would be the head and upper extremities, with a total area of about 4,400 cm^2 (USEPA, 1989b). For a young child of average age 3-6, the surface area exposed, namely 82 percent of the body area (all

Using the assumptions presented above, Tables HIF-1 through HIF-19 accompanying various scenarios described in Part II of Appendix D present calculations of individual HIF values.

8.2.3.2 Concentration Term

The concentration term was calculated using guidance provided in "Supplemental Guidance to RAGS: Calculating the Concentration Term" (USEPA, 1992b). Because of the uncertainty associated with estimating the true mean from a limited number of samples, a degree of conservatism is needed in calculating source term concentrations, which are sometimes also the exposure concentrations (USEPA, 1989a). This conservatism is provided by using the 95 percent upper confidence limit (95% UCL) of the arithmetic mean.

A source term concentration is the concentration measured at the source (e.g., soil gas concentration), while the exposure concentration is the concentration at the point of exposure (e.g., concentration of chemicals in indoor air from soil gas). As used in this report, the source term concentration is the 95% UCL of the mean concentration of a chemical in a medium, rather than the arithmetic mean itself, averaged over the source area for the expected exposure (USEPA, 1989b). Although this concentration is not usually the maximum concentration that could potentially be contacted at any one time, it is regarded as a reasonable upper bound estimate of the concentration that is likely to be operative over time.

8.2.3.2.1 Calculation of 95% Upper Confidence Limit

The method of determining the 95% UCL is described below.

- The distribution of the data is determined using the W-test (Gilbert, 1987).
- If the data fit a lognormal and a normal distribution, then the more conservative 95% UCL is used.

- If the data fit only a normal distribution, the 95% UCL for a normal distribution was calculated. The following equation is used.

$$UCL = x + t\left(\frac{s}{\sqrt{n}}\right)$$

where:

UCL	=	upper confidence limit
x	=	mean of the untransformed data
s	=	standard deviation of the untransformed data
t	=	Student-t statistic
n	=	number of samples

- If the data fits only a lognormal distribution, the 95% UCL for a lognormal distribution was calculated. The following equation was used.

$$UCL = e^{\left(x + 0.5s^2 + \frac{sH}{\sqrt{n-1}}\right)}$$

where:

UCL	=	upper confidence limit
e	=	constant (base of the natural log)
x	=	mean of the transformed data
s	=	standard deviation of the transformed data
H	=	H-statistic (from table published in Gilbert, 1987)
n	=	number of samples

- If the data do not fit either distribution, a nonparametric 95% UCL is calculated.

1. If n >20 then the following formula is used (Gilbert, 1987).

$$u = p(n+1) + Z_{1-\alpha}\sqrt{np(1-p)}$$

where:

u	=	order of upper confidence limit
p	=	quantile about which u is calculated (0.5)
$Z_{1-\alpha}$	=	quantile of the distribution

2. If n ≤ 20 then Table A3 from Conover (1980) was used to calculate a 95% UCL.

- If the corresponding 95% UCL is greater than the maximum value of the data set, the maximum value is used.

Sampling data were divided into 12 groups. These data groups are summarized in Table 8-1 and were used in exposure point or source term calculations. They accompany the scenarios described in Part II of Appendix D. These data groups include the 95% UCL values for each COPC.

8.2.3.2.2 Source Concentrations

Source concentrations can be used as exposure point concentrations for some exposure scenarios. Calculation of exposure point concentrations involves (1) selecting samples from locations that represent source terms, and (2) utilizing the sampling data to estimate the mean concentration of each chemical at each exposure point. Worksheets documenting the derivation of exposure point concentrations are presented in Part II of Appendix D.

Some of the chemicals were not found in all media. Inclusion of these chemicals in risk quantification for media in which they had not been detected would overestimate the risk. Therefore, a chemical not detected in any sample in a particular medium was not quantified for that medium. Other data adjustments were made as described below.

- All non-detect results used in obtaining a 95% UCL from a sample set for a particular medium were given a value of one half their detection limits.

- Field duplicates (two samples from the same location at the same time) were combined and the maximum detected concentration for each analyte was used.

8.2.3.2.3 Modeling of Exposure Point Concentrations

For some of the scenarios involving exposure to vapors or particulate dust, two types of models were employed: (1) emission source models and (2) dispersion/exposure models that used the emission source values as input. These were applied, as appropriate, to the three sets of conditions: (1) present-use condition, (2) transitional-use condition, and (3) future-use condition. The model/scenario combinations, described in detail in Part II of Appendix D, are listed below.

- Present Land Uses

1. Soil gas emission source (Scenario Nos. 4 and 8)

   a. Soil gas emission rate
   b. Area dispersion model

2. Airborne particulates by wind erosion (Scenario Nos. 5 and 9)

   a. Soil particulate emission rate
   b. Outdoor area dispersion model
   c. Indoor air concentration of dust-borne chemicals

3. Airborne particulates from vehicular activity in parking lot (Scenario No. 14)

   a. Soil particulate emission rate
   b. Outdoor area dispersion model
   c. Indoor air concentration of dust-borne chemicals

- Transitional Land Use

1. Soil gas emission source (Scenario Nos. 4, 8 and 23)

   a. Soil gas emission rate
   b. Area dispersion model

2. Volatiles from excavated and exposed subsurface soil (Scenario Nos. 7, 11, 15 and 26)

   a. Volatiles emission rate
   b. Area dispersion model

3. Airborne particulates by wind erosion (Scenario Nos. 5, 9 and 24)

   a. Soil particulate emission rate
   b. Outdoor area dispersion model
   c. Indoor air concentration of dust-borne chemicals (except Scenario No. 24)

4. Airborne particulates from bulldozer activity except for operators (Scenarios Nos. 6, 10 and 13)

   a. Soil particulate emission rate
   b. Outdoor area dispersion model
   c. Indoor air concentration of dust-borne chemicals

5. Airborne particulates for bulldozer operators (Scenario No. 25)

   a. Soil particulate emission rate
   b. Dispersion model

6. Airborne particulates from vehicular activity in a parking lot (Scenario No. 14)

   a. Soil particulate emission rate
   b. Outdoor area dispersion model
   c. Indoor air concentration of dust-borne chemicals

- Future Land Uses

1. Soil gas emission source (Scenario Nos. 4, 8, 12 and 17)

   a. Soil gas emission rate
   b. Area dispersion model

2. Soil gas emission source (Scenario No. 22)

   a. Soil gas emission rate
   b. Area dispersion model for juveniles in park

3. Airborne particulates from vehicular activity in parking lot (Scenario No. 14)

   a. Soil particulate emission rate
   b. Outdoor area dispersion model
   c. Indoor air concentration of dust-borne chemicals

4. Soil volatiles by vapor intrusion through cracked foundations (Scenario Nos. 16 and 18)

   a. Soil gas intrusion equilibrium concentration

8.3 Toxicity Assessment

The purpose of toxicity assessment is to evaluate available evidence regarding the potential for a chemical to cause an adverse health effect in an exposed individual. The information in this section provides an overview of the process of evaluating toxicity information to develop critical toxicity values (CTVs). These values for the COPCs are subsequently used in risk characterization to estimate the likelihood of adverse effects occurring at the exposure levels posed by the site. Acute toxic effects are not addressed here because (1) risk management to prevent occurrence of long-term exposure effects will certainly prevent acute effects, (2) acute effects generally differ from chronic effects, and (3) the literature does not describe acute effects for many of the chemicals.

8.3.1 Noncarcinogenic Effects

The non-cancer health effects of a chemical are evaluated by use of a Reference Dose (RfD) approach. A Reference Dose is a conservative estimate of the average daily dose of a chemical (mg chemical per kg body weight per day, mg/kg-day) below which it is unlikely for humans, including sensitive subpopulations, to experience adverse health effects. An RfD is specific for a given exposure route (oral, inhalation or dermal) and for a given exposure period - subchronic for two weeks to seven years, chronic for seven years to a lifetime (USEPA, 1989a). However, since so little information is available regarding subchronic RfDs, chronic RfDs were used (conservatively) in place of subchronic values. An RfD is usually calculated from experimental data that identify the No-Observed-Adverse-Effect Level (NOAEL) or the Lowest-Observed-Adverse-Effect Level (LOAEL) in animals or humans. In order to provide a margin of safety, the RfD is taken to be the NOAEL or LOAEL divided by an appropriate uncertainty factor. Tables D-3, D-4, and D-5 in Part I of Appendix D contain all available and applicable RfDs for organic chemicals of potential concern identified in the study area. As explained in Part I of Appendix D, surrogate values

were used for certain identified chemicals, for which there were no published RfDs, in the selection of indicator compounds. Owing to the absence of RfDs for the noncarcinogenic effects of most PAHs, a surrogate value was used in the calculations in Part II of Appendix D - specifically the oral chronic RfD for pyrene - as an RfD for total PAHs.

The hazard quotient is the ratio of the average daily intake (DI) to the RfD, explained in Section 8.3.5.2. The summed hazard quotients are referred to as the hazard index.

8.3.2 Carcinogenic Effects

The CTVs for cancer are termed Slope Factors (SFs) or Cancer Potency Slopes (CPSs). These are route-specific estimates of the slopes of the dose-response curves at low doses. Both human and animal studies are reviewed initially to determine the evidence of carcinogenicity for each chemical. The following weight-of-evidence classifications are assigned.

- Group A — Known human carcinogens
- Groups B1, B2 — Probable human carcinogens (B1 indicates limited evidence of carcinogenicity in humans; B2 indicates sufficient evidence in animals with inadequate or lack of evidence in humans)
- Group C — Possible human carcinogens
- Group D — Not classifiable as to human carcinogenicity
- Group E — Evidence of noncarcinogenicity for humans

In the second part of the evaluation, an SF is calculated. This SF may be used to estimate cancer risk from any given exposure level. The SF is calculated by extrapolation from observed data at high dose levels through the use of a model that assumes that the dose-response curve becomes linear at low doses and has no threshold (i.e., the curve passes through the origin). To ensure an adequate margin

of safety, the SF is taken to be the 95% UCL of the slope. Thus, the actual slope factors could be lower but are not likely to be higher. Benzo[a]pyrene's slope factor was used, along with relative potency factors (USEPA, 1995), to estimate carcinogenic potency for certain other carcinogenic PAHs in this risk assessment. Tables D-6, D-7, and D-8 in Part I of Appendix D contain the slope factors available and applicable for organic COPCs identified at the study site. The cancer risk is the product of SF and the average (70-year) DI.

8.3.3 Dermal Toxicity Values

Since dermal exposure to soil is of concern at the study area, dermal toxicity values are required. It is important to understand that dermal toxicity values must be based on the absorbed doses (rather than on exposed or administered doses), because dermal intakes are calculated as absorbed doses. Since the USEPA has not yet established any dermal toxicity values, approximate values were derived by extrapolation from oral toxicity values. This can be done by multiplying an oral subchronic or chronic RfD value by the oral absorption fraction (AF_o) or by dividing the oral slope factor by the AF_o. Absorption fractions are chemical-specific values obtained from toxicokinetic studies including, if available, results of the studies used in determining oral toxicity values. This approach is based on the assumption that equal absorbed doses are equitoxic. For all the organic COPCs at the study area, the AF_o was assumed to be 1.0 (i.e., 100% oral absorption); this reflects the fact that most organic compounds are fairly well absorbed from the gastrointestinal tract.

A workgroup headed by Mr. Mark Johnson, (USEPA Region 5) is developing guidance addressing the issue of dermal exposure to PAHs. He recommends using 13 percent of the oral absorption factor instead of 100 percent. Since the guidance is still undergoing review, the more conservative value of 100 percent absorption was used.

Oral absorption of metals is quite variable, with values ranging from 0.1 percent to 60 percent, while absorption of arsenic is estimated to be 100 percent (Owen, 1990, Seiler et al., 1988, Friberg et al., 1986). AF_o values for inorganic COPCs were assumed to be 1.0.

In addition to AF_o, the absorption factor (ABS) is required for dermal toxicity quantification. ABS is defined as the fraction of a chemical that is desorbed from a soil matrix and then absorbed by the skin.

8.3.4 Chemicals with No Critical Toxicity Values

As discussed in Part I of Appendix D, there are several chemicals that were eliminated by the toxicity screen for which Critical Toxicity Values (CTVs) have not been issued. In the case of lead, which was not eliminated by the toxicity screen, considerable controversy exists concerning the appropriate CTV. USEPA soil screening guidance (USEPA, 1996) states the following: "A screening level of 400 mg/kg has been set for lead [in the soil], based on *Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities* (U.S. EPA, 1994)".

8.3.5 Risk Characterization

8.3.5.1 Potential Carcinogenic Risks

The risk to an individual resulting from exposure to chemical carcinogens is expressed as the increased probability of a cancer occurring over the course of a lifetime. Specifically, an exposure corresponding to the appropriate 95% UCL of the mean level in the medium of concern, under the specified assumptions, would result in one extra occurrence of cancer in a lifetime among a population of 1,000,000 people if the risk is 10^{-6} (or 1.0E-6). At ten times the foregoing 95% UCL of the mean, there would be 10 extra cancers in a lifetime for a population of 1,000,000. This must be considered in light of the fact that the normal cancer rate in the U.S. from cancer due to all causes is much higher. To calculate the excess cancer risk (R) for a carcinogen, the daily intake averaged over a lifetime (DI_L) is multiplied by the chemical-specific slope factor ($R_i = DI_L \times Sf_i$).

The total cancer risks shown for the 32 scenarios in Table 8-3, the derivations of which are described in Part II of Appendix D, are the sums of the individual cancer risks for each of the chemicals of potential concern. Risks were determined for the present uses of the study area, the transitional period when earth-moving operations

and other construction activities would occur, and the future uses of the properties. The USEPA target risk range is 10^{-4} to 10^{-6}. Except for the two scenarios listed below, the results, expressed as cancer risks from individual carcinogens and the sums of such risks for a given scenario, were less than 10^{-4}. Total cancer risks to populations not affected by these two scenarios were below the upper end of the target risk range.

- Scenario 31: Onsite resident contacting surface soil (dermal).
- Scenario 32: Juvenile playing in surface soil (dermal).

8.3.5.2 Potential Noncarcinogenic Effects

Noncarcinogenic risks associated with present uses of the study area, the transitional period, and future uses were also evaluated. The results expressed as hazard indices are shown on Table 8-3 and the derivation of the values for the 32 scenarios is described in Part II of Appendix D.

A hazard quotient (HQ) provides a measure of the potential for adverse health effects other than cancer from an individual COPC. In determining an HQ, the daily intake (DI) averaged over the exposure period is divided by the RfD to derive the HQ; that is, HQ = DI/RfD. For an individual chemical, an HQ of less than 0.1 is considered to indicate a non-hazardous situation, or conversely, a quotient of 0.1 or greater is considered to indicate a potential for adverse health. The hazard quotients for all chemicals of potential concern are summed to determine a hazard index (HI). An HI of less than one indicates a non-hazardous condition and, if the value is one or above, a potential human hazard may exist.

Of the 32 exposure scenarios evaluated, 30 have HIs below one (Table 8-3), indicating for these scenarios that no unacceptable human hazard exists. Only Scenario 19 (utility worker exposure in trenches to volatile chemicals, particularly benzene) and Scenario 25 (bulldozer operator exposure to manganese-laden bulldozed particulates) have indexes above one, indicating potential hazards to such workers. In deriving the HIs for the oral route, either RfDs or carcinogenicity slope factors were available for most of the chemicals of concern. The RfD that was used for all the PAHs, that listed for pyrene, is a conservative unofficial value adopted only for the

present risk assessment. In contrast to oral RfDs, no dermal RfDs are available. The uncertainties in assessment resulting from the lack of RfDs for some compounds are discussed in Section 8.4.

There are no RfDs for lead, hence no hazard quotient was developed for this analyte. As described in Section 8.3.4, the soil cleanup action level for lead in most situations would be 400 mg/kg.

8.3.5.3 Significance of Findings

The scenarios described and the cancer risks summarized for 32 scenarios in Table 8-3 are not all of equal impact or significance. Twenty two (22) of the 32 scenarios (Scenarios 1, 2, 4 through 18, 22, 23, 24, 26, and 27) entail excess lifetime cancer risks of less than 10^{-6}, which the USEPA considers "*de minimis*", that is, negligible. Scenarios 3, 19, 20, 21, 25, 28, 29, and 30 present a somewhat higher level of risk, but the risks are within the USEPA's target risk range of 10^{-4} to 10^{-6} and most are at the low end of that range.

Scenarios 1, 2, and 3 deal with exposure to chemicals in the Anacostia River, for which a number of parties would be responsible. The river water did not contain excessive levels of any analyzed chemicals. Local regulations prohibit consumption of fish (despite the consumption rates for Anacostia River fish assumed in Scenario No. 1). Swimming and wading (Scenario Nos. 2 and 3) are also prohibited. Finally, Scenario No. 3 requires that sediment adhere to the feet and legs for several hours; it is more likely that adhering particles would be washed off by river water after the briefest contact with the skin. Thus, exposure, and hence carcinogenic risk, is probably vastly overestimated.

Scenario Nos. 19, 20, and 21 deal with the carcinogenic risk and noncarcinogenic hazards resulting from potential occupational exposures of utility maintenance workers. Utility companies promote the health of their employees via institutional controls such as vapor monitoring, ventilation, personal respiratory protection, protective clothing, and safety training. The present risk assessment is valuable in that it considers very high possible levels of exposure to chemicals at the

study area due to unprotected conditions, emphasizing the need for institutional controls.

Scenarios 23 through 28 deal with construction worker health issues. Interest would appear to center on the noncarcinogenic soil inhalation effects of manganese, a naturally occurring metal, on bulldozer operators (Scenario No. 25). This is an example of a potential hazard that could be easily contained by application of institutional controls during the limited periods when bulldozing takes place.

8.4 Uncertainties

A number of factors can introduce uncertainty into any exposure and risk estimate. This section attempts to identify those key factors and assumptions that contribute uncertainty to the evaluation of risks at the study site.

8.4.1 Selection of Chemicals of Potential Concern

Lists of target "analytes" (inorganic) and "compounds" (organic) have been developed by the USEPA for the use of analytical laboratories. These lists cover the great majority of chemicals of concern found throughout the country, but may not include all of the chemicals historically associated with a particular site. According to Graselli (1992), it has been estimated that 99 percent of the organic compounds in most environmental samples are ignored. Furthermore, she cited a study of the performance of 20 contract laboratories using USEPA Method 8020 to determine purgeable organics in ground water. Most laboratories met the precision criteria, but at concentrations below 20 μg/L the overall precision estimated by the analytical method could not be achieved. Also, "there was much confusion among the laboratories on detection limits."

Although current analytical methods are generally adequate, detection limits for some of the more toxic substances may be higher than desirable. This is not an absolute; it depends on the assumed exposure conditions. To compensate for the uncertainty, a chemical that has not been detected in a given sample, but has been detected elsewhere in the medium (e.g., surface soil), is considered to occur in the

sample in question at half its detection limit. Where a chemical is found in only a few samples and at low concentrations, this assumption leads to unrealistically high estimates of the average concentration in the medium. On the other hand, a completely undetected target compound could occur widely, though at less than the detection limit. This contributes to uncertainty, in that it implies an underestimation of risk, but the contribution is usually small.

In stationary media, such as soil, the distribution of chemicals tends to be very uneven. It is difficult, even in a small sampling area, to define average concentrations. Uncertainty in the degree to which a sample actually represents some volume of the medium from which it is taken is probably most pronounced when the number of samples is extremely small. Moreover, uneven initial distribution of non-migrating solids may be reflected even in samples taken many years later. The selection of sampling points close to "hot spots" tends to bias the results towards higher than average "mean" values, which only increases the bias created by the use of the 95% UCL of the mean.

In this risk assessment, substances of little concern have been eliminated by four screening procedures (see Section 8.1.1.1). Screening is required to bring the more important chemicals into focus. Yet each screening step does diminish the risk estimate by some increment, however small.

Table 8-4 lists those analytes having exceptional influence on the risk values. As can be seen, a small number of naturally occurring elements seem to have a great influence on the risk/hazard estimates. These elements occur at levels well within the ranges that occur naturally and do not appear to significantly affect human health (when they are in their naturally occurring form). An alternative screening option would have been to exclude an inorganic analyte whose highest level was within the local or regional range of natural occurrence, or if local or regional data are not available, a worldwide range. There is a distinct possibility that the occurrence of these substances has led to an overestimate of risk or hazard.

8.4.2 Exposure Assessment

Not all conceivable exposure scenarios at the study area have been analyzed; only the more plausible ones with reasonably high exposure frequencies and concentrations have been investigated. Other possible exposure scenarios are believed to represent very little endangerment.

Among the exposure scenarios selected for evaluation, contact with Anacostia River sediment by barefoot waders is physically quite feasible but not likely to apply to many people. For those few who might be involved in this way, the hypothetical degree of contact is overestimated to cover the worst reasonable case. It is unlikely that the river sediment would adhere to the skin to any degree.

Parameters describing human characteristics and activities at best represent population means, but are frequently biased. For example, typical breathing rates published by the USEPA could be as much as twice the true values (Layton, 1993). In this risk assessment, for simplicity, parameter values chosen for the adult are those most closely associated with 70-kg male adults, even though a majority of females would weigh less. Of course, some differences within the population compensate for each other; for instance, a larger person tends to eat more than a smaller person. Uncertainty due to population diversity can be minimized to some extent by a choice of good values for the scenario-related subpopulations (e.g., 43-kg waders). Nevertheless, the inherent diversity of human populations and their behaviors must impose a considerable degree of uncertainty on group-based risk estimates when those estimates are applied to individuals.

An exposure assessment depends to a great extent on the models and assumptions on which it is based. Evaluation of some of the scenarios addressed in the present document requires assumptions based largely on the authors' judgment. And even where the literature provides models and default values, these may be based on tenuous evidence. Thus, at best, the estimated risk is only a rough approximation of reality.

8.4.3 Toxicity Assessment

Risk from exposure to a chemical can only be credibly quantified with reliable, appropriate toxicity values (RfDs and SFs) for all routes and exposure periods. The USEPA's RfDs themselves incorporate uncertainty factors, which reflect their authors' conservatism or their doubts as to the applicability of the experimental data to the human targets of concern. These uncertainties arise from the nature of the extrapolations used to derive RfDs: high-to-low dose, short-to-long term exposure, animal-to-human, less sensitive-to-more sensitive human subpopulations, lowest-observed-adverse effect level to no-observed-adverse effect level. The uncertainties lead to overestimation of hazards and risks.

There has been much criticism of the way in which carcinogenic potency values are developed and used. An article by Harris (1992) points out that chemicals are rarely tested for carcinogenicity at doses below half the maximum tolerated dose, and also says that even the most credible extrapolations to lower doses should be restricted to about one order of magnitude outside the observable range. He thinks quantitative dose-to-risk conversions should not be attempted beyond that; instead, he favors including explicitly stated safety factors for regulatory purposes. Extrapolation to risks of one-in-a-million, Harris believes, is bad science, which "should not be used to meet objectives concerning good public policy." It must also be pointed out that there may be considerable differences in anatomy, physiology, and susceptibility to certain types of cancer between humans and the more frequently used animal models; as a result, unnecessarily conservative slope factors (SFs) may have been adopted. "As Abelson points out, 'Are human beings to be regarded as behaving biochemically like huge, obese, inbred cancer-prone rodents?'" In general, the uncertainties surrounding SFs, though not stated by their originators, are as compelling as those associated with RfDs and lead to gross overestimates of risk.

In some cases, in the absence of official RfDs, surrogate values were used in the present assessment - specifically the oral chronic RfD for pyrene being used as an RfD for total PAHs. This adoption of a low-sided RfD value for some of the PAHs serves to make the results somewhat conservative.

Benzo[a]pyrene's carcinogenic potency was used, along with relative potency factors (USEPA 1995), to estimate carcinogenic potency for certain other carcinogenic PAHs in this risk assessment. There could be other carcinogenic PAHs present, however, whose carcinogenicity has not been recognized or quantified.

The mineral forms in which inorganic analytes occur may greatly affect the degree to which they are absorbed by the digestive system. Indeed, it is virtually certain that the forms in which such elements as iron, manganese, aluminum and chromium occur -- and these appear prominently in the present study -- are not the forms in which these elements were tested. As natural (not anthropogenic) constituents of soil (see Shacklette and Boerngen, 1984 and Bodek et al., 1988), the upper ends of the ranges of soil content of such elements significantly exceed even the highest concentrations of these four elements at the study area; evidently, however, there is no indication that such levels are a threat to human health. In fact, some such elements are essential nutrients.

Little certainty exists about dermal absorption. The soil-to-skin dermal absorption factor, ABS, is probably quite variable even for a single analyte.

8.4.4 Risk Characterization

The interactive effects of exposure to a multiplicity of chemicals are unpredictable; one seldom knows whether they will be synergistic, antagonistic, or purely additive. Since exposure levels at the study area are estimated to be low for all but three of the populations, it is likely that interactive effects in most instances will be minimal, and the toxicological uncertainty will be the sum of uncertainties related to the individual substances. This still leaves in question the validity of the hazard index concept. If the chemicals attack different target organs, or are even antagonistic to one another, is it correct to lump their effects in a single hazard index? Lack of an answer to this question, except for limited groups of compounds (e.g., carcinogenic PAHs), adds to the overall toxicological uncertainty. If the compounds could be allocated to various groups, and the highest group hazard index could be considered to represent the overall hazard, then the uncertainty might be reduced.

8.5 Summary of Findings

Following a four-step process, 35 chemicals were identified as COPCs (Table 8-2). They include 14 metals, total cyanide, 16 semi-volatile organic compounds (mostly PAHs), and four volatile organic compounds (benzene, ethylbenzene, toluene, and xylenes).

Thirty (30) of the 32 analyzed exposure scenarios (Table 8-3) had carcinogenic risks less than or within the USEPA's target range of one excess lifetime cancer risk in a population of between 10,000 to 1,000,000 (10^{-4} to 10^{-6} or E-04 to E-06. Risks within this range are normally found acceptable. Twenty-two (22) of the scenarios had excess lifetime cancer risks of less than one in a population of 1,000,000, a risk level that the USEPA considers "de minimis" or negligible.

Two of the 32 scenarios (Scenarios 31 and 32) had risk levels higher than the USEPA's target range. They were dermal exposure of residents on the East Station property (assuming the future use of the property was residential) to surface soil and dermal exposure of a juvenile to surface soil while using the NPS property for recreation.

The hazard indices (noncarcinogenic risks) for 30 of the 32 risk scenarios described in Table 8-3 are below one, indicating a non-hazardous condition. The hazards to utility workers due to inhalation of soil vapors (Scenario No. 19), and the hazards to bulldozer operators due to inhalation of manganese-laden particulates (Scenario No. 25) are above one, indicating a potentially hazardous condition. Institutional controls could provide the protection necessary to eliminate these risks.

A summary of potential risk for each population is shown in Table 8-5.

8.6 Variance from Guidance

The screen for organics followed the national RAGS IA (USEPA, 1989a) guidance rather than the USEPA Region III guidance (Smith, 1993). The Region III guidance indicates that the risk assessment should focus on "dominant contaminants and routes of exposure." The Region III guidance also, in referring to the RAGS IA

screening method, states: "While very efficient at selecting dominant contaminants in each medium, this method does not evaluate significance of total risk for the medium. Thus, the concentration toxicity screen can eliminate contaminants, but not routes of exposure." In completing this risk assessment, the concentration toxicity screen for organics was not used to select routes of exposure, only to select dominant contaminants of concern. During the April 1997 meeting with the USEPA and others to discuss the first draft of the final report, SATA, USEPA's contractor that reviewed the risk assessment, indicated that the utilized screening method, while differing from Region III guidance, would result in essentially the same findings and, thus, was acceptable.

8.7 References

Atlantic Environmental Services, Inc. (Referred to as GRI), May, 1988, *Management of Manufactured Gas Plant Sites. Volume III, Risk Assessment,* GRI-87/0260.3, Prepared for Gas Research Institute (GRI), 8600 West Bryn Mawr Avenue, Chicago, IL 60631, Appendix B.

Bodek, I., W.J. Lyman, W.F. Reehl, and D.H. Rosenblatt, 1988, *Environmental Inorganic Chemistry: Properties, Processes and Estimation Methods*, Pergamon Press, New York, N.Y.

Byers T. F. 1997, *1997 District of Columbia Pilot Telephone Angler Survey*, D.C. Department of Consumer and Regulatory Affairs, Environmental Regulation Administration, Fisheries Management Branch.

Conover, W. J., 1980. *Practical Nonparametric Statistics*, 2nd ed., Wiley, New York.

Friberg L, Nordberg FG, Vouk VB. *1986 Handbook on the toxicology of metals: Volume II: Specific metals*, 2nd ed. Amsterdam: Elsevier.

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

Graselli, J.G., 1992, *Analytical Chemistry, Feeding the Environmental Revolution?*, Anal. Chem. 64(13):677A-685A.

GRI, see Atlantic Environmental Services, Inc.

Harris, W.E., 1992, *Analyses, Risks, and Authoritative Misinformation*, Anal. Chem. 64(13):665A-671A.

Hawley J.K., 1985, *Assessment of health risk from exposure to contaminated soil*, Risk Anal. 5:289-302.

Hubbard, J., December, 1995, *Assessing Dermal Exposure from Soil*, U.S. Environmental Protection Agency, Region III, Philadelphia, Pennsylvania.

Layton, D.W., 1993, *Metabolically Consistent Breathing Rates for Use in Dose Assessments*, Health Physics, 64[1]: 23-36.

Owen B.A., 1990, *Literature-derived absorption coefficients for 39 chemicals via oral and inhalation routes of exposure*, Regul. Toxicol. Pharmacol. 11: 237-252.

Pinkney, A.E., W.H. Burton, L.C. Scott and J.B. Frithsen, 1993, *An Assessment of Potential Effects of the January 1992 Oil Spill in the Anacostia River*, performed for the Steuart Petroleum Co. by Versar, Inc., Columbia, MD.

Shacklette, H.T. and J.G. Boerngen, 1984, *Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States*, U.S. Geological Survey Professional Paper 1270, U.S. Government Printing Office, Washington, D.C.

Smith, R.L., January 1993, *Selecting Exposure Routes and Chemicals of Concern by Risk-Based* Screening, U.S. Environmental Protection Agency, Region III, Philadelphia, Pennsylvania.

Smith, R.L., April 1996, *EPA Region III Risk-Based Concentration Table*, U.S. Environmental Protection Agency, Region III, Philadelphia, Pennsylvania.

Trowbridge, P.R. and D.E. Burmaster, 1997, *A Parametric Distribution for the Fraction of Outdoor Soil in Indoor Dust*, J. Soil Contam. 6: 161-168.

U.S. Department of Housing and Urban Development, June 1995, *Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing, Washington, DC*, p. 5-35.

USEPA, 1996, *Soil Screening Guidance: Tecnical Background Document*, EPA/540/R-95/128, PB96-963502, Office of Solid Waste and Emergency Response, Washington, DC, p. A-5.

USEPA, 1995, *Guidance for Assessing Chemical Chemical Data for Use in Fish Advisories. Volume 1. Fish Sampling and Analysis, Second Edition*, EPA 823-R-95-007, United States Environmental Protection Agency, Office of Water, Washington, DC.

USEPA, 1994, *Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities*, EPA 540-F-94-043, Office of Solid Waste and Emergency Response, Washington, DC.

USEPA, 1992a, *Dermal Exposure Assessment: Principles and Applications*, Interim Report, Washington, DC, Office of Health and Environmental Assessment, U.S. Environmental Protection Agency. EPA/600/8-91/011B.

USEPA, 1992b, *Supplemental Guidance to RAGS: Calculating the Concentration Term*, Washington, DC, Office of Health and Environmental Assessment, U.S. Environmental Protection Agency. Publication 92B5.7-081.

USEPA, 1991, *Risk assessment guidance for Superfund. Volume I. Human health evaluation manual Supplemental Guidance, "Standard Default Exposure Factors."* Interim final, March 25, 1991. Washington, DC: U.S. Environmental Protection Agency. OSWER Directive: 9285.6-03.

USEPA, 1989a, *Risk assessment guidance for Superfund, Volume I: Human health evaluation manual (Part A)*, Interim final, Washington, DC: U.S. Environmental Protection Agency. EPA/540/1-89/002.

USEPA, 1989b, *Exposure factors handbook*, Washington, DC: Office of Health and Environmental Assessment, U.S. Environmental Protection Agency. EPA/600/8-89/043.

FIGURE 8-1

Conceptual Exposure Diagram

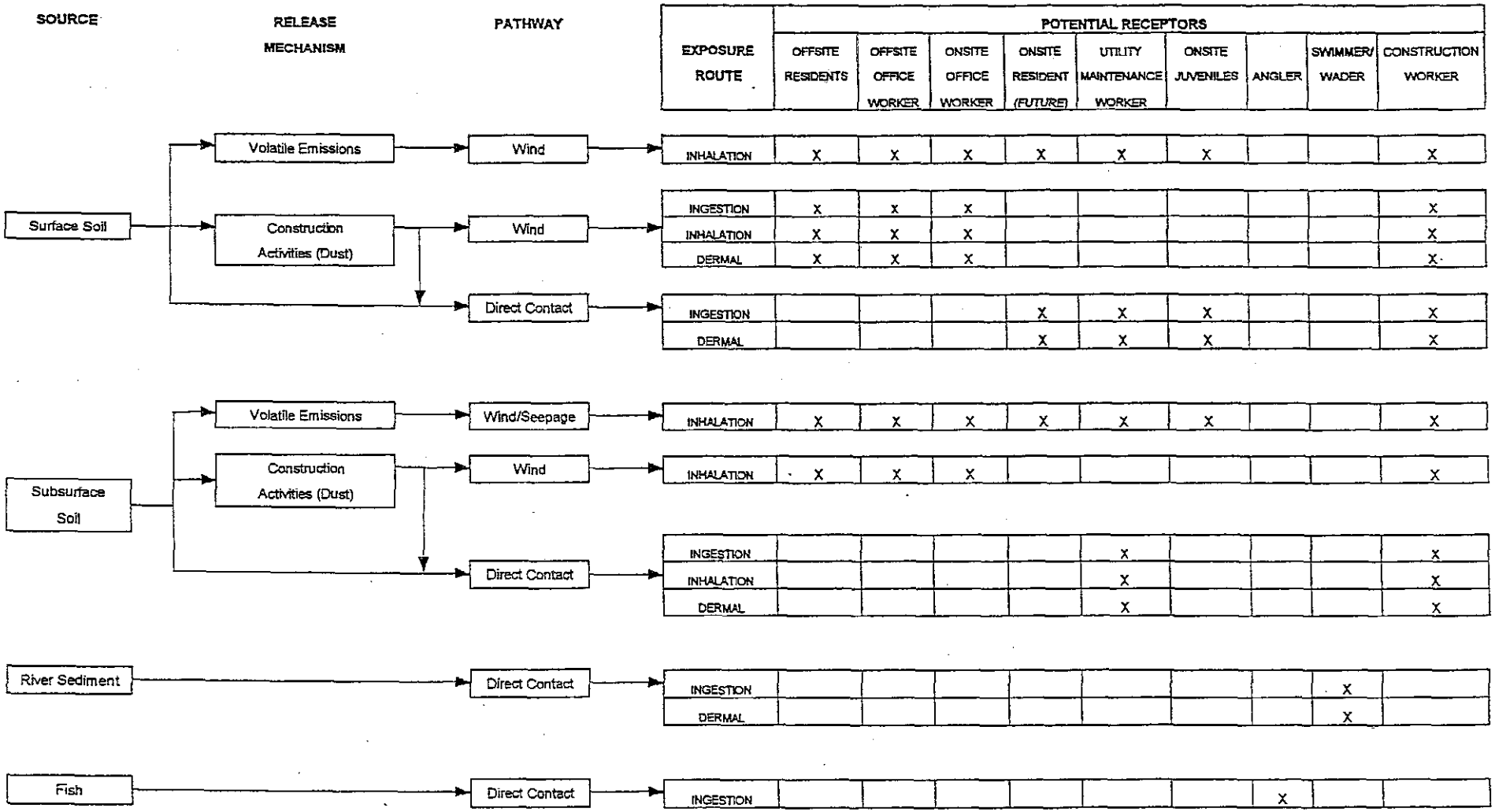

TABLE 8-1

Data Group Summary Table

Data Group	Description of Data Group	Samples in Data Group
1	Surface soil samples at the southwest corner of the study area	SR-16 thru SR-22, SR-24, and SR-25
2	Soil boring and surface soil samples from the East Station property	SB-2 thru SB-10 (0-2' in depth); SR-1 thru SR-20 & SR-23
3	Surface soil sample on DC DPW parking lot (NPS property)	SR-25 only
4	Surface soil samples on East Station property	SR-1 thru SR-20 and SR-23
5	Surface soil samples on NPS property	SR-21, SR-22, SR-24, SR-25, and SR-26
6	Soil gas samples from the southwest corner of the study area	SG-20 thru SG-23, SG-25 thru SG-34, & SG-38 thru SG-42
7	Sediment samples adjacent to study area and upstream	96SD02 thru 96SD05, 96SD07
8	Soil boring samples north of the 900-North Grid Line (East Station property)	SB-2 thru SB-8, 0-2' and 2-4' in depth
9	Soil gas sample located in area of potential future construction (East Station property)	SG-12 only
10	All soil gas samples from study area	SG-1 thru SG-45
11	All soil boring samples from study area	SB-1 thru SB-13, 0 to 6' in depth
12	Fish samples collected by Versar (1993)	

Note: The sample locations are shown on figures in Section 5 of this report.

TABLE 8-2
Chemicals of Potential Concern for Each Data Group

Chemicals of Potential Concern	Data Groups*											
	1	2	3	4	5	6	7	8	9	10	11	12
Inorganics												
Aluminum	X	X		X	X		X				X	
Antimony		X									X	
Arsenic	X	X	X	X	X		X				X	
Beryllium	X	X	X	X	X		X				X	
Cadmium											X	
Chromium	X	X	X	X	X		X				X	
Copper							X				X	
Iron	X	X	X	X	X		X				X	
Lead**							X				X	
Manganese	X	X	X	X	X		X				X	
Mercury		X		X								
Nickel		X		X								
Thallium		X									X	
Vanadium	X	X	X	X	X		X				X	
Total Cyanides		X									X	
Organics												
Total PAHs***	X	X	X	X	X		X				X	X
Acenaphthene							X					
Benzene						X		X	X	X		
Ethylbenzene						X		X	X	X		
Benzo[a]anthracene	X	X	X	X	X		X				X	X
Benzo[a]pyrene	X	X	X	X	X		X				X	X
Benzo[b]fluoranthene	X	X	X	X	X		X				X	X
Benzo[g,h,i]perylene	X	X	X	X	X		X				X	
Benzo[k]fluoranthene	X	X	X	X	X		X				X	X
Bis(2-ethylhexyl) Phthalate	X		X	X	X		X					
Chrysene	X	X	X	X	X		X				X	X
Dibenzo[a,h]anthracene	X	X	X	X	X		X				X	X
Dibenzofuran		X					X				X	
Fluoranthene	X	X	X	X	X		X				X	
Fluorene							X					
Indeno[1,2,3-cd]pyrene	X	X	X	X	X		X				X	X
2-Methylnaphthalene							X					
Naphthalene	X	X	X	X	X		X				X	
Pyrene	X	X	X	X	X		X				X	
Toluene						X		X	X	X		
Xylenes						X		X	X	X		

* Data Groups:

1. Surface Soil Samples Southwest Crnr. of Site (SR16 - SR22, SR24 & SR25)
2. Soil Borings & Surface Soil North of Water Street (SB2 - SB10, 0-2' in depth; SR1 - SR20 & SR23)
3. Surface Soil Sample SR-25
4. Surface Soil Samples North of Water Street (SR-1 through SR-20 and SR-23)
5. Surface Soil Samples South of Water Street (SR-21, SR-22, SR-24, SR-25 and SR-26)
6. Soil Gas Samples Southwest Crnr. of Site (SG20 - SG23, SG25 - SG34 & SG38 - SG42)
7. Sediment Samples Downstream of East Station (96SD02 - 96SD05 & 96SD07)
8. Soil Borings North of 900-North Grid Line (SB2 - SB8, 0-2' & 2-4' in depth)
9. Soil Gas Sample SG-12
10. All Soil Gas Samples (SG-1 through SG-45)
11. All Soil Borings (SB-1 through SB-13; all three intervals)
12. Fish Samples Collected by Versar (1993)

** Risk/Hazard was not evaluated for Lead because no RfD or CPS values are available.

*** Total PAH's are the sum of the chemicals listed in Section 8.1.1.2.

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TABLE 8-3
SUMMARY OF HUMAN HEALTH RISK ASSESSMENT

Scenario No.	Population	Exposure Location	Exposure Route	Time Frame			HIF Table	Cancer Risk	Hazard Index
				Pres	Trans	Future			
1	Angler	Anacostia R.	Fish Ingestion	x	x	x	1	2.8E-07	4.8E-03
2	Swimmer/	Anacostia R.	Sediment Ingestion	x	x	x	2	9.7E-07	5.0E-03
3	Wader		Sediment Dermal	x	x	x	3	8.9E-06	7.6E-03
4	Offsite Resident	Outside Study Area	Soil VOC Inhalation	x	x	x	4	4.3E-09	4.3E-04
5			Eroded Dust Inhalation	x	x		4	2.4E-09	9.2E-05
6			Bulldozer Dust Inhalation		x		15	8.0E-07	7.4E-01
7			Excav. Soil VOC Inhalation		x		4	5.0E-08	4.8E-03
8	Offsite Office Worker	Outside Study Area	Soil VOC Inhalation	x	x	x	5	2.2E-10	1.1E-05
9			Eroded Dust Inhalation	x	x		5	1.2E-10	2.3E-06
10			Bulldozed Dust Inhalation		x		14	3.4E-08	3.2E-02
11			Excav. Soil VOC Inhalation		x		5	1.6E-09	7.4E-04
12	Onsite Office Worker	East Station Property	Soil VOC Inhalation			x	5	9.6E-10	4.6E-05
13			Bulldozed Dust Inhalation		x		14	4.9E-07	4.5E-01
14		NPS Property	Vehicular Dust Inhalation	x	x	x	5	2.8E-07	5.1E-03
15		East Station Property	Excav. Soil VOC Inhalation		x		5	2.3E-08	1.1E-03
16			Soil VOC Inhal. via Cracks			x	5	2.8E-10	1.4E-05
17	Onsite Resident	East Station Property	Soil VOC Inhalation			x	4	8.7E-09	8.6E-04
18			Soil VOC Inhal. via Cracks			x	4	2.5E-09	2.6E-04
29			Surface Soil Ingestion			x	16	9.0E-05	9.7E-
31			Surface Soil Dermal			x	18	2.4E-04	4.6E-01
19	Utility Maint. Worker	Study Area	Subsurface Soil VOC Inhal.	x	x	x	6	5.5E-05	3.9E+00
20			Subsurface Soil Ingestion	x	x	x	7	2.8E-06	4.5E-03
21			Subsurface Soil Dermal	x	x	x	8	1.2E-05	6.4E-03
22	Juvenile Recreation	NPS Property	Soil VOC Inhalation			x	9	1.8E-08	2.2E-03
30			Surface Soil Ingestion			x	17	3.2E-05	2.2E-01
32			Surface Soil Dermal			x	19	3.0E-04	3.5E-01
23	Construction Worker	East Station Property	Soil VOC Inhalation		x		10	1.1E-10	1.5E-04
24			Eroded Dust Inhalation		x		10	1.4E-10	8.2E-05
25*			Bulldozed Dust Inhalation		x		13	3.7E-05	3.5E+01
26			Excav. Soil VOC Inhalation		x		10	2.5E-09	3.5E-03
27			Soil Ingestion		x		11	4.5E-07	3.8E-02
28			Soil Dermal		x		.12	1.9E-06	2.7E-02

Shaded areas indicate an exceedance of acceptable risk levels:
Hazard Index > 1.0 Cancer > 1.0E-04

Scenarios are not listed in numerical order (Scenarios 29 - 32 were added later).

HIF Tables are found in Appendix D

* Scenario 25 only applies to the bulldozer operator.

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TABLE 8
Analytes of Exceptional Influence

Scenario No.	Data Group	Population	Exposure Route	Cancer Risk	Hazard Index	Cancer Risk		Hazard Index	
						Analytes of Exceptional Influence	Percent of Total	Analytes of Exceptional Influence	Percent of Total
1	12	Angler	Fish Ingestion	2.8E-07	4.8E-03				
2	7	Swimmer/ Wader	Sediment Ingestion	9.7E-07	5.0E-03	Benzo[a]pyrene	67%	Iron	50%
3	7		Sediment Dermal	8.9E-06	7.6E-03				
4	6	Offsite Resident	Soil VOC Inhalation	4.3E-09	4.3E-04			Benzene	97%
5	1		Eroded Dust Inhalation	2.4E-09	9.2E-05	Chromium	88%	Manganese	99%
6	2		Bulldozer Dust Inhalation	8.0E-07	7.4E-01	Chromium	88%	Manganese	99%
7	8		Excav. Soil VOC Inhalation	5.0E-08	4.8E-03			Benzene	100%
8	6	Offsite Office Worker	Soil VOC Inhalation	2.2E-10	1.1E-05			Benzene	95%
9	1		Eroded Dust Inhalation	1.2E-10	2.3E-06	Chromium	89%	Manganese	97%
10	2		Bulldozed Dust Inhalation	3.4E-08	3.2E-02	Chromium	89%	Manganese	98%
11	8		Excav. Soil VOC Inhalation	1.6E-09	7.4E-04			Benzene	100%
12	6	Onsite Office Worker	Soil VOC Inhalation	9.6E-10	4.6E-05			Benzene	98%
13	2		Bulldozed Dust Inhalation	4.9E-07	4.5E-01	Chromium	88%	Manganese	100%
14	3		Vehicular Dust Inhalation	2.8E-07	5.1E-03	Chromium	90%	Manganese	99%
15	8		Excav. Soil VOC Inhalation	2.3E-08	1.1E-03			Benzene	96%
16	9		Soil VOC Inhal. via Cracks	2.8E-10	1.4E-05			Benzene	93%
17	6	Onsite Resident	Soil VOC Inhalation	8.7E-09	8.6E-04			Benzene	98%
18	9		Soil VOC Inhal. via Cracks	2.5E-09	2.6E-04			Benzene	93%
29	4		Surface Soil Ingestion	9.0E-05	9.7E-01	Benzo[a]pyrene	56%	Iron	58%
31	4		Surface Soil Dermal	2.4E-04	4.6E-01	Benzo[a]pyrene	62%		
19	10	Utility Maint. Worker	Subsurface Soil VOC Inhal.	5.5E-05	3.9E+00			Benzene	99%
20	11		Subsurface Soil Ingestion	2.8E-06	4.5E-03	Benzo[a]pyrene	57%		
21	11		Subsurface Soil Dermal	1.2E-05	6.4E-03	Dibenz[a,h]anthracene	58%		
22	6	Juvenile Recreation	Soil VOC Inhalation	1.8E-08	2.2E-03			Benzene	96%
30	5		Surface Soil Ingestion	3.2E-05	2.2E-01	Benzo[a]pyrene	60%	Iron	53%
32	5		Surface Soil Dermal	3.0E-04	3.5E-01	Benzo[a]pyrene	63%		
23	6	Construction Worker	Soil VOC Inhalation	1.1E-10	1.5E-04			Benzene	100%
24	1		Eroded Dust Inhalation	1.4E-10	8.2E-05	Chromium	92%	Manganese	99%
25*	2		Bulldozed Dust Inhalation	3.7E-05	3.5E+01	Chromium	89%	Manganese	98%
26	8		Excav. Soil VOC Inhalation	2.5E-09	3.5E-03			Benzene	100%
27	2		Soil Ingestion	4.5E-07	3.8E-02	Benzo[a]pyrene	56%	Iron	55%
28	2		Soil Dermal	1.9E-06	2.7E-02	Benzo[a]pyrene	59%		

Exceptional Influence - An analyte which contributes 50% or greater to the total risk.

Shaded areas indicate an exceedance of acceptable risk levels:
Cancer > 1.0E-04
Hazard Index > 1.0

* Scenario 25 only applies to the bulldozer operator.

TABLE 8-5
Summary of Total Potential Risk for Each Population

RISK	TIME FRAME	POPULATION								
		Angler	Swimmer/ Wader	Offsite Resident	Offsite Office Worker	Onsite Office Worker	Onsite Resident	Utility Maintenance Worker	Juvenile Recreation	Construction Worker *
TOTAL CANCER RISK	Present	2.8E-07	9.9E-06	6.7E-09	3.4E-10	2.8E-07	NA	7.0E-05	NA	NA
	Transient	2.8E-07	9.9E-06	8.6E-07	3.6E-08	7.9E-07	NA	7.0E-05	NA	3.9E-05
	Future	2.8E-07	9.9E-06	4.3E-09	2.2E-10	2.8E-07	3.3E-04	7.0E-05	3.3E-04	NA
TOTAL HAZARD INDEX	Present	4.8E-03	1.3E-02	5.2E-04	1.3E-05	5.1E-03	NA	3.9E+00	NA	NA
	Transient	4.8E-03	1.3E-02	7.5E-01	3.3E-02	4.6E-01	NA	3.9E+00	NA	3.5E+01
	Future	4.8E-03	1.3E-02	4.3E-04	1.1E-05	5.2E-03	1.4E+00	3.9E+00	5.7E-01	NA

Shaded areas indicate an exceedance of acceptable risk levels:
Cancer Risk > 1.0E-04.
Hazard Index > 1.0

Tabulated risk and hazard index is only for a bulldozer operator exposed to equipment-generated dust. Risk and hazard index to other construction workers are 1.3E-06 and 1.0E-01, respectively.

APPENDIX G

Risk Calculations

TABLE OF CONTENTS
APPENDIX G

HEALTH RISK TO UTILITY MAINTENANCE WORKERS DUE TO INHALATION OF SUBSURFACE SOIL GAS

EXPOSURE

As a worst-case situation, utility maintenance workers working in trenches and other below-ground spaces will be exposed to levels of volatile organic compounds (soil gas) approaching the reported soil gas levels. The indicator compounds are benzene, toluene, ethylbenzene and total xylenes ("BTEX").

Soil gas samples taken from the NPS property were analyzed, and the 95 percent upper confidence level of the mean (95% UCL) for each indicator compound was calculated (see Appendix H). The 95% UCL concentrations (mg/m^3) for all four compounds were 0.50 mg/m^3. These were used directly in the calculations, with no allowance for dilution with clean air.

CARCINOGENIC AND NONCARCINOGENIC RISKS

Reference: Smith, R.L., 1996, EPA Region III Risk-Based Concentration Table, United States Environmental Protection Agency, Philadelphia, PA.

Human intake factors (HIFs) for inhalation of soil gas by utility maintenance workers (see Table G1, Appendix G) were as follows:

- Inhalation carcinogenic HIF = 7.83E-04 $m^3/(kg \cdot day)$
- Inhalation noncarcinogenic HIF = 2.74E-03 $m^3/(kg \cdot day)$

A. Carcinogenic Risk

The 95% UCL (0.50 mg/m^3) for the one carcinogen, benzene, was multiplied by its CPS_i value, 0.029 kg·day/mg, and by the HIF value appropriate for carcinogens to obtain the cancer risk by inhalation.

Cancer Risk to Utility Maintenance Worker = 1.14E-05

B. Noncarcinogenic Risk (Hazard Index)

Inhalation reference doses (RfDs) with respect to noncarcinogenic effects, in mg/(kg•day), were obtained from the reference document: Benzene, 0.00171; toluene, 0.114; ethylbenzene, 0.286; and xylenes (using the value for p-xylene), 0.0857.

Ninety-five percent upper confidence levels of the means for all four indicator compounds were used in calculating the hazard index (the sum of the hazard quotients). To obtain hazard quotients, one multiplies soil gas concentration by the noncarcinogenic HIF and divides by the appropriate RfD_i value.

Analyte	95 % UCL Soil Gas Concentration (mg/m^3)	RfD_I (mg/kg/d)	Hazard Quotient
Benzene	0.5	0.00171	8.01E-01
Toluene	0.5	0.114	1.20E-02
Ethylbenzene	0.5	0.286	5.00E-03
Xylenes	0.5	0.0857	1.60E-02
HAZARD INDEX FOR UTILITY MAINTENANCE WORKERS EXPOSED TO SOIL GAS THROUGH INHALATION			**8.34E-01**

HEALTH RISK TO UTILITY MAINTENANCE WORKERS DUE TO INGESTION OF SUBSURFACE SOIL

EXPOSURE

Utility maintenance workers are exposed to soil to a depth of 3.5 feet

Subsurface soil samples taken from the NPS property were analyzed and the 95 percent upper confidence level (95% UCL)for each indicator analyte shown below was calculated (see Appendix H).

CARCINOGENIC AND NONCARCINOGENIC RISKS

Reference: Smith, R.L., 1996, EPA Region III Risk-Based Concentration Table, United States Environmental Protection Agency, Philadelphia, PA.

Human intake factors (HIFs) for ingestion of soil by utility maintenance workers (see Table G2, Appendix G) were as follows:

- Ingestion carcinogenic HIF = 5.59E-09 d^{-1}
- Ingestion noncarcinogenic HIF = 1.96E-08 d^{-1}

A. Carcinogenic Risk

The 95% UCLs of the means for the indicator analytes were multiplied by CPS_o values (see Reference) and by the HIF value appropriate for carcinogens to obtain the cancer risk by ingestion for each compound. The results are shown below.

Analyte	95% UCL Conc. in Soil (mg/kg)	CPS_o (kg·d/mg)	Cancer Risk
Benzo[a]anthracene	1.810	0.73	7.39E-09
Benzo[a]pyrene	2.831	7.3	1.16E-07
Benzo[b]fluoranthene	2.095	0.73	8.55E-09
Benzo[k]fluoranthene	1.821	0.073	7.43E-10
Chrysene	2.168	0.0073	8.85E-11
Dibenzo[a,h]anthracene	1.863	7.3	7.60E-08
Ideno[1,2,3-cd]pyrene	1.942	0.73	7.92E-09
Arsenic	12.734	1.5	1.07E-07
Beryllium	1.250	4.3	3.00E-08
TOTAL CANCER RISK FOR UTILITY MAINTENANCE WORKERS INGESTING SUBSURFACE SOIL			**3.54E-07**

B. Noncarcinogenic Risk (Hazard Index)

The 95% UCLs for all of the indicator polynuclear aromatic hydrocarbons (PAHs), carcinogenic or not, were summed to obtain a 95% UCL for total PAHs. It is assumed here that all these PAHs have the oral reference dose (RfD_o) of pyrene, namely 0.03 mg/(kg•day). To obtain hazard quotients, one multiplies concentration in the subsurface soil by the non-carcinogenic HIF and divides by the appropriate RfD_o value. The results are shown below.

Analyte	95% UCL Conc. in Soil (mg/kg)	RfD_o (mg/kg/d)	Hazard Quotient
Total PAHs	63.158	0.03	4.13E-05
Dibenzofuran	2.401	0.004	1.18E-05
Aluminum	6860.000	1.00	1.34E-04
Antimony	1.250	0.0004	6.12E-05
Arsenic	12.734	0.0003	8.32E-04
Beryllium	1.250	0.005	4.90E-06
Cadmium	1.250	0.0005	4.90E-05
Chromium	28.411	0.005	1.11E-04
Copper	101.500	0.04	4.97E-05
Iron	26824.000	0.3	1.75E-03
Manganese	422.867	0.023	3.60E-04
Thallium	1.000	0.00008	2.45E-04
Vanadium	39.638	0.007	1.11E-04
Total Cyanides	2.500	0.02	2.45E-06
HAZARD INDEX FOR UTILITY MAINTENANCE WORKERS INGESTING SUBSURFACE SOIL			**3.76E-03**

HEALTH RISK TO UTILITY MAINTENANCE WORKERS DUE TO DERMAL CONTACT WITH SUBSURFACE SOIL

EXPOSURE

Utility maintenance workers will be exposed to soil to a depth of 3.5 feet on the NPS property.

Subsurface soil samples taken from the NPS property were analyzed and the 95 percent upper confidence level (95% UCL) for each indicator analyte was calculated (see Appendix H).

CARCINOGENIC AND NONCARCINOGENIC RISKS

Reference:. Smith, R.L., 1996, EPA Region III Risk-Based Concentration Table, United States Environmental Protection Agency, Philadelphia, PA.

Human intake factors (HIFs) for dermal exposure of utility maintenance workers to subsurface soil (see Table G3, Appendix G), were as follows:

- Ingestion carcinogenic HIF = 2.46E-07 d^{-1} ABS
- Ingestion noncarcinogenic HIF = 8.61E-07 d^{-1} ABS

The dermal absorption factors (ABS) for the indicator analytes are: 0.1 for organics, 0.032 for arsenic, and 0.01 for all other inorganics.

A. Carcinogenic Risk

The 95% UCLs for the seven carcinogenic polynuclear aromatic hydrocarbons (PAHs) and two metals were multiplied by CPS_o values, by the ABS factor, and by the HIF value appropriate for carcinogens to obtain the cancer risk by ingestion for each compound. The results are shown below.

Analyte	95% UCL Conc. in Soil (mg/kg)	ABS Factor	CPS_o (kg @ d/mg)	Cancer Risk
Benz[a]anthracene	1.810	0.1	0.73	3.25E-08
Benzo[a]pyrene	2.831	0.1	7.3	5.08E-07
Benzo[b]fluoranthene	2.095	0.1	0.73	3.76E-08
Benzo[k]fluoranthene	1.821	0.1	0.073	3.27E-09
Chrysene	2.168	0.1	0.0.0073	3.89E-10
Dibenz[a,h]anthracene	1.863	0.1	7.3	3.35E-07
Ideno[1,2,3-cd]pyrene	1.942	0.1	0.73	3.49E-08
Arsenic	12.734	0.032	1.5	1.50E-07
Beryllium	1.250	0.01	4.3	1.32E-08
TOTAL CANCER RISK FOR UTILITY MAINTENANCE WORKER DUE TO DERMAL CONTACT WITH SUBSURFACE SOIL				**1.11E-06**

B. Noncarcinogenic Risk (Hazard Index)

The 95% UCLs for the all indicator polynuclear aromatic hydrocarbons (PAHs), carcinogenic or not, were summed to obtain a 95% UCL for total PAHs. It is assumed here that all these PAHs have the oral reference dose (RfD_o) of pyrene, namely 0.03 mg/(kg•day). To obtain hazard quotients, one multiplies concentration in the subsurface soil by the noncarcinogenic HIF and by the ABS factor and divides by the appropriate RfD_o value.

Analyte	95% UCL Conc. in Soil (mg/kg)	ABS Factor	RfD_o (mg/kg/d)	Hazard Quotient
Total PAHs	63.158	0.1	0.03	1.81E-04
Dibenzofuran	2.401	0.1	0.004	5.17E-05
Aluminum	6860.000	0.01	1.00	5.91E-05
Antimony	1.250	0.01	0.0004	2.69E-05
Arsenic	12.734	0.032	0.0003	1.17E-03
Beryllium	1.250	0.01	0.005	2.15E-06
Cadmium	1.250	0.01	0.0005	2.15E-05
Chromium	28.411	0.01	0.005	4.89E-05
Copper	101.500	0.01	0.04	2.18E-05
Iron	26824.000	0.01	0.3	7.70E-04
Manganese	422.867	0.01	0.023	1.58E-04
Thallium	1.000	0.01	0.00008	1.08E-04
Vanadium	39.638	0.01	0.007	4.88E-05
Total Cyanides	2.500	0.01	0.02	1.08E-06
HAZARD INDEX FOR UTILITY MAINTENANCE WORKER HAVING DERMAL CONTACT WITH SUBSURFACE SOIL				**2.67E-03**

HEALTH RISK TO UTILITY LANDSCAPE WORKER DUE TO INHALATION OF SOIL GAS

EXPOSURE

Landscape workers will work in shallow excavations where the breathing zone is above ground, and, thus, will be exposed to levels of volatile organic compounds (soil gases) less that the concentration measured in the soil. The indicator compounds are benzene, toluene, ethylbenzene and total xylenes ("BTEX").

Soil gas samples taken from in situ soil on the NPS property were analyzed, and the 95 percent upper confidence level (95% UCL) of the mean for each indicator compound was calculated (see Appendix H). The 95% UCL concentrations (mg/m^3) for all four compounds were 0.50 mg/m^3. It was assumed that landscape workers will be exposed to diluted soil gases equal to one half the 95% UCLs for the compounds present in the soil.

CARCINOGENIC AND NONCARCINOGENIC RISKS

Reference: Smith, R.L., 1996, EPA Region III Risk-Based Concentration Table, United States Environmental Protection Agency, Philadelphia, PA.

Since the exposure events per year for landscape workers were assumed to be 2.5 rather than the 5.0 assumed for utility maintenance workers, the human intake factors (HIFs) for inhalation of soil gas by landscape workers is one half those determined for utility maintenance workers (see Table G1, Appendix G).

- Inhalation carcinogenic HIF = 3.92E-04 $m^3/(kg\text{-}day)$
- Inhalation noncarcinogenic HIF = 1.37E-03 $m^3/(kg\text{-}day)$

A. Carcinogenic Risk

The 95% UCL (0.25 mg/m^3) for the one carcinogen, benzene, was multiplied by its CPS_i value, 0.029 kg-day/mg, and by the HIF value appropriate for carcinogens to obtain the cancer risk by inhalation.

Cancer Risk to Landscape Worker = 2.84E-06

B. Noncarcinogenic Risk (Hazard Index)

Inhalation reference doses (RfDs) with respect to noncarcinogenic effects, in mg/(kg-day), were obtained from the referenced document: Benzene, 0.00171; toluene, 0.114; ethylbenzene, 0.286; and xylenes (using the value for p-xylene), 0.0857.

One half the 95% UCLs for all four indicator compounds were used in calculating the hazard index (the sum of the hazard quotients). To obtain hazard quotients, one multiplies soil gas concentration by the noncarcinogenic HIF and divides by the appropriate RfD_i value. The results are shown on the next page.

Analyte	95 % UCL Soil Gas Concentration (mg/m^3)	RfD_i (mg/kg/d)	Hazard Quotient
Benzene	0.25	0.00171	2.00E-01
Toluene	0.25	0.114	3.00E-03
Ethylbenzene	0.25	0.286	1.20E-03
Xylenes	0.25	0.0857	4.00E-03
HAZARD INDEX FOR LANDSCAPE WORKER EXPOSED TO SOIL GAS THROUGH INHALATION			**2.01E-01**

HEALTH RISK TO LANDSCAPE WORKER DUE TO INGESTION OF SUBSURFACE SOIL

EXPOSURE

Landscape workers are conservatively assumed to be exposed to soil to a depth of 3.5 feet on the NPS property.

Subsurface soil samples taken from the NPS property were analyzed, and the 95 percent upper confidence level (95% UCL) for each indicator analyte shown below were calculated (see Appendix H).

CARCINOGENIC AND NONCARCINOGENIC RISKS

Reference: Smith, R.L., 1996, EPA Region III Risk-Based Concentration Table, United States Environmental Protection Agency, Philadelphia, PA.

Since the exposure events per year for landscape workers was assumed to be one half that of utility maintenance workers, the human intake factors (HIFs) are one half the values determined for utility maintenance workers (see Table G2, Appendix G). The HIFs for landscape workers are as follows:

- Ingestion carcinogenic HIF = 2.79E-09 d^{-1}
- Ingestion noncarcinogenic HIF = 9.80E-09 d^{-1}

A. Carcinogenic Risk

The 95%UCLs for the indicator analytes were multiplied by CPS_o values (see Reference) and by the HIF values appropriate for carcinogens to obtain the cancer risk by ingestion for each compound. The results are shown below.

Analyte	95% UCL Conc. in Soil (mg/kg)	CPS_o (kg-d/mg)	Cancer Risk
Benzo[a]anthracene	1.810	0.73	3.69E-09
Benzo[a]pyrene	2.831	7.3	5.78E-08
Benzo[b]fluoranthene	2.095	0.73	4.27E-09
Benzo[k]fluoranthene	1.821	0.073	3.72E-10
Chrysene	2.168	0.0073	4.42E-11
Dibenzo[a,h]anthracene	1.863	7.3	3.80E-08
Ideno[1,2,3-cd]pyrene	1.942	0.73	3.96E-09
Arsenic	12.734	1.5	5.34E-08
Beryllium	1.250	4.3	1.50E-08
HAZARD INDEX FOR LANDSCAPE WORKER INGESTING SUBSURFACE SOIL			**1.77E-07**

B. Noncarcinogenic Risk (Hazard Index)

The 95% UCL of the indicator polynuclear aromatic hydrocarbons (PAHs), carcinogenic or not, were summed to obtain a 95% UCL for total PAHs. It is assumed here that all these PAHs have the oral reference dose (RfD_o) of pyrene, namely 0.03 mg/(kg·day). To obtain hazard quotients, one multiplies concentration in the subsurface soil by the noncarcinogenic HIF and divides by the appropriate RfD_o value. The results are shown below.

Analyte	95% UCL Conc. in Soil (mg/kg)	RfD_o (mg/kg/d)	Hazard Quotient
Total PAHs	63.158	0.03	2.06E-05
Dibenzofuran	2.401	0.004	5.88E-06
Aluminum	6860.000	1.00	6.72E-05
Antimony	1.250	0.0004	3.06E-05
Arsenic	12.734	0.0003	4.16E-04
Beryllium	1.250	0.005	2.45E-06
Cadmium	1.250	0.0005	2.45E-05
Chromium	28.411	0.005	5.57E-05
Copper	101.500	0.04	2.49E-05
Iron	26824.000	0.3	8.76E-04
Manganese	422.867	0.023	1.80E-04
Thallium	1.000	0.00008	1.22E-04
Vanadium	39.638	0.007	5.55E-05
Total Cyanides	2.500	0.02	1.22E-06
HAZARD INDEX FOR LANDSCAPE WORKER INGESTING SUBSURFACE SOIL			**1.88E-03**

HEALTH RISK TO LANDSCAPE WORKER DUE TO DERMAL CONTACT WITH SUBSURFACE SOIL

EXPOSURE

Landscape workers are conservatively assumed to be exposed to soil on the NPS property to a depth of 3.5 feet.

Subsurface soil samples taken from the NPS property were analyzed, and the 95 percent upper confidence level (95% UCL) for each indicator analyte shown below was calculated (see Appendix H).

CARCINOGENIC AND NONCARCINOGENIC RISKS

Reference:. Smith, R.L., 1996, EPA Region III Risk-Based Concentration Table, United States Environmental Protection Agency, Philadelphia, PA.

Since the exposure events per year for landscape workers was assumed to be one half that of utility maintenance workers, the human intake factors (HIFs) for landscape workers will be one half the values determined for utility maintenance workers (see Table G3, Appendix G). The HIFs for landscape workers are as follows:

- Ingestion carcinogenic HIF = 1.23E-07 d^{-1} ABS
- Ingestion noncarcinogenic HIF = 4.30E-07 d^{-1} ABS

The dermal absorption factors (ABS) for the indicator analytes are: 0.1 for organics, 0.032 for arsenic, and 0.01 for all other inorganics.

A. Carcinogenic Risk

The 95% UCLs for the seven carcinogenic polynuclear aromatic hydrocarbons (PAHs) and two metals were multiplied by CPS_o values, by the ABS factor, and by the HIF value appropriate for carcinogens to obtain the cancer risk by dermal contact with each compound. The results are shown below.

Analyte	95% UCL Conc. in Soil (mg/kg)	ABS Factor	CPS_o (kg-d/mg)	Cancer Risk
Benzo[a]anthracene	1.810	0.1	0.73	1.63E-08
Benzo[a]pyrene	2.831	0.1	7.3	2.548E-07
Benzo[b]fluoranthene	2.095	0.1	0.73	1.88E-08
Benzo[k]fluoranthene	1.821	0.1	0.073	1.64E-09
Chrysene	2.168	0.1	0.0073	1.94E-10
Dibenzo[a,h]anthracene	1.863	0.1	7.3	1.67E-07
Ideno[1,2,3-cd]pyrene	1.942	0.1	0.73	1.74E-08
Arsenic	12.734	0.032	1.5	7.52E-08
Beryllium	1.250	0.01	4.3	6.61E-09
TOTAL CANCER RISK FOR LANDSCAPE WORKER DUE TO DERMAL CONTACT WITH SUBSURFACE SOIL				**5.57E-07**

B. Noncarcinogenic Risk (Hazard Index)

The 95% UCLs for the all indicator polynuclear aromatic hydrocarbons (PAHs), carcinogenic or not, were summed to obtain a 95% UCL for total PAHs. It is assumed here that all these PAHs have the oral reference dose (RfD_o) of pyrene, namely 0.03 mg/(kg-day). To obtain hazard quotients, one multiplies concentration in the subsurface soil by the non-carcinogenic HIF and by the ABS factor and divides by the appropriate RfD_o value. The results are shown below.

Analyte	95% UCL Conc. in Soil (mg/kg)	ABS Factor	RfD_o (mg/kg/d)	Hazard Quotient
Total PAHs	63.158	0.1	0.03	9.05E-05
Dibenzofuran	2.401	0.1	0.004	2.58E-05
Aluminum	6860.000	0.01	1.00	2.95E-05
Antimony	1.250	0.01	0.0004	1.34E-05
Arsenic	12.734	0.032	0.0003	5.84E-04
Beryllium	1.250	0.01	0.005	1.08E-06
Cadmium	1.250	0.01	0.0005	1.08E-05
Chromium	28.411	0.01	0.005	2.44E-05
Copper	101.500	0.01	0.04	1.09E-05
Iron	26824.000	0.01	0.3	3.84E-04
Manganese	422.867	0.01	0.023	7.91E-05
Thallium	1.000	0.01	0.00008	5.38E-05
Vanadium	39.638	0.01	0.007	2.43E-05
Total Cyanides	2.500	0.01	0.02	5.38E-07
HAZARD INDEX FOR LANDSCAPE WORKER HAVING DERMAL CONTACT WITH SUBSURFACE SOIL				**1.33E-03**

TABLE G1
HIF CALCULATIONS FOR INHALATION OF VOLATILES BY UTILITY MAINTENANCE WORKERS

Basic HIF Equation:[a] (m^3/kg-day) = $\frac{IR \times EF \times ED}{BW \times AT}$

Symbol [b]	Units	Chronic	Lifetime
IR	m^3/event	14	14
EF	events/year	5	5
ED	year	20	20
BW	kg	70	70
AT	year (days)	30 (7,300)	70 (25,550)
HIF	m^3/kg-day	2.74E-03	7.83E-04

(a) Equation for the adult engaged in moderately heavy work.
(b) Symbols: IR = Inhalation Rate (per 8-hour workday); EF = Exposure Frequency; ED = Exposure Duration; BW = Body Weight; AT = Averaging Time (use days here); HIF = Human Intake Factor.

TABLE G2
HIF CALCULATIONS FOR INCIDENTAL INGESTION OF SOIL BY UTILITY MAINTENANCE WORKERS

$$\text{Basic HIF Equation:}^{(a)}\ (\text{day}^{-1}) = \frac{IR \times CF \times EF \times ED}{BW \times AT}$$

Symbol [b]	Units	Chronic	Lifetime
IR	mg/event	100	100
CF	kg/mg	10^{-6}	10^{-6}
EF	events/year	5	5
ED	year	20	20
BW	kg	70	70
AT	year (days)	20 (7,300)	70 (25,550)
HIF	(day^{-1})	1.96E-08	5.59E-09

(a) Equation for the adult engaged in work involving direct contact with soil.
(b) Symbols: IR = Ingestion Rate; CF = Conversion Factor (to translate mg to kg); EF = Exposure Frequency (events per year); ED = Exposure Duration; BW = Body Weight; AT = Averaging Time (use days here); HIF = Human Intake Factor.

AR 05350

TABLE G3
HIF CALCULATIONS FOR DERMAL EXPOSURE OF UTILITY MAINTENANCE WORKERS TO SOIL

Basic HIF Equation:[a] (day^{-1}) = $\frac{SA \times CF \times AF \times EF \times ED \times ABS}{BW \times AT}$

Symbol [b]	Units	Chronic	Lifetime
SA	cm^2/event	4,400	4,400
CF	kg/mg	10^{-6}	10^{-6}
AF	mg/cm^2	1.0	1.0
EF	events/year	5	5
ED	year	20	20
BW	kg	70	70
AT	year (days)	20 (7,300)	70 (25,550)
HIF[c]	(day^{-1})	8.61E-07 ABS	2.46E-07 ABS

(a) Equation for the adult engaged in work involving direct contact with soil.
(b) Symbols: SA = Surface Area (head and upper extremities); CF = Conversion Factor (to translate mg to kg); AF = Adherence Factor; EF = Exposure Frequency; ED = Exposure Duration; BW = Body Weight; AT = Averaging Time (use days here); HIF = Human Intake Factor; ABS = chemical-specific absorption term.
(c) The HIF expression includes the chemical-specific absorption (ABS) term.

APPENDIX H

Calculation of 95% UCLs

STATISTICAL RESULTS FOR BTEX ANALYSES
NPS PR(RTY
(Soil Gas samples SG-31, -32, -34, -37, -38, -39, -40, -41, -42, -44, -58, -59)
Units: mg/m3 (µg/L)

Benzene		Toluene		Ethylbenzene	
Arithmetic Mean	16.51	Arithmetic Mean	2.74	Arithmetic Mean	30.45
Arithmetic Mean ln(x)	-0.04	*Arithmetic Mean ln(x)*	-0.23	*Arithmetic Mean ln(x)*	0.16
Standard Error	14.60	Standard Error	1.91	Standard Error	26.10
Std. Dev.	54.64	Std. Dev.	7.16	Std. Dev.	97.65
Std. Dev. ln(x)	1.75	*Std. Dev. ln(x)*	1.18	*Std. Dev. ln(x)*	2.08
Minimum	0.50	Minimum	0.50	Minimum	0.50
Maximum	190.00	Maximum	25.40	Maximum	340.00
Count	12.00	Count	12.00	Count	12.00
Student-t Statistic	1.80	Student-t Statistic	1.80	Student-t Statistic	1.80
H Statistic	4.795	H Statistic	3.489	H Statistic	5.592
95% UCL (normal)	42.80	95% UCL (normal)	6.18	95% UCL (normal)	77.43
95% UCL (lognormal)	55.24	95% UCL (lognormal)	5.56	95% UCL (lognormal)	339.64
95% UCL (nonparametric)	0.50	95% UCL (nonparametric)	0.50	95% UCL (nonparametric)	0.50

Xylenes	
Arithmetic Mean	27.84
Arithmetic Mean ln(x)	0.09
Standard Error	24.60
Std. Dev.	92.04
Std. Dev. ln(x)	1.97
Minimum	0.50
Maximum	320.00
Count	12.00
Student-t Statistic	1.80
H Statistic	4.828
95% UCL (normal)	72.12
95% UCL (lognormal)	135.56
95% UCL (nonparametric)	0.50

Shaded value is the correct 95% UCL value.

AR 05353

BENZENE

Schapiro-Wilks Test for Normality

n = 12
k = 6
Mean, M = 16.51250

No.	ID	Conc.(mg/L)	(xi - M)^2
1	SG-31	0.5	256.4002
2	SG-34	0.5	256.4002
3	SG-37	0.5	256.4002
4	SG-38	0.5	256.4002
5	SG-39	0.5	256.4002
6	SG-41	0.5	256.4002
7	SG-42	0.5	256.4002
8	SG-44	0.5	256.4002
9	SG-58	0.5	256.4002
10	SG-59	0.5	256.4002
11	SG-40	3.15	178.5564
12	SG-32	190	30097.9127
	d =		32584.0705

		x(i)	x(n-i+1)	b(i)
a1 =	0.5475	0.5000	190.0000	103.7513
a2 =	0.3325	0.5000	3.1500	0.8811
a3 =	0.2347	0.5000	0.5000	0.0000
a4 =	0.1586	0.5000	0.5000	0.0000
a5 =	0.0922	0.5000	0.5000	0.0000
a6=	0.0303	0.5000	0.5000	0.0000
		0.5000	0.5000	b = 104.6324
		0.5000	0.5000	
		0.5000	0.5000	
		0.5000	0.5000	
		3.1500	0.5000	
		190.0000	0.5000	

W = 1/d(b)^2

W = 0.3360

W(0.05) = 0.8590

W(Calculated) is less than W(0.05) therefore DOES NOT FIT A NORMAL DISTRIBUTION

Schapiro-Wilks Test for Lognormality

n = 12
k = 6
Mean, M = -0.04475

No.	ID	Ln Conc.	(xi - M)^2
1	SG-31	-0.69315	0.4204
2	SG-34	-0.69315	0.4204
3	SG-37	-0.69315	0.4204
4	SG-38	-0.69315	0.4204
5	SG-39	-0.69315	0.4204
6	SG-41	-0.69315	0.4204
7	SG-42	-0.69315	0.4204
8	SG-44	-0.69315	0.4204
9	SG-58	-0.69315	0.4204
10	SG-59	-0.69315	0.4204
11	SG-40	1.14740	1.4212
12	SG-32	5.24702	28.0029
	d =		33.6283

		Ln x(i)	Ln x(n-i+1)	b(i)
a1 =	0.5475	-0.6931	5.2470	3.2522
a2 =	0.3325	-0.6931	1.1474	0.6120
a3 =	0.2347	-0.6931	-0.6931	0.0000
a4 =	0.1586	-0.6931	-0.6931	0.0000
a5 =	0.0922	-0.6931	-0.6931	0.0000
a6=	0.0303	-0.6931	-0.6931	0.0000
		-0.6931	-0.6931	b = 3.8642
		-0.6931	-0.6931	
		-0.6931	-0.6931	
		-0.6931	-0.6931	
		1.1474	-0.6931	
		5.2470	-0.6931	

W = 1/d(b)^2

W = 0.4440

W(0.05) = 0.8590

W(Calculated) is less than W(0.05) therefore DOES NOT FIT A LOGNORMAL DISTRIBUTION

****

CALCULATION OF NONPARAMETRIC 95% UCL
(Conover 1980)

n = 12
p = 0.50

From Table A3 in Conover, 95%UCL corresponds with
u = 8.43
n8 = 0.5
n9 = 0.5
n8.43 = 0.5

95% UCL= 0.5 µg/L = 0.5 mg/m3

AR 05354

TOLUENE

Schapiro-Wilks Test for Normality

n = 12
k = 6
Mean, M = 2.73917

No.	ID	Conc.(mg/L)	(xi - M)^2
1	SG-31	0.5	5.0139
2	SG-32	0.5	5.0139
3	SG-34	0.5	5.0139
4	SG-38	0.5	5.0139
5	SG-39	0.5	5.0139
6	SG-41	0.5	5.0139
7	SG-42	0.5	5.0139
8	SG-44	0.5	5.0139
9	SG-58	0.5	5.0139
10	SG-59	0.5	5.0139
11	SG-40	2.47	0.0725
12	SG-37	25.4	513.5134
	d =		563.7245

a1 =	0.5475
a2 =	0.3325
a3 =	0.2347
a4 =	0.1586
a5=	0.0922
a6=	0.0303

x(i)	x(n-i+1)	b(i)
0.5000	25.4000	13.6328
0.5000	2.4700	0.6550
0.5000	0.5000	0.0000
0.5000	0.5000	0.0000
0.5000	0.5000	0.0000
0.5000	0.5000	0.0000
0.5000	0.5000	b = 14.2878
0.5000	0.5000	
0.5000	0.5000	
0.5000	0.5000	
2.4700	0.5000	
25.4000	0.5000	

W = 1/d(b)^2

W = 0.3621

W(0.05) : 0.8590

W(Calculated) is less than W(0.05) therefore DOES NOT FIT A NORMAL DISTRIBUTION

Schapiro-Wilks Test for Lognormality

n = 12
k = 6
Mean, M = -0.23271

No.	ID	Ln Conc.	(xi - M)^2
1	SG-31	-0.69315	0.2120
2	SG-32	-0.69315	0.2120
3	SG-34	-0.69315	0.2120
4	SG-38	-0.69315	0.2120
5	SG-39	-0.69315	0.2120
6	SG-41	-0.69315	0.2120
7	SG-42	-0.69315	0.2120
8	SG-44	-0.69315	0.2120
9	SG-58	-0.69315	0.2120
10	SG-59	-0.69315	0.2120
11	SG-40	0.90422	1.2926
12	SG-37	3.23475	12.0233
	d =		15.4359

a1 =	0.5475
a2 =	0.3325
a3 =	0.2347
a4 =	0.1586
a5=	0.0922
a6=	0.0303

Ln x(i)	Ln x(n-i+1)	b(i)
-0.6931	3.2347	2.1505
-0.6931	0.9042	0.5311
-0.6931	-0.6931	0.0000
-0.6931	-0.6931	0.0000
-0.6931	-0.6931	0.0000
-0.6931	-0.6931	0.0000
-0.6931	-0.6931	b = 2.6816
-0.6931	-0.6931	
-0.6931	-0.6931	
-0.6931	-0.6931	
0.9042	-0.6931	
3.2347	-0.6931	

W = 1/d(b)^2

W = 0.4659

W(0.05) : 0.8590

W(Calculated) is less than W(0.05) therefore DOES NOT FIT A LOGNORMAL DISTRIBUTION

****

CALCULATION OF NONPARAMETRIC 95% UCL
(Conover 1980)

n = 12
p = 0.50

From Table A3 in Conover, 95%UCL corresponds with
u = 8.43
n8 = 0.5
n9 = 0.5
n8.43 = 0.5

95% UCL= 0.5 µg/L = 0.5 mg/m3

AR 05355

ETHYLBENZENE

Schapiro-Wilks Test for Normality

n = 12
k = 6
Mean, M = 30.45000

No.	ID	Conc.(mg/L)	(xi - M)^2
1	SG-31	0.5	897.0025
2	SG-34	0.5	897.0025
3	SG-38	0.5	897.0025
4	SG-39	0.5	897.0025
5	SG-40	0.5	897.0025
6	SG-41	0.5	897.0025
7	SG-42	0.5	897.0025
8	SG-44	0.5	897.0025
9	SG-58	0.5	897.0025
10	SG-59	0.5	897.0025
11	SG-32	20.4	101.0025
12	SG-37	340	95821.2025
	d =		104892.2300

a1 =	0.5475
a2 =	0.3325
a3 =	0.2347
a4 =	0.1586
a5=	0.0922
a6=	0.0303

x(i)	x(n-i+1)	b(i)
0.5000	340.0000	185.8763
0.5000	20.4000	6.6168
0.5000	0.5000	0.0000
0.5000	0.5000	0.0000
0.5000	0.5000	0.0000
0.5000	0.5000	0.0000
0.5000	0.5000	b = 192.4930
0.5000	0.5000	
0.5000	0.5000	
0.5000	0.5000	
20.4000	0.5000	
340.0000	0.5000	

W = 1/d(b)^2

W = 0.3533
W(0.05) : 0.8590

W(Calculated) is less than W(0.05) therefore
DOES NOT FIT A NORMAL DISTRIBUTION

Schapiro-Wilks Test for Lognormality

n = 12
k = 6
Mean, M = 0.15942

No.	ID	Ln Conc.	(xi - M)^2
1	SG-31	-0.69315	0.7269
2	SG-34	-0.69315	0.7269
3	SG-38	-0.69315	0.7269
4	SG-39	-0.69315	0.7269
5	SG-40	-0.69315	0.7269
6	SG-41	-0.69315	0.7269
7	SG-42	-0.69315	0.7269
8	SG-44	-0.69315	0.7269
9	SG-58	-0.69315	0.7269
10	SG-59	-0.69315	0.7269
11	SG-32	3.01553	8.1574
12	SG-37	5.82895	32.1436
	d =		47.5696

a1 =	0.5475
a2 =	0.3325
a3 =	0.2347
a4 =	0.1586
a5=	0.0922
a6=	0.0303

Ln x(i)	Ln x(n-i+1)	b(i)
-0.6931	5.8289	3.5708
-0.6931	3.0155	1.2331
-0.6931	-0.6931	0.0000
-0.6931	-0.6931	0.0000
-0.6931	-0.6931	0.0000
-0.6931	-0.6931	0.0000
-0.6931	-0.6931	b = 4.8040
-0.6931	-0.6931	
-0.6931	-0.6931	
-0.6931	-0.6931	
3.0155	-0.6931	
5.8289	-0.6931	

W = 1/d(b)^2

W = 0.4851
W(0.05) : 0.8590

W(Calculated) is less than W(0.05) therefore
DOES NOT FIT A LOGNORMAL DISTRIBUTION
****

CALCULATION OF NONPARAMETRIC 95% UCL
(Conover 1980)

n = 12
p = 0.50

From Table A3 in Conover, 95%UCL corresponds with
u = 8.43
n8 = 0.5
n9 = 0.5
n8.43 = 0.5

95% UCL= 0.5 µg/L = 0.5 mg/m3

AR 05356

XYLENES

Schapiro-Wilks Test for Normality

n = 12
k = 6
Mean, M = 27.84250

No.	ID	Conc.(mg/L)	(xi - M)^2
1	SG-31	0.5	747.6123
2	SG-32	0.5	747.6123
3	SG-34	0.5	747.6123
4	SG-38	0.5	747.6123
5	SG-39	0.5	747.6123
6	SG-41	0.5	747.6123
7	SG-42	0.5	747.6123
8	SG-44	0.5	747.6123
9	SG-58	0.5	747.6123
10	SG-59	0.5	747.6123
11	SG-40	9.11	350.9066
12	SG-37	320	85356.0048
		d =	93183.0344

a1 =	0.5475
a2 =	0.3325
a3 =	0.2347
a4 =	0.1586
a5=	0.0922
a6=	0.0303

x(i)	x(n-i+1)	b(i)
0.5000	320.0000	174.9263
0.5000	9.1100	2.8628
0.5000	0.5000	0.0000
0.5000	0.5000	0.0000
0.5000	0.5000	0.0000
0.5000	0.5000	0.0000
0.5000	0.5000	b = 177.7891
0.5000	0.5000	
0.5000	0.5000	
0.5000	0.5000	
9.1100	0.5000	
320.0000	0.5000	

W = 1/d(b)^2

W = 0.3392

W(0.05) = 0.8590

W(Calculated) is less than W(0.05) therefore DOES NOT FIT A NORMAL DISTRIBUTION

Schapiro-Wilks Test for Lognormality

n = 12
k = 6
Mean, M = 0.08719

No.	ID	Ln Conc.	(xi - M)^2
1	SG-31	-0.69315	0.6089
2	SG-32	-0.69315	0.6089
3	SG-34	-0.69315	0.6089
4	SG-38	-0.69315	0.6089
5	SG-39	-0.69315	0.6089
6	SG-41	-0.69315	0.6089
7	SG-42	-0.69315	0.6089
8	SG-44	-0.69315	0.6089
9	SG-58	-0.69315	0.6089
10	SG-59	-0.69315	0.6089
11	SG-40	2.20937	4.5037
12	SG-37	5.76832	32.2753
		d =	42.8682

a1 =	0.5475
a2 =	0.3325
a3 =	0.2347
a4 =	0.1586
a5=	0.0922
a6=	0.0303

Ln x(i)	Ln x(n-i+1)	b(i)
-0.6931	5.7683	3.5377
-0.6931	2.2094	0.9651
-0.6931	-0.6931	0.0000
-0.6931	-0.6931	0.0000
-0.6931	-0.6931	0.0000
-0.6931	-0.6931	0.0000
-0.6931	-0.6931	b = 4.5027
-0.6931	-0.6931	
-0.6931	-0.6931	
-0.6931	-0.6931	
2.2094	-0.6931	
5.7683	-0.6931	

W = 1/d(b)^2

W = 0.4730

W(0.05) = 0.8590

W(Calculated) is less than W(0.05) therefore DOES NOT FIT A LOGNORMAL DISTRIBUTION

****

CALCULATION OF NONPARAMETRIC 95% UCL
(Conover 1980)

n = 12
p = 0.50

From Table A3 in Conover, 95%UCL corresponds with
u = 8.43
n8 = 0.5
n9 = 0.5
n8.43 = 0.5

95% UCL= 0.5 µg/L = 0.5 mg/m3

AR 05357

STATISTICAL RESULTS FOR PAH ANALYSES
NPS PROPERTY
SOIL BORINGS SB-1, SB-11, SB-12, and SB-13 (average of 0'- 2' and 2'- 4' depths)
TEST BORINGS TB-50 (2'- 4'), TB-70 through TB-81 (0'- 3.5')
PIEZOMETER BORINGS P-5S (2'- 4'), P-6S (3'- 5'), and P-7S (3'- 5')
(Units: mg/kg)

BENZ[A]ANTHRACENE		BENZO[B]FLUOROANTHENE		BENZO[K]FLUORANTHENE	
Arithmetic Mean	2.964	Arithmetic Mean	2.248	Arithmetic Mean	2.230
Arithmetic Mean ln(x)	0.151	*Arithmetic Mean ln(x)*	0.021	*Arithmetic Mean ln(x)*	0.032
Standard Error	1.662	Standard Error	1.014	Standard Error	1.079
Std. Dev.	4.070	Std. Dev.	2.531	Std. Dev.	2.642
Std. Dev. ln(x)	1.549	*Std. Dev. ln(x)*	1.541	*Std. Dev. ln(x)*	1.492
Minimum	0.044	Minimum	0.027	Minimum	0.028
Maximum	16.000	Maximum	8.700	Maximum	8.900
Count	20.000	Count	20.000	Count	20.000
Student-t Statistic	1.730	Student-t Statistic	1.730	Student-t Statistic	1.730
H Statistic	3.593	H Statistic	3.429	H Statistic	3.346
95% UCL (normal)	5.838	95% UCL (normal)	4.002	95% UCL (normal)	4.096
95% UCL (lognormal)	13.859	95% UCL (lognormal)	11.246	95% UCL (lognormal)	9.880
95% UCL (nonparametric)	**1.810**	**95% UCL (nonparametric)**	**2.095**	**95% UCL (nonparametric)**	**1.821**

BENZO[A]PYRENE		CHRYSENE		DIBENZ[A,H]ANTHRACENE	
Arithmetic Mean	3.273	Arithmetic Mean	3.367	Arithmetic Mean	1.857
Arithmetic Mean ln(x)	0.169	*Arithmetic Mean ln(x)*	0.225	*Arithmetic Mean ln(x)*	0.079
Standard Error	1.798	Standard Error	1.878	Standard Error	0.662
Std. Dev.	4.405	Std. Dev.	4.599	Std. Dev.	1.622
Std. Dev. ln(x)	1.748	*Std. Dev. ln(x)*	1.676	*Std. Dev. ln(x)*	1.316
Minimum	0.021	Minimum	0.031	Minimum	0.033
Maximum	15.000	Maximum	18.000	Maximum	5.700
Count	20.000	Count	20.000	Count	20.000
Student-t Statistic	1.730	Student-t Statistic	1.730	Student-t Statistic	1.730
H Statistic	3.778	H Statistic	3.657	H Statistic	3.069
95% UCL (normal)	6.384	95% UCL (normal)	6.615	95% UCL (normal)	3.003
95% UCL (lognormal)	24.840	95% UCL (lognormal)	20.791	95% UCL (lognormal)	6.504
95% UCL (nonparametric)	**2.831**	**95% UCL (nonparametric)**	**2.168**	**95% UCL (nonparametric)**	**1.863**

IDENO[1,2,3-CD]PYRENE		TOTAL PAHs	
Arithmetic Mean	2.508	Arithmetic Mean	63.669
Arithmetic Mean ln(x)	0.206	*Arithmetic Mean ln(x)*	3.302
Standard Error	1.197	Standard Error	30.605
Std. Dev.	2.931	Std. Dev.	74.966
Std. Dev. ln(x)	1.455	*Std. Dev. ln(x)*	1.546
Minimum	0.031	Minimum	0.813
Maximum	11.000	Maximum	230.300
Count	20.000	Count	20.000
Student-t Statistic	1.730	Student-t Statistic	1.730
H Statistic	3.290	H Statistic	3.439
95% UCL (normal)	4.578	95% UCL (normal)	116.615
95% UCL (lognormal)	10.624	95% UCL (lognormal)	304.191
95% UCL (nonparametric)	**1.942**	**95% UCL (nonparametric)**	**63.158**

Shaded value is the correct 95% UCL value.

BENZ \NTHRACENE

Shapiro-Wilks Test for Normality

n = 20.000
k = 10.000
Mean, M 2.896

No.	ID	Conc.	(xi - M)^2
1	TB-50	0.0435	8.52E+00
2	SB-13	0.1265	8.04E+00
3	TB-72	0.2	7.63E+00
4	P-7S	0.235	7.44E+00
5	TB-79	0.32	6.98E+00
6	TB-75	0.49	6.11E+00
7	TB-76	0.55	5.82E+00
8	TB-71	0.62	5.48E+00
9	TB-81	0.69	5.16E+00
10	TB-77	0.825	4.57E+00
11	TB-80	0.92	4.17E+00
12	TB-74	0.94	4.09E+00
13	SB-12	1.6	1.86E+00
14	SB-1	2.6	1.31E-01
15	TB-78	4.8	3.38E+00
16	TB-70	4.95	3.95E+00
17	SB-11	5	4.15E+00
18	TB-73	7.6	2.15E+01
19	P-6S	9.4	4.14E+01
20	P-5S	16	1.70E+02
		d =	3.20E+02

a1 =	0.4734
a2 =	0.3211
a3 =	0.2565
a4 =	0.2085
a5=	0.1686
a6=	0.1334
a7=	0.1013
a8=	0.0711
a9=	0.0422
a10=	0.0140

x(i)	x(n-i+1)		b(i)
0.044	16.000		7.5538
0.127	9.400		2.9777
0.200	7.600		1.8981
0.235	5.000		0.9935
0.320	4.950		0.7806
0.490	4.800		0.5750
0.550	2.600		0.2077
0.620	1.600		0.0697
0.690	0.940		0.0106
0.825	0.920		0.0013
0.920	0.825	b	13.4231
0.940	0.690		
1.600	0.620		
2.600	0.550		
4.800	0.490		
4.950	0.320		
5.000	0.235		
7.600	0.200		
9.400	0.127		
16.000	0.044		

W = 1/d(b)^2

W = 0.562 W(Calculated) is less than W(0.05) therefore DOES NOT FIT A NORMAL DISTRIBUTION

W(0.05) 0.905

Shapiro-Wilks Test for Lognormality

n = 20.000
k = 10.000
Mean, M 0.067

No.	ID	Ln Conc.	Ln (xi - M)^2
1	TB-50	-3.135	1.06E+01
2	SB-13	-2.068	4.76E+00
3	TB-72	-1.609	2.97E+00
4	P-7S	-1.448	2.44E+00
5	TB-79	-1.139	1.57E+00
6	TB-75	-0.713	6.85E-01
7	TB-76	-0.598	5.07E-01
8	TB-71	-0.478	3.51E-01
9	TB-81	-0.371	2.35E-01
10	TB-77	-0.192	9.39E-02
11	TB-80	-0.083	3.90E-02
12	TB-74	-0.062	3.09E-02
13	SB-12	0.470	1.27E-01
14	SB-1	0.956	7.08E-01
15	TB-78	1.569	2.12E+00
16	TB-70	1.599	2.21E+00
17	SB-11	1.609	2.24E+00
18	TB-73	2.028	3.66E+00
19	P-6S	2.241	4.52E+00
20	P-5S	2.773	7.07E+00
		d =	4.69E+01

a1 =	0.4734
a2 =	0.3211
a3 =	0.2565
a4 =	0.2085
a5=	0.1686
a6=	0.1334
a7=	0.1013
a8=	0.0711
a9=	0.0422
a10=	0.0140

Ln x(i)	Ln x(n-i+1)		b(i)
(3.135)	2.773		2.7966
(2.068)	2.241		1.3834
(1.609)	2.028		0.9330
(1.448)	1.609		0.6375
(1.139)	1.599		0.4618
(0.713)	1.569		0.3044
(0.598)	0.956		0.1574
(0.478)	0.470		0.0674
(0.371)	(0.062)		0.0130
(0.192)	(0.083)		0.0015
(0.083)	(0.192)	b	5.7506
(0.062)	(0.371)		
0.470	(0.478)		
0.956	(0.598)		
1.569	(0.713)		
1.599	(1.139)		
1.609	(1.448)		
2.028	(1.609)		
2.241	(2.068)		
2.773	(3.135)		

W = 1/d(b)^2

W = 0.705 W(Calculated) is less than W(0.05) therefore DOES NOT FIT A LOGNORMAL DISTRIBUTION

W(0.05) 0.905

****

CALCULATION OF NONPARAMETRIC 95% UCL
(Conover 1980)

n = 20
p = 0.5

From Table A3 in Conover, 95% UCL corresponds with
u = 13.21
n13 = 1.600
n14 = 2.600
n13.21 = 1.810

95% UCL = 1.810 mg/kg

AR 05359

CHRYSENE

Shapiro-Wilks Test for Normality

n = 20.000
k = 10.000
Mean, M 3.367

No.	ID	Conc.	(xi - M)^2
1	TB-50	0.031	1.11E+01
2	SB-13	0.08	1.08E+01
3	P-7S	0.165	1.03E+01
4	TB-72	0.21	9.97E+00
5	TB-79	0.4	8.80E+00
6	TB-71	0.73	6.95E+00
7	TB-81	0.82	6.49E+00
8	TB-77	0.825	6.46E+00
9	TB-80	1.1	5.14E+00
10	TB-74	1.4	3.87E+00
11	TB-76	1.4	3.87E+00
12	TB-75	1.7	2.78E+00
13	SB-12	1.9725	1.94E+00
14	SB-1	2.9	2.18E-01
15	TB-70	4.95	2.51E+00
16	TB-78	5	2.67E+00
17	SB-11	5.85	6.17E+00
18	TB-73	8.8	2.95E+01
19	P-6S	11	5.83E+01
20	P-5S	18	2.14E+02
		d =	4.02E+02

a1 =	0.4734
a2 =	0.3211
a3 =	0.2565
a4 =	0.2085
a5=	0.1686
a6=	0.1334
a7=	0.1013
a8=	0.0711
a9=	0.0422
a10=	0.0140

x(i)	x(n-i+1)		b(i)
0.031	18.000		8.5065
0.080	11.000		3.5064
0.165	8.800		2.2149
0.210	5.850		1.1759
0.400	5.000		0.7756
0.730	4.950		0.5629
0.820	2.900		0.2107
0.825	1.973		0.0816
1.100	1.700		0.0253
1.400	1.400		0.0000
1.400	1.400	b	15.4038
1.700	1.100		
1.973	0.825		
2.900	0.820		
4.950	0.730		
5.000	0.400		
5.850	0.210		
8.800	0.165		
11.000	0.080		
18.000	0.031		

W = 1/d(b)^2

W = 0.590 W(Calculated) is less than W(0.05) therefore DOES NOT FIT A NORMAL DISTRIBUTION

W(0.05) 0.905

Shapiro-Wilks Test for Lognormality

n = 20.000
k = 10.000
Mean, M 0.225

No.	ID	Ln Conc.	Ln (xi - M)^2
1	TB-50	-3.474	1.37E+01
2	SB-13	-2.526	7.57E+00
3	P-7S	-1.802	4.11E+00
4	TB-72	-1.561	3.19E+00
5	TB-79	-0.916	1.30E+00
6	TB-71	-0.315	2.91E-01
7	TB-81	-0.198	1.79E-01
8	TB-77	-0.192	1.74E-01
9	TB-80	0.095	1.68E-02
10	TB-74	0.336	1.24E-02
11	TB-76	0.336	1.24E-02
12	TB-75	0.531	9.34E-02
13	SB-12	0.679	2.06E-01
14	SB-1	1.065	7.05E-01
15	TB-70	1.599	1.89E+00
16	TB-78	1.609	1.92E+00
17	SB-11	1.766	2.38E+00
18	TB-73	2.175	3.80E+00
19	P-6S	2.398	4.72E+00
20	P-5S	2.890	7.10E+00
		d =	5.33E+01

a1 =	0.4734
a2 =	0.3211
a3 =	0.2565
a4 =	0.2085
a5=	0.1686
a6=	0.1334
a7=	0.1013
a8=	0.0711
a9=	0.0422
a10=	0.0140

Ln x(i)	Ln x(n-i+1)		b(i)
(3.474)	2.890		3.0126
(2.526)	2.398		1.5810
(1.802)	2.175		1.0200
(1.561)	1.766		0.6937
(0.916)	1.609		0.4258
(0.315)	1.599		0.2553
(0.198)	1.065		0.1280
(0.192)	0.679		0.0620
0.095	0.531		0.0184
0.336	0.336		0.0000
0.336	0.336	b	6.3074
0.531	0.095		
0.679	(0.192)		
1.065	(0.198)		
1.599	(0.315)		
1.609	(0.916)		
1.766	(1.561)		
2.175	(1.802)		
2.398	(2.526)		
2.890	(3.474)		

W = 1/d(b)^2

W = 0.746 W(Calculated) is less than W(0.05) therefore DOES NOT FIT A LOGNORMAL DISTRIBUTION

W(0.05) 0.905

****

CALCULATION OF NONPARAMETRIC 95% UCL
(Conover 1980)

n = 20
p = 0.5

From Table A3 in Conover, 95% UCL corresponds with
u = 13.21
n13 = 1.973
n14 = 2.900
n13.21 = 2.167

95% UCL = 2.167 mg/kg

AR 05360

BE. B]FLOURANTHENE

Shapiro-Wilks Test for Normality

n = 20.000
k = 10.000
Mean, M 2.228

No.	ID	Conc.	(xi - M)^2
1	TB-50	0.027	4.93E+00
2	SB-13	0.0755	4.72E+00
3	P-7S	0.14	4.44E+00
4	TB-71	0.32	3.72E+00
5	TB-79	0.33	3.68E+00
6	TB-76	0.59	2.75E+00
7	TB-81	0.61	2.68E+00
8	TB-72	0.825	2.02E+00
9	TB-77	0.825	2.02E+00
10	TB-80	1.1	1.32E+00
11	TB-74	1.2	1.10E+00
12	TB-75	1.6	4.20E-01
13	SB-1	2.05	3.92E-02
14	SB-12	2.2625	2.10E-04
15	TB-78	2.6	1.24E-01
16	P-6S	4.2	3.81E+00
17	TB-70	4.95	7.30E+00
18	TB-73	5.2	8.71E+00
19	SB-11	6.95	2.21E+01
20	P-5S	8.7	4.16E+01
		d =	1.18E+02

a1 =	0.4734
a2 =	0.3211
a3 =	0.2565
a4 =	0.2085
a5=	0.1686
a6=	0.1334
a7=	0.1013
a8=	0.0711
a9=	0.0422
a10=	0.0140

x(i)	x(n-i+1)		b(i)
0.027	8.700		4.1058
0.076	6.950		2.2074
0.140	5.200		1.2979
0.320	4.950		0.9654
0.330	4.200		0.6525
0.590	2.600		0.2681
0.610	2.263		0.1674
0.825	2.050		0.0871
0.825	1.600		0.0327
1.100	1.200		0.0014
1.200	1.100	b	8.5764
1.600	0.825		
2.050	0.825		
2.263	0.610		
2.600	0.590		
4.200	0.330		
4.950	0.320		
5.200	0.140		
6.950	0.076		
8.700	0.027		

W = 1/d(b)^2

W = 0.626 W(0.05) 0.905

W(Calculated) is less than W(0.05) therefore DOES NOT FIT A NORMAL DISTRIBUTION

Shapiro-Wilks Test for Lognormality

n = 20.000
k = 10.000
Mean, M 0.010

No.	ID	Ln Conc.	Ln (xi - M)^2
1	TB-50	-3.612	1.32E+01
2	SB-13	-2.584	6.78E+00
3	P-7S	-1.966	3.95E+00
4	TB-71	-1.139	1.35E+00
5	TB-79	-1.109	1.28E+00
6	TB-76	-0.528	3.01E-01
7	TB-81	-0.494	2.66E-01
8	TB-72	-0.192	4.55E-02
9	TB-77	-0.192	4.55E-02
10	TB-80	0.095	5.52E-03
11	TB-74	0.182	2.60E-02
12	TB-75	0.470	2.02E-01
13	SB-1	0.718	4.86E-01
14	SB-12	0.816	6.33E-01
15	TB-78	0.956	8.73E-01
16	P-6S	1.435	2.00E+00
17	TB-70	1.599	2.49E+00
18	TB-73	1.649	2.65E+00
19	SB-11	1.939	3.68E+00
20	P-5S	2.163	4.59E+00
		d =	4.48E+01

a1 =	0.4734
a2 =	0.3211
a3 =	0.2565
a4 =	0.2085
a5=	0.1686
a6=	0.1334
a7=	0.1013
a8=	0.0711
a9=	0.0422
a10=	0.0140

Ln x(i)	Ln x(n-i+1)		b(i)
(3.612)	2.163		2.7340
(2.584)	1.939		1.4521
(1.966)	1.649		0.9272
(1.139)	1.599		0.5710
(1.109)	1.435		0.4289
(0.528)	0.956		0.1979
(0.494)	0.816		0.1328
(0.192)	0.718		0.0647
(0.192)	0.470		0.0280
0.095	0.182		0.0012
0.182	0.095	b	5.6844
0.470	(0.192)		
0.718	(0.192)		
0.816	(0.494)		
0.956	(0.528)		
1.435	(1.109)		
1.599	(1.139)		
1.649	(1.966)		
1.939	(2.584)		
2.163	(3.612)		

W = 1/d(b)^2

W = 0.721 W(0.05) 0.905

W(Calculated) is less than W(0.05) therefore DOES NOT FIT A LOGNORMAL DISTRIBUTION

****

CALCULATION OF NONPARAMETRIC 95% UCL
(Conover 1980)

n = 20
p = 0.5

From Table A3 in Conover, 95% UCL corresponds with
u = 13.21
n13 = 2.05
n14 = 2.263
n13.21 = 2.095

95% UCL = 2.095 mg/kg

AR 05361

BENZO[K]FLUOROANTHENE

Shapiro-Wilks Test for Normality

n = 20.000
k = 10.000
Mean, M 2.230

No.	ID	Conc.	(xi - M)^2
1	TB-50	0.028	4.85E+00
2	SB-13	0.086	4.60E+00
3	P-7S	0.145	4.35E+00
4	TB-79	0.31	3.69E+00
5	TB-71	0.45	3.17E+00
6	TB-81	0.7	2.34E+00
7	TB-76	0.77	2.13E+00
8	TB-72	0.825	1.97E+00
9	TB-77	0.825	1.97E+00
10	TB-74	1.1	1.28E+00
11	TB-80	1.3	8.65E-01
12	SB-1	1.7	2.81E-01
13	P-6S	1.8	1.85E-01
14	TB-75	1.9	1.09E-01
15	SB-12	2.2625	1.06E-03
16	TB-78	3.1	7.57E-01
17	SB-11	4.75	6.35E+00
18	TB-70	4.95	7.40E+00
19	P-5S	8.7	4.19E+01
20	TB-73	8.9	4.45E+01
		d =	1.33E+02

a1 =	0.4734
a2 =	0.3211
a3 =	0.2565
a4 =	0.2085
a5=	0.1686
a6=	0.1334
a7=	0.1013
a8=	0.0711
a9=	0.0422
a10=	0.0140

x(i)	x(n-i+1)		b(i)	W = 1/d(b)^2		
0.028	8.900		4.2000			
0.086	8.700		2.7660			
0.145	4.950		1.2325	W =	0.628	W(Calculated) is less than W(0.05) therefore
0.310	4.750		0.9257			DOES NOT FIT A NORMAL DISTRIBUTION
0.450	3.100		0.4468			
0.700	2.263		0.2084			
0.770	1.900		0.1145	W(0.05)	0.905	
0.825	1.800		0.0693			
0.825	1.700		0.0369			
1.100	1.300		0.0028			
1.300	1.100	b	9.1242			
1.700	0.825					
1.800	0.825					
1.900	0.770					
2.263	0.700					
3.100	0.450					
4.750	0.310					
4.950	0.145					
8.700	0.086					
8.900	0.028					

Shapiro-Wilks Test for Lognormality

n = 20.000
k = 10.000
Mean, M 0.032

No.	ID	Ln Conc.	Ln (xi - M)^2
1	TB-50	-3.576	1.30E+01
2	SB-13	-2.453	6.18E+00
3	P-7S	-1.931	3.85E+00
4	TB-79	-1.171	1.45E+00
5	TB-71	-0.799	6.90E-01
6	TB-81	-0.357	1.51E-01
7	TB-76	-0.261	8.61E-02
8	TB-72	-0.192	5.03E-02
9	TB-77	-0.192	5.03E-02
10	TB-74	0.095	4.01E-03
11	TB-80	0.262	5.31E-02
12	SB-1	0.531	2.49E-01
13	P-6S	0.588	3.09E-01
14	TB-75	0.642	3.72E-01
15	SB-12	0.816	6.15E-01
16	TB-78	1.131	1.21E+00
17	SB-11	1.558	2.33E+00
18	TB-70	1.599	2.46E+00
19	P-5S	2.163	4.54E+00
20	TB-73	2.186	4.64E+00
		d =	4.23E+01

a1 =	0.4734
a2 =	0.3211
a3 =	0.2565
a4 =	0.2085
a5=	0.1686
a6=	0.1334
a7=	0.1013
a8=	0.0711
a9=	0.0422
a10=	0.0140

Ln x(i)	Ln x(n-i+1)		b(i)	W = 1/d(b)^2		
(3.576)	2.186		2.7275			
(2.453)	2.163		1.4824			
(1.931)	1.599		0.9055	W =	0.764	W(Calculated) is less than W(0.05) therefore
(1.171)	1.558		0.5691			DOES NOT FIT A LOGNORMAL DISTRIBUTION
(0.799)	1.131		0.3254			
(0.357)	0.816		0.1565			
(0.261)	0.642		0.0915			
(0.192)	0.588		0.0555	W(0.05)	0.905	
(0.192)	0.531		0.0305			
0.095	0.262		0.0023			
0.262	0.095	b	5.6846			
0.531	(0.192)					
0.588	(0.192)					
0.642	(0.261)					
0.816	(0.357)					
1.131	(0.799)					
1.558	(1.171)					
1.599	(1.931)					
2.163	(2.453)					
2.186	(3.576)					

****

CALCULATION OF NONPARAMETRIC 95% UCL
(Conover 1980)

n = 20
p = 0.5

From Table A3 in Conover, 95% UCL corresponds with
u = 13.21
n13 = 1.8
n14 = 1.9
n13.21 = 1.821

95% UCL = 1.821 mg/kg

AR 05362

BEN[illegible]APYRENE

Shapiro-Wilks Test for Lognormality

n = 20.000
k = 10.000
Mean, M 3.323

No.	ID	Conc.	(xi - M)^2
1	TB-50	0.021	1.06E+01
2	SB-13	0.0605	1.03E+01
3	P-7S	0.11	1.00E+01
4	TB-79	0.33	8.66E+00
5	TB-76	0.53	7.52E+00
6	TB-71	0.65	6.88E+00
7	TB-81	0.65	6.88E+00
8	TB-72	0.825	5.99E+00
9	TB-77	0.825	5.99E+00
10	TB-80	1.3	3.89E+00
11	TB-75	1.9	1.89E+00
12	TB-74	2.475	6.37E-01
13	SB-1	2.6	4.53E-01
14	TB-78	3.7	1.82E-01
15	SB-12	3.99	5.14E-01
16	TB-70	4.95	2.81E+00
17	TB-73	5.5	4.96E+00
18	P-6S	6.4	9.78E+00
19	SB-11	14.65	1.29E+02
20	P-5S	15	1.38E+02
		d =	3.65E+02

a1 =	0.4734
a2 =	0.3211
a3 =	0.2565
a4 =	0.2085
a5=	0.1686
a6=	0.1334
a7=	0.1013
a8=	0.0711
a9=	0.0422
a10=	0.0140

x(i)	x(n-i+1)		b(i)
0.021	15.000		7.0911
0.061	14.650		4.6847
0.110	6.400		1.6134
0.330	5.500		1.0779
0.530	4.950		0.7452
0.650	3.990		0.4456
0.650	3.700		0.3090
0.825	2.600		0.1262
0.825	2.475		0.0696
1.300	1.900		0.0084
1.900	1.300	b	14.4671
2.475	0.825		
2.600	0.825		
3.700	0.650		
3.990	0.650		
4.950	0.530		
5.500	0.330		
6.400	0.110		
14.650	0.061		
15.000	0.021		

W = 1/d(b)^2

W = 0.574

W(0.05) 0.905

W(Calculated) is less than W(0.05) therefore
DOES NOT FIT A NORMAL DISTRIBUTION

Shapiro-Wilks Test for Lognormality

n = 20.000
k = 10.000
Mean, M 0.207

No.	ID	Ln Conc.	Ln (xi - M)^2
1	TB-50	-3.863	1.63E+01
2	SB-13	-2.805	8.85E+00
3	P-7S	-2.207	5.65E+00
4	TB-79	-1.109	1.63E+00
5	TB-76	-0.635	6.46E-01
6	TB-71	-0.431	3.60E-01
7	TB-81	-0.431	3.60E-01
8	TB-72	-0.192	1.31E-01
9	TB-77	-0.192	1.31E-01
10	TB-80	0.262	8.72E-03
11	TB-75	0.642	2.24E-01
12	TB-74	0.906	5.44E-01
13	SB-1	0.956	6.19E-01
14	TB-78	1.308	1.30E+00
15	SB-12	1.384	1.48E+00
16	TB-70	1.599	2.05E+00
17	TB-73	1.705	2.36E+00
18	P-6S	1.856	2.85E+00
19	SB-11	2.684	6.33E+00
20	P-5S	2.708	6.45E+00
		d =	5.82E+01

a1 =	0.4734
a2 =	0.3211
a3 =	0.2565
a4 =	0.2085
a5=	0.1686
a6=	0.1334
a7=	0.1013
a8=	0.0711
a9=	0.0422
a10=	0.0140

Ln x(i)	Ln x(n-i+1)		b(i)
(3.863)	2.708		3.1108
(2.805)	2.684		1.7627
(2.207)	1.856		1.0423
(1.109)	1.705		0.5866
(0.635)	1.599		0.3767
(0.431)	1.384		0.2421
(0.431)	1.308		0.1762
(0.192)	0.956		0.0816
(0.192)	0.906		0.0464
0.262	0.642		0.0053
0.642	0.262	b	6.5024
0.906	(0.192)		
0.956	(0.192)		
1.308	(0.431)		
1.384	(0.431)		
1.599	(0.635)		
1.705	(1.109)		
1.856	(2.207)		
2.684	(2.805)		
2.708	(3.863)		

W = 1/d(b)^2

W = 0.726

W(0.05) 0.905

W(Calculated) is less than W(0.05) therefore
DOES NOT FIT A LOGNORMAL DISTRIBUTION

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CALCULATION OF NONPARAMETRIC 95% UCL
(Conover 1980)

n = 20
p = 0.5

From Table A3 in Conover, 95% UCL corresponds with
u = 13.21
n13 = 2.6
n14 = 3.7
n13.21 = 2.831

95% UCL = 2.831 mg/kg

AR 05363

DIBENZ[A,H]ANTHRACENE

Shapiro-Wilks Test for Normality

n = 20.000
k = 10.000
Mean, M 1.857

No.	ID	Conc.	(xi - M)^2
1	TB-50	0.033	3.33E+00
2	SB-13	0.0965	3.10E+00
3	P-7S	0.18	2.81E+00
4	SB-12	0.7775	1.17E+00
5	TB-71	0.825	1.07E+00
6	TB-72	0.825	1.07E+00
7	TB-75	0.825	1.07E+00
8	TB-77	0.825	1.07E+00
9	TB-79	0.825	1.07E+00
10	TB-81	0.825	1.07E+00
11	TB-78	1.65	4.28E-02
12	TB-80	1.65	4.28E-02
13	P-6S	1.7	2.46E-02
14	TB-74	2.475	3.82E-01
15	SB-11	2.85	9.86E-01
16	SB-1	2.925	1.14E+00
17	TB-78	3.3	2.08E+00
18	TB-73	3.9	4.17E+00
19	TB-70	4.95	9.57E+00
20	P-5S	5.7	1.48E+01
		d =	5.00E+01

a1 =	0.4734
a2 =	0.3211
a3 =	0.2565
a4 =	0.2085
a5=	0.1686
a6=	0.1334
a7=	0.1013
a8=	0.0711
a9=	0.0422
a10=	0.0140

x(i)	x(n-i+1)		b(i)
0.033	5.700		2.6828
0.097	4.950		1.5585
0.180	3.900		0.9542
0.778	3.300		0.5259
0.825	2.925		0.3541
0.825	2.850		0.2701
0.825	2.475		0.1671
0.825	1.700		0.0622
0.825	1.650		0.0348
0.825	1.650		0.0116
1.650	0.825	b	5.7213
1.650	0.825		
1.700	0.825		
2.475	0.825		
2.850	0.825		
2.925	0.825		
3.300	0.778		
3.900	0.180		
4.950	0.097		
5.700	0.033		

W = 1/d(b)^2

W = 0.655 W(Calculated) is less than W(0.05) therefore DOES NOT FIT A NORMAL DISTRIBUTION

W(0.05) 0.905

Shapiro-Wilks Test for Lognormality

n = 20.000
k = 10.000
Mean, M 0.079

No.	ID	Ln Conc.	Ln (xi - M)^2
1	TB-50	-3.411	1.22E+01
2	SB-13	-2.338	5.84E+00
3	P-7S	-1.715	3.22E+00
4	SB-12	-0.252	1.09E-01
5	TB-71	-0.192	7.36E-02
6	TB-72	-0.192	7.36E-02
7	TB-75	-0.192	7.36E-02
8	TB-77	-0.192	7.36E-02
9	TB-79	-0.192	7.36E-02
10	TB-81	-0.192	7.36E-02
11	TB-76	0.501	1.78E-01
12	TB-80	0.501	1.78E-01
13	P-6S	0.531	2.04E-01
14	TB-74	0.906	6.84E-01
15	SB-11	1.047	9.38E-01
16	SB-1	1.073	9.89E-01
17	TB-78	1.194	1.24E+00
18	TB-73	1.361	1.64E+00
19	TB-70	1.599	2.31E+00
20	P-5S	1.740	2.76E+00
		d =	3.29E+01

a1 =	0.4734
a2 =	0.3211
a3 =	0.2565
a4 =	0.2085
a5=	0.1686
a6=	0.1334
a7=	0.1013
a8=	0.0711
a9=	0.0422
a10=	0.0140

Ln x(i)	Ln x(n-i+1)		b(i)
(3.411)	1.740		2.4388
(2.338)	1.599		1.2644
(1.715)	1.361		0.7889
(0.252)	1.194		0.3014
(0.192)	1.073		0.2134
(0.192)	1.047		0.1654
(0.192)	0.906		0.1113
(0.192)	0.531		0.0514
(0.192)	0.501		0.0293
(0.192)	0.501		0.0097
0.501	(0.192)	b	4.7935
0.501	(0.192)		
0.531	(0.192)		
0.906	(0.192)		
1.047	(0.192)		
1.073	(0.192)		
1.194	(0.252)		
1.361	(1.715)		
1.599	(2.338)		
1.740	(3.411)		

W = 1/d(b)^2

W = 0.698 W(Calculated) is less than W(0.05) therefore DOES NOT FIT A LOGNORMAL DISTRIBUTION

W(0.05) 0.905

****

CALCULATION OF NONPARAMETRIC 95% UCL
(Conover 1980)

n = 20
p = 0.5

From Table A3 in Conover, 95% UCL corresponds with
u = 13.21
n13 = 1.7
n14 = 2.475
n13.21 = 1.863

95% UCL = 1.863 mg/kg

AR 05364

IDE. _1,2,3]PYRENE

Shapiro-Wilks Test for Normality

n = 20.000
k = 10.000
Mean, M 2.508

No.	ID	Conc.	(xi - M)^2
1	TB-50	0.031	6.14E+00
2	SB-13	0.0905	5.84E+00
3	P-7S	0.17	5.47E+00
4	TB-71	0.825	2.83E+00
5	TB-72	0.825	2.83E+00
6	TB-75	0.825	2.83E+00
7	TB-77	0.825	2.83E+00
8	TB-79	0.825	2.83E+00
9	TB-81	0.825	2.83E+00
10	TB-76	1.65	7.36E-01
11	TB-80	1.65	7.36E-01
12	SB-12	1.695	6.61E-01
13	SB-1	1.8	5.01E-01
14	TB-74	2.475	1.09E-03
15	P-6S	2.5	6.40E-05
16	TB-78	3.3	6.27E-01
17	TB-70	4.95	5.96E+00
18	TB-73	4.95	5.96E+00
19	SB-11	8.95	4.15E+01
20	P-5S	11	7.21E+01
		d =	1.63E+02

a1 =	0.4734
a2 =	0.3211
a3 =	0.2565
a4 =	0.2085
a5=	0.1686
a6=	0.1334
a7=	0.1013
a8=	0.0711
a9=	0.0422
a10=	0.0140

x(i)	x(n-i+1)		b(i)
0.031	11.000		5.1927
0.091	8.950		2.8448
0.170	4.950		1.2261
0.825	4.950		0.8601
0.825	3.300		0.4173
0.825	2.500		0.2234
0.825	2.475		0.1671
0.825	1.800		0.0693
0.825	1.695		0.0367
1.650	1.650		0.0000
1.650	1.650	b	10.1236
1.695	0.825		
1.800	0.825		
2.475	0.825		
2.500	0.825		
3.300	0.825		
4.950	0.825		
4.950	0.170		
8.950	0.091		
11.000	0.031		

W = 1/d(b)^2

W = 0.628

W(0.05) 0.905

W(Calculated) is less than W(0.05) therefore DOES NOT FIT A NORMAL DISTRIBUTION

Shapiro-Wilks Test for Lognormality

n = 20.000
k = 10.000
Mean, M 0.206

No.	ID	Ln Conc.	Ln (xi - M)^2
1	TB-50	-3.474	1.35E+01
2	SB-13	-2.402	6.80E+00
3	P-7S	-1.772	3.91E+00
4	TB-71	-0.192	1.59E-01
5	TB-72	-0.192	1.59E-01
6	TB-75	-0.192	1.59E-01
7	TB-77	-0.192	1.59E-01
8	TB-79	-0.192	1.59E-01
9	TB-81	-0.192	1.59E-01
10	TB-76	0.501	8.69E-02
11	TB-80	0.501	8.69E-02
12	SB-12	0.528	1.03E-01
13	SB-1	0.588	1.46E-01
14	TB-74	0.906	4.90E-01
15	P-6S	0.916	5.05E-01
16	TB-78	1.194	9.76E-01
17	TB-70	1.599	1.94E+00
18	TB-73	1.599	1.94E+00
19	SB-11	2.192	3.94E+00
20	P-5S	2.398	4.80E+00
		d =	4.02E+01

a1 =	0.4734
a2 =	0.3211
a3 =	0.2565
a4 =	0.2085
a5=	0.1686
a6=	0.1334
a7=	0.1013
a8=	0.0711
a9=	0.0422
a10=	0.0140

Ln x(i)	Ln x(n-i+1)		b(i)
(3.474)	2.398		2.7796
(2.402)	2.192		1.4752
(1.772)	1.599		0.8647
(0.192)	1.599		0.3736
(0.192)	1.194		0.2337
(0.192)	0.916		0.1479
(0.192)	0.906		0.1113
(0.192)	0.588		0.0555
(0.192)	0.528		0.0304
0.501	0.501		0.0000
0.501	0.501	b	5.4931
0.528	(0.192)		
0.588	(0.192)		
0.906	(0.192)		
0.916	(0.192)		
1.194	(0.192)		
1.599	(0.192)		
1.599	(1.772)		
2.192	(2.402)		
2.398	(3.474)		

W = 1/d(b)^2

W = 0.750

W(0.05) 0.905

W(Calculated) is less than W(0.05) therefore DOES NOT FIT A LOGNORMAL DISTRIBUTION

****

CALCULATION OF NONPARAMETRIC 95% UCL
(Conover 1980)

n = 20
p = 0.5

From Table A3 in Conover, 95% UCL corresponds with
u = 13.21
n13 = 1.8
n14 = 2.475
n13.21 = 1.942

95% UCL = 1.942 mg/kg

AR 05365

TOTAL PAH

Shapiro-Wilks Test for Normality

n = 20.000
k = 10.000
Mean, M 63.669

No.	ID	Conc.	(xi - M)^2
1	TB-50	0.813	3.95E+03
2	SB-13	2.275	5.18E+00
3	P-7S	4.270	1.82E+01
4	TB-79	9.860	9.72E+01
5	TB-71	11.420	1.13E+02
6	TB-72	11.460	8.44E+01
7	TB-77	13.650	8.80E+01
8	TB-81	13.760	1.52E+01
9	TB-78	23.880	1.55E+02
10	TB-75	24.470	1.69E+02
11	TB-80	24.950	1.28E+02
12	TB-74	34.390	4.26E+02
13	SB-1	59.133	1.24E+03
14	TB-76	78.300	2.90E+03
15	TB-70	84.150	3.50E+03
16	SB-12	100.968	4.43E+03
17	SB-11	127.585	4.69E+03
18	TB-73	190.950	1.27E+04
19	P-6S	226.800	2.03E+04
20	P-5S	230.300	1.67E+04
	d =		7.18E+04

a1 =	0.4734
a2 =	0.3211
a3 =	0.2565
a4 =	0.2085
a5=	0.1686
a6=	0.1334
a7=	0.1013
a8=	0.0711
a9=	0.0422
a10=	0.0140

x(i)	x(n-i+1)		b(i)
0.813	230.300		108.6391
2.275	226.800		72.0950
4.270	190.950		47.8834
9.860	127.585		24.5457
11.420	100.968		15.0977
11.460	84.150		9.6968
13.650	78.300		6.5490
13.760	59.133		3.2260
23.880	34.390		0.4435
24.470	24.950		0.0067
24.950	24.470	b	253.1632
34.390	23.880		
59.133	13.760		
78.300	13.650		
84.150	11.460		
100.968	11.420		
127.585	9.860		
190.950	4.270		
226.800	2.275		
230.300	0.813		

W = 1/d(b)^2

W = 0.893 W(Calculated) is less than W(0.05) therefore DOES NOT FIT A NORMAL DISTRIBUTION

W(0.05) 0.905

Shapiro-Wilks Test for Lognormality

n = 20.000
k = 10.000
Mean, M 3.302

No.	ID	Ln Conc.	Ln (xi - M)^2
1	TB-50	-0.207	1.23E+01
2	SB-13	0.822	6.15E+00
3	P-7S	1.452	3.42E+00
4	TB-79	2.288	1.03E+00
5	TB-71	2.435	7.51E-01
6	TB-72	2.439	7.45E-01
7	TB-77	2.614	4.74E-01
8	TB-81	2.622	4.63E-01
9	TB-78	3.173	1.66E-02
10	TB-75	3.197	1.09E-02
11	TB-80	3.217	7.25E-03
12	TB-74	3.538	5.56E-02
13	SB-1	4.080	6.05E-01
14	TB-76	4.361	1.12E+00
15	TB-70	4.433	1.28E+00
16	SB-12	4.615	1.72E+00
17	SB-11	4.849	2.39E+00
18	TB-73	5.252	3.80E+00
19	P-6S	5.424	4.50E+00
20	P-5S	5.439	4.57E+00
	d =		4.54E+01

a1 =	0.4734
a2 =	0.3211
a3 =	0.2565
a4 =	0.2085
a5=	0.1686
a6=	0.1334
a7=	0.1013
a8=	0.0711
a9=	0.0422
a10=	0.0140

Ln x(i)	Ln x(n-i+1)		b(i)
(0.207)	5.439		2.6730
0.822	5.424		1.4777
1.452	5.252		0.9748
2.288	4.849		0.5338
2.435	4.615		0.3675
2.439	4.433		0.2660
2.614	4.361		0.1770
2.622	4.080		0.1037
3.173	3.538		0.0154
3.197	3.217		0.0003
3.217	3.197	b	5.6594
3.538	3.173		
4.080	2.622		
4.361	2.614		
4.433	2.439		
4.615	2.435		
4.849	2.288		
5.252	1.452		
5.424	0.822		
5.439	(0.207)		

W = 1/d(b)^2

W = 0.705 W(Calculated) is less than W(0.05) therefore DOES NOT FIT A LOGNORMAL DISTRIBUTION

W(0.05) 0.905

CALCULATION OF NONPARAMETRIC 95% UCL
(Conover 1980)

n = 20
p = 0.5

From Table A3 in Conover, 95% UCL corresponds with
u = 13.21
n13 = 59.133
n14 = 78.3
n13.21 = 63.158

95% UCL = 63.158 mg/kg

AR 05366

STATISTICAL RESULTS FOR METALS ANALYSES
NPS PROPERTY
SOIL BORINGS SB-1, SB-11, SB-12, and SB-13 (average of 0'- 2' and 2'- 4' depths)
TEST BORINGS TB-70 through TB-81 (0' - 3.5' depth)
(Units: mg/kg)

ALUMINUM		ANTIMONY		ARSENIC	
Arithmetic Mean	7308.750	Arithmetic Mean	3.324	Arithmetic Mean	7.636
Arithmetic Mean ln(x)	8.416	*Arithmetic Mean ln(x)*	0.143	*Arithmetic Mean ln(x)*	1.784
Standard Error	3597.945	Standard Error	3.648	Standard Error	2.068
Std. Dev.	8813.129	Std. Dev.	8.937	Std. Dev.	5.065
Std. Dev. ln(x)	1.104	*Std. Dev. ln(x)*	1.183	*Std. Dev. ln(x)*	0.776
Minimum	200.000	Minimum	0.150	Minimum	1.330
Maximum	37450.000	Maximum	36.800	Maximum	17.000
Count	16.000	Count	16.000	Count	16.000
Student-t Statistic	1.750	Student-t Statistic	1.750	Student-t Statistic	1.750
H Statistic	2.877	H Statistic	2.727	H Statistic	2.293
95% UCL (normal)	13605.153	95% UCL (normal)	9.709	95% UCL (normal)	11.255
95% UCL (lognormal)	18872.391	95% UCL (lognormal)	5.344	**95% UCL (lognormal)**	**12.734**
95% UCL (nonparametric)	**6860.000**	**95% UCL (nonparametric)**	**1.250**	95% UCL (nonparametric)	NA

BERYLLIUM		CADMIUM		CHROMIUM	
Arithmetic Mean	1.087	Arithmetic Mean	1.305	Arithmetic Mean	20.784
Arithmetic Mean ln(x)	-0.020	*Arithmetic Mean ln(x)*	-0.044	*Arithmetic Mean ln(x)*	2.905
Standard Error	0.159	Standard Error	0.295	Standard Error	4.358
Std. Dev.	0.390	Std. Dev.	0.722	Std. Dev.	10.674
Std. Dev. ln(x)	0.536	*Std. Dev. ln(x)*	1.267	*Std. Dev. ln(x)*	0.533
Minimum	0.250	Minimum	0.010	Minimum	7.300
Maximum	1.300	Maximum	3.650	Maximum	41.000
Count	16.000	Count	16.000	Count	16.000
Student-t Statistic	1.750	Student-t Statistic	1.750	Student-t Statistic	1.750
H Statistic	2.092	H Statistic	3.145	H Statistic	2.088
95% UCL (normal)	1.365	95% UCL (normal)	1.821	**95% UCL (normal)**	**28.411**
95% UCL (lognormal)	1.513	95% UCL (lognormal)	5.971	95% UCL (lognormal)	28.085
95% UCL (nonparametric)	**1.250**	**95% UCL (nonparametric)**	**1.250**	95% UCL (nonparametric)	NA

COPPER		IRON		MANGANESE	
Arithmetic Mean	98.647	Arithmetic Mean	22053.125	Arithmetic Mean	254.978
Arithmetic Mean ln(x)	4.208	*Arithmetic Mean ln(x)*	9.773	*Arithmetic Mean ln(x)*	5.233
Standard Error	36.619	Standard Error	6496.873	Standard Error	94.136
Std. Dev.	89.699	Std. Dev.	15914.024	Std. Dev.	230.585
Std. Dev. ln(x)	0.905	*Std. Dev. ln(x)*	0.697	*Std. Dev. ln(x)*	0.797
Minimum	18.000	Minimum	7300.000	Minimum	44.000
Maximum	272.500	Maximum	65000.000	Maximum	960.000
Count	16.000	Count	16.000	Count	16.000
Student-t Statistic	1.750	Student-t Statistic	1.750	Student-t Statistic	1.750
H Statistic	2.566	H Statistic	2.177	H Statistic	2.412
95% UCL (normal)	162.731	95% UCL (normal)	33422.653	95% UCL (normal)	419.716
95% UCL (lognormal)	184.574	95% UCL (lognormal)	33102.028	**95% UCL (lognormal)**	**422.867**
95% UCL (nonparametric)	**101.500**	**95% UCL (nonparametric)**	**26824.000**	95% UCL (nonparametric)	NA

Shaded value is the correct 95% UCL value.

AR 05367

STATISTICAL RESULTS FOR METALS ANALYSES
NPS PROPERTY
SOIL BORINGS SB-1, SB-11, SB-12, and SB-13 (average of 0'- 2' and 2'- 4' depths)
TEST BORINGS TB-70 through TB-81 (0' - 3.5' depth)
(Units: mg/kg)

THALLIUM		VANADIUM		TOTAL CYANIDES	
Arithmetic Mean	2.782	Arithmetic Mean	28.478	Arithmetic Mean	9.619
Arithmetic Mean ln(x)	0.293	*Arithmetic Mean ln(x)*	3.204	*Arithmetic Mean ln(x)*	1.540
Standard Error	2.548	Standard Error	6.212	Standard Error	5.342
Std. Dev.	6.242	Std. Dev.	15.217	Std. Dev.	13.086
Std. Dev. ln(x)	0.936	*Std. Dev. ln(x)*	0.570	*Std. Dev. ln(x)*	1.158
Minimum	0.425	Minimum	9.600	Minimum	1.000
Maximum	26.100	Maximum	50.650	Maximum	44.250
Count	16.000	Count	16.000	Count	16.000
Student-t Statistic	1.750	Student-t Statistic	1.750	Student-t Statistic	1.750
H Statistic	2.612	H Statistic	2.129	H Statistic	2.965
95% UCL (normal)	7.241	95% UCL (normal)	39.350	95% UCL (normal)	18.968
95% UCL (lognormal)	3.907	95% UCL (lognormal)	39.638	95% UCL (lognormal)	22.131
95% UCL (nonparametric)	**1.000**	95% UCL (nonparametric)	NA	**95% UCL (nonparametric)**	**2.500**

Shaded value is the correct 95% UCL value.

STATISTICAL RESULTS FOR DIBENZOFURAN ANALYSIS
NPS PROPERTY
SOIL BORINGS SB-1, SB-11, SB-12, and SB-13 (average of 0'- 2' and 2'- 4' depths)
TEST BORING TB-50 (2'- 4')
PIEZOMETER BORINGS P-5S (2'- 4'), P-6S (3'- 5'), and P-7S (3'- 5')
(Units: mg/kg)

DIBENZOFURAN	
Arithmetic Mean	1.607
Arithmetic Mean ln(x)	0.183
Standard Error	0.418
Std. Dev.	1.024
Std. Dev. ln(x)	0.945
Minimum	0.190
Maximum	2.950
Count	8.000
Student-t Statistic	1.900
H Statistic	3.357
95% UCL (normal)	**2.401**
95% UCL (lognormal)	6.232
95% UCL (nonparametric)	NA

Shaded value is the correct 95% UCL value.

ALU[illegible]UM

Shapiro-Wilks Test for Normality

n = 16.000
k = 8.000
Mean, M 7308.750

No.	ID	Conc.	(xi - M)^2
1	TB-81	200	5.05E+07
2	TB-75	2500	2.31E+07
3	TB-74	2600	2.22E+07
4	TB-79	2800	2.03E+07
5	TB-80	2900	1.94E+07
6	TB-77	3300	1.61E+07
7	TB-72	3600	1.38E+07
8	TB-76	4200	9.66E+06
9	TB-78	4800	6.29E+06
10	TB-70	5200	4.45E+06
11	TB-71	7200	1.18E+04
12	TB-73	7200	1.18E+04
13	SB-11	8250	8.86E+05
14	SB-12	9320	4.05E+06
15	SB-1	15420	6.58E+07
16	SB-13	37450	9.08E+08
		d =	1.17E+09

a1 =	0.5056
a2 =	0.3290
a3 =	0.2521
a4 =	0.1939
a5=	0.1447
a6=	0.1005
a7=	0.0593
a8=	0.0196

x(i)	x(n-i+1)		b(i)
200	37,450		18833.6000
2,500	15,420		4250.6800
2,600	9,320		1694.1120
2,800	8,250		1056.7550
2,900	7,200		622.2100
3,300	7,200		391.9500
3,600	5,200		94.8800
4,200	4,800		11.7600
4,800	4,200	b	26955.9470
5,200	3,600		
7,200	3,300		
7,200	2,900		
8,250	2,800		
9,320	2,600		
15,420	2,500		
37,450	200		

W = 1/d(b)^2

W = 0.624 W(0.05) 0.887

W(Calculated) is less than W(0.05) therefore DOES NOT FIT A NORMAL DISTRIBUTION

Shapiro-Wilks Test for Lognormality

n = 16.000
k = 8.000
Mean, M 8.416

No.	ID	Ln Conc.	Ln (xi - M)^2
1	TB-81	5.298	9.72E+00
2	TB-75	7.824	3.50E-01
3	TB-74	7.863	3.06E-01
4	TB-79	7.937	2.29E-01
5	TB-80	7.972	1.97E-01
6	TB-77	8.102	9.88E-02
7	TB-72	8.189	5.17E-02
8	TB-76	8.343	5.35E-03
9	TB-78	8.476	3.64E-03
10	TB-70	8.556	1.97E-02
11	TB-71	8.882	2.17E-01
12	TB-73	8.882	2.17E-01
13	SB-11	9.018	3.62E-01
14	SB-12	9.140	5.24E-01
15	SB-1	9.643	1.51E+00
16	SB-13	10.531	4.47E+00
		d =	1.83E+01

a1 =	0.5056
a2 =	0.3290
a3 =	0.2521
a4 =	0.1939
a5=	0.1447
a6=	0.1005
a7=	0.0593
a8=	0.0196

Ln x(i)	Ln x(n-i+1)		b(i)
5.298	10.531		2.6455
7.824	9.643		0.5986
7.863	9.140		0.3218
7.937	9.018		0.2095
7.972	8.882		0.1316
8.102	8.882		0.0784
8.189	8.556		0.0218
8.343	8.476		0.0026
8.476	8.343	b	4.0099
8.556	8.189		
8.882	8.102		
8.882	7.972		
9.018	7.937		
9.140	7.863		
9.643	7.824		
10.531	5.298		

W = 1/d(b)^2

W = 0.880 W(0.05) 0.887

W(Calculated) is less than W(0.05) therefore DOES NOT FIT A LOGNORMAL DISTRIBUTION

CALCULATION OF NONPARAMETRIC 95% UCL
(Conover 1980)

n = 16
p = 0.5

From Table A3 in Conover, 95% UCL corresponds with
u = 10.83
n10 = 5200
n11 = 7200
n10.83 = 6860

95% UCL = 6860 mg/kg

AR 05369

ANTIMONY

Shapiro-Wilks Test for Normality

n = 16.000
k = 8.000
Mean, M 3.288

No.	ID	Conc.	(xi - M)^2
1	SB-1	0.15	9.84E+00
2	SB-11	0.17	9.72E+00
3	SB-12	0.48	7.88E+00
4	TB-70	1.25	4.15E+00
5	TB-71	1.25	4.15E+00
6	TB-72	1.25	4.15E+00
7	TB-73	1.25	4.15E+00
8	TB-74	1.25	4.15E+00
9	TB-75	1.25	4.15E+00
10	TB-76	1.25	4.15E+00
11	TB-77	1.25	4.15E+00
12	TB-78	1.25	4.15E+00
13	TB-79	1.25	4.15E+00
14	TB-80	1.25	4.15E+00
15	TB-81	1.25	4.15E+00
16	SB-13	36.80	1.12E+03
		d =	1.20E+03

a1 =	0.5056
a2 =	0.3290
a3 =	0.2521
a4 =	0.1939
a5=	0.1447
a6=	0.1005
a7=	0.0593
a8=	0.0196

x(i)	x(n-i+1)		b(i)
0.150	36.800		18.5302
0.170	1.250		0.3553
0.480	1.250		0.1941
1.250	1.250		0.0000
1.250	1.250		0.0000
1.250	1.250		0.0000
1.250	1.250		0.0000
1.250	1.250		0.0000
1.250	1.250	b	19.0797
1.250	1.250		
1.250	1.250		
1.250	1.250		
1.250	1.250		
1.250	0.480		
1.250	0.170		
36.800	0.150		

W = 1/d(b)^2

W = 0.303

W(Calculated) is less than W(0.05) therefore DOES NOT FIT A NORMAL DISTRIBUTION

W(0.05) 0.887

Shapiro-Wilks Test for Lognormality

n = 16.000
k = 8.000
Mean, M 0.118

No.	ID	Ln Conc.	Ln (xi - M)^2
1	SB-1	-1.897	4.04E+00
2	SB-11	-1.772	3.56E+00
3	SB-12	-0.734	7.19E-01
4	TB-70	0.223	1.19E-02
5	TB-71	0.223	1.19E-02
6	TB-72	0.223	1.19E-02
7	TB-73	0.223	1.19E-02
8	TB-74	0.223	1.19E-02
9	TB-75	0.223	1.19E-02
10	TB-76	0.223	1.19E-02
11	TB-77	0.223	1.19E-02
12	TB-78	0.223	1.19E-02
13	TB-79	0.223	1.19E-02
14	TB-80	0.223	1.19E-02
15	TB-81	0.223	1.19E-02
16	SB-13	3.605	1.22E+01
		d =	2.07E+01

a1 =	0.5056
a2 =	0.3290
a3 =	0.2521
a4 =	0.1939
a5=	0.1447
a6=	0.1005
a7=	0.0593
a8=	0.0196

Ln x(i)	Ln x(n-i+1)		b(i)
(1.897)	3.605		2.7821
(1.772)	0.223		0.6564
(0.734)	0.223		0.2413
0.223	0.223		0.0000
0.223	0.223		0.0000
0.223	0.223		0.0000
0.223	0.223		0.0000
0.223	0.223		0.0000
0.223	0.223	b	3.6798
0.223	0.223		
0.223	0.223		
0.223	0.223		
0.223	0.223		
0.223	(0.734)		
0.223	(1.772)		
3.605	(1.897)		

W = 1/d(b)^2

W = 0.656

W(Calculated) is less than W(0.05) therefore DOES NOT FIT A LOGNORMAL DISTRIBUTION

W(0.05) 0.887

****

CALCULATION OF NONPARAMETRIC 95% UCL
(Conover 1980)

n = 16
p = 0.5

From Table A3 in Conover, 95% UCL corresponds with
u = 10.83
n10 = 1.25
n11 = 1.25
n10.83 = 1.25

95% UCL = 1.25 mg/kg

AR 05370

ARSENIC

Shapiro-Wilks Test for Normality

n = 16.000
k = 8.000
Mean, M 7.636

No.	ID	Conc.	(xi - M)^2
1	SB-13	1.32	3.99E+01
2	TB-73	2.10	3.06E+01
3	TB-71	2.70	2.44E+01
4	TB-72	2.90	2.24E+01
5	TB-79	2.90	2.24E+01
6	TB-80	5.30	5.46E+00
7	TB-75	5.40	5.00E+00
8	SB-11	5.75	3.56E+00
9	SB-12	5.90	3.01E+00
10	SB-1	8.60	9.29E-01
11	TB-70	9.30	2.77E+00
12	TB-74	12.00	1.90E+01
13	TB-81	12.00	1.90E+01
14	TB-78	13.00	2.88E+01
15	TB-77	16.00	7.00E+01
16	TB-76	17.00	8.77E+01
		d =	3.85E+02

a1 =	0.5056
a2 =	0.3290
a3 =	0.2521
a4 =	0.1939
a5=	0.1447
a6=	0.1005
a7=	0.0593
a8=	0.0196

x(i)	x(n-i+1)		b(i)
1.320	17.000		7.9278
2.100	16.000		4.5731
2.700	13.000		2.5966
2.900	12.000		1.7645
2.900	12.000		1.3168
5.300	9.300		0.4020
5.400	8.600		0.1898
5.750	5.900		0.0029
5.900	5.750	b	18.7735
8.600	5.400		
9.300	5.300		
12.000	2.900		
12.000	2.900		
13.000	2.700		
16.000	2.100		
17.000	1.320		

W = 1/d(b)^2

W = 0.915 W(0.05) 0.887

W(Calculated) is greater than W(0.05) therefore FITS A NORMAL DISTRIBUTION

Shapiro-Wilks Test for Lognormality

n = 16.000
k = 8.000
Mean, M 1.784

No.	ID	Ln Conc.	Ln (xi - M)^2
1	SB-13	0.278	2.27E+00
2	TB-73	0.742	1.09E+00
3	TB-71	0.993	6.25E-01
4	TB-72	1.065	5.17E-01
5	TB-79	1.065	5.17E-01
6	TB-80	1.668	1.35E-02
7	TB-75	1.686	9.53E-03
8	SB-11	1.749	1.21E-03
9	SB-12	1.775	8.19E-05
10	SB-1	2.152	1.35E-01
11	TB-70	2.230	1.99E-01
12	TB-74	2.485	4.91E-01
13	TB-81	2.485	4.91E-01
14	TB-78	2.565	6.10E-01
15	TB-77	2.773	9.77E-01
16	TB-76	2.833	1.10E+00
		d =	9.04E+00

a1 =	0.5056
a2 =	0.3290
a3 =	0.2521
a4 =	0.1939
a5=	0.1447
a6=	0.1005
a7=	0.0593
a8=	0.0196

Ln x(i)	Ln x(n-i+1)		b(i)
0.278	2.833		1.2921
0.742	2.773		0.6681
0.993	2.565		0.3962
1.065	2.485		0.2754
1.065	2.485		0.2055
1.668	2.230		0.0565
1.686	2.152		0.0276
1.749	1.775		0.0005
1.775	1.749	b	2.9219
2.152	1.686		
2.230	1.668		
2.485	1.065		
2.485	1.065		
2.565	0.993		
2.773	0.742		
2.833	0.278		

W = 1/d(b)^2

W = 0.944 W(0.05) 0.887

W(Calculated) is graeater than W(0.05) therefore FITS A LOGNORMAL DISTRIBUTION

****

SINCE THE LOGNORMAL 95%UCL IS MORE CONSERVATIVE, A LOGNORMAL DISTRIBUTION WILL BE ASSUMED

AR 05371

BERYLLIUM

Shapiro-Wilks Test for Normality

n = 16.000
k = 8.000
Mean, M 1.049

No.	ID	Conc.	(xi - M)^2
1	SB-12	0.25	6.38E-01
2	SB-1	0.41	4.08E-01
3	SB-13	0.46	3.53E-01
4	SB-11	0.67	1.44E-01
5	TB-70	1.25	4.04E-02
6	TB-71	1.25	4.04E-02
7	TB-72	1.25	4.04E-02
8	TB-73	1.25	4.04E-02
9	TB-74	1.25	4.04E-02
10	TB-75	1.25	4.04E-02
11	TB-76	1.25	4.04E-02
12	TB-77	1.25	4.04E-02
13	TB-78	1.25	4.04E-02
14	TB-79	1.25	4.04E-02
15	TB-80	1.25	4.04E-02
16	TB-81	1.25	4.04E-02
	d =		2.03E+00

a1 =	0.5056
a2 =	0.3290
a3 =	0.2521
a4 =	0.1939
a5=	0.1447
a6=	0.1005
a7=	0.0593
a8=	0.0196

x(i)	x(n-i+1)		b(i)
0.250	1.250		0.5056
0.410	1.250		0.2764
0.455	1.250		0.2004
0.670	1.250		0.1125
1.250	1.250		0.0000
1.250	1.250		0.0000
1.250	1.250		0.0000
1.250	1.250		0.0000
1.250	1.250	b	1.0948
1.250	1.250		
1.250	1.250		
1.250	1.250		
1.250	0.670		
1.250	0.455		
1.250	0.410		
1.250	0.250		

W = 1/d(b)^2

W = 0.591 W(Calculated) is less than W(0.05) therefore DOES NOT FIT A NORMAL DISTRIBUTION

W(0.05) 0.887

Shapiro-Wilks Test for Lognormality

n = 16.000
k = 8.000
Mean, M -0.049

No.	ID	Ln Conc.	Ln (xi - M)^2
1	SB-12	-1.386	1.79E+00
2	SB-1	-0.892	7.10E-01
3	SB-13	-0.787	5.45E-01
4	SB-11	-0.400	1.24E-01
5	TB-70	0.223	7.41E-02
6	TB-71	0.223	7.41E-02
7	TB-72	0.223	7.41E-02
8	TB-73	0.223	7.41E-02
9	TB-74	0.223	7.41E-02
10	TB-75	0.223	7.41E-02
11	TB-76	0.223	7.41E-02
12	TB-77	0.223	7.41E-02
13	TB-78	0.223	7.41E-02
14	TB-79	0.223	7.41E-02
15	TB-80	0.223	7.41E-02
16	TB-81	0.223	7.41E-02
	d =		4.06E+00

a1 =	0.5056
a2 =	0.3290
a3 =	0.2521
a4 =	0.1939
a5=	0.1447
a6=	0.1005
a7=	0.0593
a8=	0.0196

Ln x(i)	Ln x(n-i+1)		b(i)
(1.386)	0.223		0.8136
(0.892)	0.223		0.3668
(0.787)	0.223		0.2548
(0.400)	0.223		0.1209
0.223	0.223		0.0000
0.223	0.223		0.0000
0.223	0.223		0.0000
0.223	0.223		0.0000
0.223	0.223	b	1.5560
0.223	0.223		
0.223	0.223		
0.223	0.223		
0.223	(0.400)		
0.223	(0.787)		
0.223	(0.892)		
0.223	(1.386)		

W = 1/d(b)^2

W = 0.597 W(Calculated) is less than W(0.05) therefore DOES NOT FIT A LOGNORMAL DISTRIBUTION

W(0.05) 0.887

****

CALCULATION OF NONPARAMETRIC 95% UCL
(Conover 1980)

n = 16
p = 0.5

From Table A3 in Conover, 95% UCL corresponds with
u = 10.83
n10 = 1.25
n11 = 1.25
n10.83 = 1.25

95% UCL = 1.25 mg/kg

AR 05372

CA_ .JM

Shapiro-Wilks Test for Normality

n = 16.000
k = 8.000
Mean, M 1.268

No.	ID	Conc.	(xi - M)^2
1	SB-1	0.01	1.58E+00
2	SB-12	0.54	5.30E-01
3	SB-11	1.08	3.53E-02
4	TB-70	1.25	3.24E-04
5	TB-71	1.25	3.24E-04
6	TB-72	1.25	3.24E-04
7	TB-73	1.25	3.24E-04
8	TB-74	1.25	3.24E-04
9	TB-75	1.25	3.24E-04
10	TB-76	1.25	3.24E-04
11	TB-77	1.25	3.24E-04
12	TB-78	1.25	3.24E-04
13	TB-79	1.25	3.24E-04
14	TB-80	1.25	3.24E-04
15	TB-81	1.25	3.24E-04
16	SB-13	3.65	5.67E+00
		d =	7.83E+00

a1 =	0.5056
a2 =	0.3290
a3 =	0.2521
a4 =	0.1939
a5=	0.1447
a6=	0.1005
a7=	0.0593
a8=	0.0196

x(i)	x(n-i+1)		b(i)
0.010	3.650		1.8404
0.540	1.250		0.2336
1.080	1.250		0.0429
1.250	1.250		0.0000
1.250	1.250		0.0000
1.250	1.250		0.0000
1.250	1.250		0.0000
1.250	1.250		0.0000
1.250	1.250	b	2.1168
1.250	1.250		
1.250	1.250		
1.250	1.250		
1.250	1.250		
1.250	1.080		
1.250	0.540		
3.650	0.010		

W = 1/d(b)^2

W = 0.573 W(Calculated) is less than W(0.05) therefore DOES NOT FIT A NORMAL DISTRIBUTION

W(0.05) 0.887

Shapiro-Wilks Test for Lognormality

n = 16.000
k = 8.000
Mean, M -0.073

No.	ID	Ln Conc.	Ln (xi - M)^2
1	SB-1	-4.605	2.05E+01
2	SB-12	-0.616	2.95E-01
3	SB-11	0.077	2.25E-02
4	TB-70	0.223	8.77E-02
5	TB-71	0.223	8.77E-02
6	TB-72	0.223	8.77E-02
7	TB-73	0.223	8.77E-02
8	TB-74	0.223	8.77E-02
9	TB-75	0.223	8.77E-02
10	TB-76	0.223	8.77E-02
11	TB-77	0.223	8.77E-02
12	TB-78	0.223	8.77E-02
13	TB-79	0.223	8.77E-02
14	TB-80	0.223	8.77E-02
15	TB-81	0.223	8.77E-02
16	SB-13	1.295	1.87E+00
		d =	2.38E+01

a1 =	0.5056
a2 =	0.3290
a3 =	0.2521
a4 =	0.1939
a5=	0.1447
a6=	0.1005
a7=	0.0593
a8=	0.0196

Ln x(i)	Ln x(n-i+1)		b(i)
(4.605)	1.295		2.9830
(0.616)	0.223		0.2761
0.077	0.223		0.0369
0.223	0.223		0.0000
0.223	0.223		0.0000
0.223	0.223		0.0000
0.223	0.223		0.0000
0.223	0.223		0.0000
0.223	0.223	b	3.2960
0.223	0.223		
0.223	0.223		
0.223	0.223		
0.223	0.223		
0.223	0.223		
0.223	0.077		
0.223	(0.616)		
1.295	(4.605)		

W = 1/d(b)^2

W = 0.457 W(Calculated) is less then than W(0.05) therefore DOES NOT FIT A LOGNORMAL DISTRIBUTION

W(0.05) 0.887

****

CALCULATION OF NONPARAMETRIC 95% UCL
(Conover 1980)

n = 16
p = 0.5

From Table A3 in Conover, 95% UCL corresponds with
u = 10.83
n10 = 1.25
n11 = 1.25
n10.83 = 1.25

95% UCL = 1.25 mg/kg

AR 05373

CHROMIUM

Shapiro-Wilks Test for Normality

n = 16.000
k = 8.000
Mean, M 20.784

No.	ID	Conc.	(xi - M)^2
1	TB-75	7.30	1.82E+02
2	TB-72	9.20	1.34E+02
3	TB-71	9.40	1.30E+02
4	TB-79	12.00	7.72E+01
5	TB-80	12.00	7.72E+01
6	TB-73	15.00	3.35E+01
7	SB-11	16.40	1.92E+01
8	TB-81	17.00	1.43E+01
9	TB-78	19.00	3.18E+00
10	TB-70	20.00	6.15E-01
11	SB-13	24.75	1.57E+01
12	SB-12	25.05	1.82E+01
13	TB-76	33.00	1.49E+02
14	SB-1	35.45	2.15E+02
15	TB-74	36.00	2.32E+02
16	TB-77	41.00	4.09E+02
		d =	1.71E+03

a1 =	0.5056
a2 =	0.3290
a3 =	0.2521
a4 =	0.1939
a5=	0.1447
a6=	0.1005
a7=	0.0593
a8=	0.0196

x(i)	x(n-i+1)		b(i)
7.300	41.000		17.0387
9.200	36.000		8.8172
9.400	35.450		6.5672
12.000	33.000		4.0719
12.000	25.050		1.8883
15.000	24.750		0.9799
16.400	20.000		0.2135
17.000	19.000		0.0392
19.000	17.000	b	39.6159
20.000	16.400		
24.750	15.000		
25.050	12.000		
33.000	12.000		
35.450	9.400		
36.000	9.200		
41.000	7.300		

W = 1/d(b)^2

W = 0.918

W(0.05) 0.887

W(Calculated) is greater than W(0.05) therefore FITS A NORMAL DISTRIBUTION

SINCE THE NORMAL 95% UCL IS MORE CONSERVATIVE A NORMAL DISTRIBUTION WILL BE ASSUMED

Shapiro-Wilks Test for Lognormality

n = 16.000
k = 8.000
Mean, M 2.905

No.	ID	Ln Conc.	Ln (xi - M)^2
1	TB-75	1.988	8.41E-01
2	TB-72	2.219	4.70E-01
3	TB-71	2.241	4.41E-01
4	TB-79	2.485	1.76E-01
5	TB-80	2.485	1.76E-01
6	TB-73	2.708	3.88E-02
7	SB-11	2.797	1.16E-02
8	TB-81	2.833	5.15E-03
9	TB-78	2.944	1.56E-03
10	TB-70	2.996	8.23E-03
11	SB-13	3.209	9.23E-02
12	SB-12	3.221	9.96E-02
13	TB-76	3.497	3.50E-01
14	SB-1	3.568	4.40E-01
15	TB-74	3.584	4.60E-01
16	TB-77	3.714	6.54E-01
		d =	4.27E+00

a1 =	0.5056
a2 =	0.3290
a3 =	0.2521
a4 =	0.1939
a5=	0.1447
a6=	0.1005
a7=	0.0593
a8=	0.0196

Ln x(i)	Ln x(n-i+1)		b(i)
1.988	3.714		0.8725
2.219	3.584		0.4489
2.241	3.568		0.3346
2.485	3.497		0.1961
2.485	3.221		0.1065
2.708	3.209		0.0503
2.797	2.996		0.0118
2.833	2.944		0.0022
2.944	2.833	b	2.0229
2.996	2.797		
3.209	2.708		
3.221	2.485		
3.497	2.485		
3.568	2.241		
3.584	2.219		
3.714	1.988		

W = 1/d(b)^2

W = 0.959

W(0.05) 0.887

W(Calculated) is greater than W(0.05) therefore FITS A LOGNORMAL DISTRIBUTION

AR 05374

CO. . ER

Shapiro-Wilks Test for Normality

n = 16.000
k = 8.000
Mean, M 98.647

No.	ID	Conc.	(xi - M)^2
1	TB-71	18.00	6.50E+03
2	TB-79	19.00	6.34E+03
3	TB-72	33.00	4.31E+03
4	TB-80	34.00	4.18E+03
5	SB-12	34.05	4.17E+03
6	SB-1	38.80	3.58E+03
7	TB-70	48.00	2.57E+03
8	TB-73	50.00	2.37E+03
9	TB-74	58.00	1.65E+03
10	TB-81	60.00	1.49E+03
11	TB-78	110.00	1.29E+02
12	TB-77	120.00	4.56E+02
13	TB-75	200.00	1.03E+04
14	SB-13	213.00	1.31E+04
15	TB-76	270.00	2.94E+04
16	SB-11	272.50	3.02E+04
		d =	1.21E+05

a1 =	0.5056
a2 =	0.3290
a3 =	0.2521
a4 =	0.1939
a5=	0.1447
a6=	0.1005
a7=	0.0593
a8=	0.0196

x(i)	x(n-i+1)		b(i)
18.000	272.500		128.6752
19.000	270.000		82.5790
33.000	213.000		45.3780
34.000	200.000		32.1874
34.050	120.000		12.4370
38.800	110.000		7.1556
48.000	60.000		0.7116
50.000	58.000		0.1568
58.000	50.000	b	309.2806
60.000	48.000		
110.000	38.800		
120.000	34.050		
200.000	34.000		
213.000	33.000		
270.000	19.000		
272.500	18.000		

W = 1/d(b)^2

W = 0.793 W(0.05) 0.887

W(Calculated) is less than W(0.05) therefore
DOES NOT FIT A NORMAL DISTRIBUTION

Shapiro-Wilks Test for Lognormality

n = 16.000
k = 8.000
Mean, M 4.208

No.	ID	Ln Conc.	Ln (xi - M)^2
1	TB-71	2.890	1.74E+00
2	TB-79	2.944	1.60E+00
3	TB-72	3.497	5.06E-01
4	TB-80	3.526	4.65E-01
5	SB-12	3.528	4.63E-01
6	SB-1	3.658	3.02E-01
7	TB-70	3.871	1.13E-01
8	TB-73	3.912	8.76E-02
9	TB-74	4.060	2.18E-02
10	TB-81	4.094	1.29E-02
11	TB-78	4.700	2.43E-01
12	TB-77	4.787	3.36E-01
13	TB-75	5.298	1.19E+00
14	SB-13	5.361	1.33E+00
15	TB-76	5.598	1.93E+00
16	SB-11	5.608	1.96E+00
		d =	6.73E+01

a1 =	0.5056
a2 =	0.3290
a3 =	0.2521
a4 =	0.1939
a5=	0.1447
a6=	0.1005
a7=	0.0593
a8=	0.0196

Ln x(i)	Ln x(n-i+1)		b(i)
2.890	5.608		1.3739
2.944	5.598		0.8732
3.497	5.361		0.4701
3.526	5.298		0.3436
3.528	4.787		0.1823
3.658	4.700		0.1047
3.871	4.094		0.0132
3.912	4.060		0.0029
4.060	3.912	b	3.3638
4.094	3.871		
4.700	3.658		
4.787	3.528		
5.298	3.526		
5.361	3.497		
5.598	2.944		
5.608	2.890		

W = 1/d(b)^2

W = 0.168 W(0.05) 0.887

W(Calculated) is less than W(0.05) therefore
DOES NOT FIT A LOGNORMAL DISTRIBUTION

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CALCULATION OF NONPARAMETRIC 95% UCL
(Conover 1980)

n = 16
p = 0.5

From Table A3 in Conover, 95% UCL corresponds with
u = 10.83
n10 = 60
n11 = 110
n10.83 = 101.5

95% UCL = 101.5 mg/kg

AR 05375

IRON

Shapiro-Wilks Test for Normality

n = 16.000
k = 8.000
Mean, M 22053.125

No.	ID	Conc.	(xi - M)^2
1	TB-70	7300.00	2.18E+08
2	TB-75	7300.00	2.18E+08
3	TB-79	7800.00	2.03E+08
4	TB-71	9300.00	1.63E+08
5	TB-72	9400.00	1.60E+08
6	TB-73	11000.00	1.22E+08
7	TB-80	11000.00	1.22E+08
8	TB-81	16000.00	3.66E+07
9	TB-78	21000.00	1.11E+06
10	SB-13	22300.00	6.10E+04
11	SB-11	27750.00	3.25E+07
12	TB-74	30000.00	6.32E+07
13	SB-12	30750.00	7.56E+07
14	TB-77	38000.00	2.54E+08
15	SB-1	38950.00	2.86E+08
16	TB-76	65000.00	1.84E+09
		d =	3.80E+09

a1 =	0.5056
a2 =	0.3290
a3 =	0.2521
a4 =	0.1939
a5=	0.1447
a6=	0.1005
a7=	0.0593
a8=	0.0196

x(i)	x(n-i+1)		b(i)
7,300.000	65,000.000		29173.1200
7,300.000	38,950.000		10412.8500
7,800.000	38,000.000		7613.4200
9,300.000	30,750.000		4159.1550
9,400.000	30,000.000		2980.8200
11,000.000	27,750.000		1683.3750
11,000.000	22,300.000		670.0900
16,000.000	21,000.000		98.0000
21,000.000	16,000.000	b	56790.8300
22,300.000	11,000.000		
27,750.000	11,000.000		
30,000.000	9,400.000		
30,750.000	9,300.000		
38,000.000	7,800.000		
38,950.000	7,300.000		
65,000.000	7,300.000		

W = 1/d(b)^2

W = 0.849 W(Calculated) is less than W(0.05) therefore DOES NOT FIT A NORMAL DISTRIBUTION

W(0.05) 0.887

Shapiro-Wilks Test for Lognormality

n = 16.000
k = 8.000
Mean, M 9.773

No.	ID	Ln Conc.	Ln (xi - M)^2
1	TB-70	8.896	7.70E-01
2	TB-75	8.896	7.70E-01
3	TB-79	8.962	6.58E-01
4	TB-71	9.138	4.04E-01
5	TB-72	9.148	3.90E-01
6	TB-73	9.306	2.18E-01
7	TB-80	9.306	2.18E-01
8	TB-81	9.680	8.59E-03
9	TB-78	9.952	3.21E-02
10	SB-13	10.012	5.73E-02
11	SB-11	10.231	2.10E-01
12	TB-74	10.309	2.87E-01
13	SB-12	10.334	3.14E-01
14	TB-77	10.545	5.97E-01
15	SB-1	10.570	6.35E-01
16	TB-76	11.082	1.71E+00
		d =	1.42E+04

a1 =	0.5056
a2 =	0.3290
a3 =	0.2521
a4 =	0.1939
a5=	0.1447
a6=	0.1005
a7=	0.0593
a8=	0.0196

Ln x(i)	Ln x(n-i+1)		b(i)
8.896	11.082		1.1055
8.896	10.570		0.5509
8.962	10.545		0.3992
9.138	10.334		0.2319
9.148	10.309		0.1679
9.306	10.231		0.0930
9.306	10.012		0.0419
9.680	9.952		0.0053
9.952	9.680	b	2.5956
10.012	9.306		
10.231	9.306		
10.309	9.148		
10.334	9.138		
10.545	8.962		
10.570	8.896		
11.082	8.896		

W = 1/d(b)^2

W = 0.000 W (calculated) is less than W(0.05) therefore DOES NOT FIT A LOGNORMAL

W(0.05) 0.887

CALCULATION OF NONPARAMETRIC 95% UCL
(Conover 1980)

n = 16
p = 0.5

From Table A3 in Conover, 95% UCL corresponds with
u = 10.83
n10 = 22300
n11 = 27750
n10.83 = 26824

95% UCL = 26824 mg/kg

AR 05376

MANGANESE

Shapiro-Wilks Test for Normality

n = 16.000
k = 8.000
Mean, M 254.978

No.	ID	Conc.	(xi - M)^2
1	TB-75	44.00	4.45E+04
2	TB-81	82.00	2.99E+04
3	SB-1	92.65	2.64E+04
4	TB-79	93.00	2.62E+04
5	TB-72	120.00	1.82E+04
6	TB-80	120.00	1.82E+04
7	TB-74	150.00	1.10E+04
8	SB-12	150.50	1.09E+04
9	TB-71	180.00	5.63E+03
10	TB-78	190.00	4.23E+03
11	SB-11	238.50	2.72E+02
12	TB-77	380.00	1.56E+04
13	TB-73	400.00	2.10E+04
14	SB-13	429.00	3.03E+04
15	TB-76	450.00	3.80E+04
16	TB-70	960.00	4.97E+05
		d =	7.98E+05

a1 =	0.5056
a2 =	0.3290
a3 =	0.2521
a4 =	0.1939
a5=	0.1447
a6=	0.1005
a7=	0.0593
a8=	0.0196

x(i)	x(n-i+1)		b(i)
44.000	960.000		463.1296
82.000	450.000		121.0720
92.650	429.000		84.7938
93.000	400.000		59.5273
120.000	380.000		37.6220
120.000	238.500		11.9093
150.000	190.000		2.3720
150.500	180.000		0.5782
180.000	150.500	b	781.0042
190.000	150.000		
238.500	120.000		
380.000	120.000		
400.000	93.000		
429.000	92.650		
450.000	82.000		
960.000	44.000		

W = 1/d(b)^2

W = 0.765 W(0.05) 0.887

W(Calculated) is less than W(0.05) therefore DOES NOT FIT A NORMAL DISTRIBUTION

Shapiro-Wilks Test for Lognormality

n = 16.000
k = 8.000
Mean, M 5.233

No.	ID	Ln Conc.	Ln (xi - M)^2
1	TB-75	3.784	2.10E+00
2	TB-81	4.407	6.83E-01
3	SB-1	4.529	4.96E-01
4	TB-79	4.533	4.91E-01
5	TB-72	4.787	1.98E-01
6	TB-80	4.787	1.98E-01
7	TB-74	5.011	4.94E-02
8	SB-12	5.014	4.80E-02
9	TB-71	5.193	1.60E-03
10	TB-78	5.247	1.97E-04
11	SB-11	5.474	5.83E-02
12	TB-77	5.940	5.00E-01
13	TB-73	5.991	5.75E-01
14	SB-13	6.061	6.86E-01
15	TB-76	6.109	7.68E-01
16	TB-70	6.867	2.67E+00
		d =	9.52E+00

a1 =	0.5056
a2 =	0.3290
a3 =	0.2521
a4 =	0.1939
a5=	0.1447
a6=	0.1005
a7=	0.0593
a8=	0.0196

Ln x(i)	Ln x(n-i+1)		b(i)
3.784	6.867		1.5586
4.407	6.109		0.5601
4.529	6.061		0.3864
4.533	5.991		0.2829
4.787	5.940		0.1668
4.787	5.474		0.0690
5.011	5.247		0.0140
5.014	5.193		0.0035
5.193	5.014	b	3.0414
5.247	5.011		
5.474	4.787		
5.940	4.787		
5.991	4.533		
6.061	4.529		
6.109	4.407		
6.867	3.784		

W = 1/d(b)^2

W = 0.971 W(0.05) 0.887

W(Calculated) is greater than W(0.05) therefore FITS A LOGNORMAL DISTRIBUTION

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THALLIUM

Shapiro-Wilks Test for Normality

n = 16.000
k = 8.000
Mean, M 2.580

No.	ID	Conc.	(xi - M)^2
1	SB-13	0.43	4.63E+00
2	SB-12	0.47	4.44E+00
3	SB-11	0.49	4.35E+00
4	TB-70	1.00	2.48E+00
5	TB-71	1.00	2.48E+00
6	TB-72	1.00	2.48E+00
7	TB-73	1.00	2.48E+00
8	TB-74	1.00	2.48E+00
9	TB-75	1.00	2.48E+00
10	TB-76	1.00	2.48E+00
11	TB-77	1.00	2.48E+00
12	TB-78	1.00	2.48E+00
13	TB-79	1.00	2.48E+00
14	TB-80	1.00	2.48E+00
15	TB-81	2.80	5.02E-02
16	SB-1	26.10	5.53E+02
	d =		5.94E+02

a1 =	0.5056
a2 =	0.3290
a3 =	0.2521
a4 =	0.1939
a5=	0.1447
a6=	0.1005
a7=	0.0593
a8=	0.0196

x(i)	x(n-i+1)		b(i)
0.425	26.100		12.9813
0.470	2.800		0.7666
0.490	1.000		0.1286
1.000	1.000		0.0000
1.000	1.000		0.0000
1.000	1.000		0.0000
1.000	1.000		0.0000
1.000	1.000		0.0000
1.000	1.000	b	13.8764
1.000	1.000		
1.000	1.000		
1.000	1.000		
1.000	1.000		
1.000	1.000		
1.000	0.490		
2.800	0.470		
26.100	0.425		

W = 1/d(b)^2

W = 0.324 W(0.05) 0.887

W(Calculated) is less than W(0.05) therefore DOES NOT FIT A NORMAL DISTRIBUTION

Shapiro-Wilks Test for Lognormality

n = 16.000
k = 8.000
Mean, M 0.123

No.	ID	Ln Conc.	Ln (xi - M)^2
1	SB-13	-0.856	9.38E-01
2	SB-12	-0.755	7.53E-01
3	SB-11	-0.713	6.83E-01
4	TB-70	0.000	1.28E-02
5	TB-71	0.000	1.28E-02
6	TB-72	0.000	1.28E-02
7	TB-73	0.000	1.28E-02
8	TB-74	0.000	1.28E-02
9	TB-75	0.000	1.28E-02
10	TB-76	0.000	1.28E-02
11	TB-77	0.000	1.28E-02
12	TB-78	0.000	1.28E-02
13	TB-79	0.000	1.28E-02
14	TB-80	0.000	1.28E-02
15	TB-81	1.030	8.40E-01
16	SB-1	3.262	9.92E+00
	d =		1.33E+01

a1 =	0.5056
a2 =	0.3290
a3 =	0.2521
a4 =	0.1939
a5=	0.1447
a6=	0.1005
a7=	0.0593
a8=	0.0196

Ln x(i)	Ln x(n-i+1)		b(i)
(0.856)	3.262		2.0819
(0.755)	1.030		0.5871
(0.713)	0.000		0.1798
0.000	0.000		0.0000
0.000	0.000		0.0000
0.000	0.000		0.0000
0.000	0.000		0.0000
0.000	0.000		0.0000
0.000	0.000	b	2.8488
0.000	0.000		
0.000	0.000		
0.000	0.000		
0.000	0.000		
0.000	(0.713)		
1.030	(0.755)		
3.262	(0.856)		

W = 1/d(b)^2

W = 0.612 W(0.05) 0.887

W(Calculated) is less than W(0.05) therefore DOES NOT FIT A LOGNORMAL DISTRIBUTION

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CALCULATION OF NONPARAMETRIC 95% UCL
(Conover 1980)

n = 16
p = 0.5

From Table A3 in Conover, 95% UCL corresponds with
u = 10.83
n10 = 1
n11 = 1
n10.83 = 1

95% UCL = 1 mg/kg

AR 05378

VANADIUM

Shapiro-Wilks Test for Normality

n = 16.000
k = 8.000
Mean, M 28.478

No.	ID	Conc.	(xi - M)^2
1	TB-75	9.60	3.56E+02
2	TB-79	12.00	2.72E+02
3	TB-72	13.00	2.40E+02
4	TB-73	14.00	2.10E+02
5	TB-80	16.00	1.56E+02
6	TB-78	18.00	1.10E+02
7	TB-71	20.00	7.19E+01
8	TB-74	21.00	5.59E+01
9	SB-11	27.00	2.18E+00
10	TB-76	33.00	2.04E+01
11	TB-81	34.00	3.05E+01
12	SB-13	37.85	8.78E+01
13	SB-1	49.55	4.44E+02
14	TB-70	50.00	4.63E+02
15	TB-77	50.00	4.63E+02
16	SB-12	50.65	4.92E+02
		d =	3.47E+03

a1 =	0.5056
a2 =	0.3290
a3 =	0.2521
a4 =	0.1939
a5=	0.1447
a6=	0.1005
a7=	0.0593
a8=	0.0196

x(i)	x(n-i+1)		b(i)
9.600	50.650		20.7549
12.000	50.000		12.5020
13.000	50.000		9.3277
14.000	49.550		6.8931
16.000	37.850		3.1617
18.000	34.000		1.6080
20.000	33.000		0.7709
21.000	27.000		0.1176
27.000	21.000	b	55.1359
33.000	20.000		
34.000	18.000		
37.850	16.000		
49.550	14.000		
50.000	13.000		
50.000	12.000		
50.650	9.600		

W = 1/d(b)^2

W = 0.875 W(0.05) 0.887

W(Calculated) is less than W(0.05) therefore DOES NOT FIT A NORMAL DISTRIBUTION

Shapiro-Wilks Test for Lognormality

n = 16.000
k = 8.000
Mean, M 3.204

No.	ID	Ln Conc.	Ln (xi - M)^2
1	TB-75	2.262	8.88E-01
2	TB-79	2.485	5.17E-01
3	TB-72	2.565	4.08E-01
4	TB-73	2.639	3.19E-01
5	TB-80	2.773	1.86E-01
6	TB-78	2.890	9.84E-02
7	TB-71	2.996	4.34E-02
8	TB-74	3.045	2.54E-02
9	SB-11	3.296	8.43E-03
10	TB-76	3.497	8.56E-02
11	TB-81	3.526	1.04E-01
12	SB-13	3.634	1.85E-01
13	SB-1	3.903	4.89E-01
14	TB-70	3.912	5.01E-01
15	TB-77	3.912	5.01E-01
16	SB-12	3.925	5.20E-01
		d =	4.88E+00

a1 =	0.5056
a2 =	0.3290
a3 =	0.2521
a4 =	0.1939
a5=	0.1447
a6=	0.1005
a7=	0.0593
a8=	0.0196

Ln x(i)	Ln x(n-i+1)		b(i)
2.262	3.925		0.8409
2.485	3.912		0.4695
2.565	3.912		0.3396
2.639	3.903		0.2451
2.773	3.634		0.1246
2.890	3.526		0.0639
2.996	3.497		0.0297
3.045	3.296		0.0049
3.296	3.045	b	2.1182
3.497	2.996		
3.526	2.890		
3.634	2.773		
3.903	2.639		
3.912	2.565		
3.912	2.485		
3.925	2.262		

W = 1/d(b)^2

W = 0.920 W(0.05) 0.887

W(Calculated) is greater than W(0.05) therefore FITS A LOGNORMAL DISTRIBUTION

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TOTAL CYANIDES

Shapiro-Wilks Test for Normality

n = 16.000
k = 8.000
Mean, M 9.619

No.	ID	Conc.	(xi - M)^2
1	SB-13	1.00	7.43E+01
2	TB-70	2.50	5.07E+01
3	TB-71	2.50	5.07E+01
4	TB-72	2.50	5.07E+01
5	TB-75	2.50	5.07E+01
6	TB-76	2.50	5.07E+01
7	TB-77	2.50	5.07E+01
8	TB-78	2.50	5.07E+01
9	TB-79	2.50	5.07E+01
10	TB-80	2.50	5.07E+01
11	TB-81	2.50	5.07E+01
12	SB-12	7.40	4.92E+00
13	TB-73	21.00	1.30E+02
14	TB-74	26.00	2.68E+02
15	SB-11	29.25	3.85E+02
16	SB-1	44.25	1.20E+03
		d =	2.57E+03

a1 =	0.5056
a2 =	0.3290
a3 =	0.2521
a4 =	0.1939
a5=	0.1447
a6=	0.1005
a7=	0.0593
a8=	0.0196

x(i)	x(n-i+1)		b(i)
1.000	44.250		21.8672
2.500	29.250		8.8008
2.500	26.000		5.9244
2.500	21.000		3.5872
2.500	7.400		0.7090
2.500	2.500		0.0000
2.500	2.500		0.0000
2.500	2.500		0.0000
2.500	2.500	b	40.8885
2.500	2.500		
2.500	2.500		
7.400	2.500		
21.000	2.500		
26.000	2.500		
29.250	2.500		
44.250	1.000		

W = 1/d(b)^2

W = 0.651 W(0.05) 0.887

W(Calculated) is less than W(0.05) therefore DOES NOT FIT A NORMAL DISTRIBUTION

Shapiro-Wilks Test for Lognormality

n = 16.000
k = 8.000
Mean, M 1.540

No.	ID	Ln Conc.	Ln (xi - M)^2
1		0.000	2.37E+00
2	TB-70	0.916	3.89E-01
3	TB-71	0.916	3.89E-01
4	TB-72	0.916	3.89E-01
5	TB-75	0.916	3.89E-01
6	TB-76	0.916	3.89E-01
7	TB-77	0.916	3.89E-01
8	TB-78	0.916	3.89E-01
9	TB-79	0.916	3.89E-01
10	TB-80	0.916	3.89E-01
11	TB-81	0.916	3.89E-01
12	SB-12	2.001	2.13E-01
13	TB-73	3.045	2.26E+00
14	TB-74	3.258	2.95E+00
15	SB-11	3.376	3.37E+00
16	SB-1	3.790	5.06E+00
		d =	2.01E+01

a1 =	0.5056
a2 =	0.3290
a3 =	0.2521
a4 =	0.1939
a5=	0.1447
a6=	0.1005
a7=	0.0593
a8=	0.0196

Ln x(i)	Ln x(n-i+1)		b(i)
0.000	3.790		1.9162
0.916	3.376		0.8092
0.916	3.258		0.5904
0.916	3.045		0.4127
0.916	2.001		0.1570
0.916	0.916		0.0000
0.916	0.916		0.0000
0.916	0.916		0.0000
0.916	0.916	b	3.8854
0.916	0.916		
0.916	0.916		
2.001	0.916		
3.045	0.916		
3.258	0.916		
3.376	0.916		
3.790	0.000		

W = 1/d(b)^2

W = 0.750 W(0.05) 0.887

W(Calculated) is less than W(0.05) therefore DOES NOT FIT A LOGNORMAL DISTRIBUTION

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CALCULATION OF NONPARAMETRIC 95% UCL
(Conover 1980)

n = 16
p = 0.5

From Table A3 in Conover, 95% UCL corresponds with
u = 10.83
n10 = 2.5
n11 = 2.5
n10.83 = 2.5

95% UCL = 2.5 mg/kg

AR 05380

DIBENZOFURAN

Shapiro-Wilks Test for Normality

n = 8.000
k = 4.000
Mean, M 1.607

No.	ID	Conc.	(xi - M)^2
1	TB-50	0.19	2.01E+00
2	SB-13	0.5425	1.13E+00
3	P-7S	1	3.68E-01
4	SB-1	1.085	2.72E-01
5	P-5S	2.2	7.71E-01
6	P-6S	2.4	1.80E+00
7	SB-11	2.485	3.52E-01
8	SB-12	2.95	6.29E-01
	d =		7.34E+00

a1 =	0.6052
a2 =	0.3164
a3 =	0.1743
a4 =	0.0561

x(i)	x(n-i+1)		b(i)
0.190	2.950		1.6704
0.543	2.485		0.6146
1.000	2.400		0.2440
1.085	2.200		0.0626
2.200	1.085	b	2.5915
2.400	1.000		
2.485	0.543		
2.950	0.190		

W = 1/d(b)^2

W = 0.915

W(0.05) 0.818

W(Calculated) is greater than W(0.05) therefore FITS A NORMAL DISTRIBUTION

Shapiro-Wilks Test for Lognormality

n = 8.000
k = 4.000
Mean, M 0.183

No.	ID	Ln Conc.	Ln (xi - M)^2
1	TB-50	-1.661	3.40E+00
2	SB-13	-0.612	6.31E-01
3	P-7S	0.000	3.35E-02
4	SB-1	0.082	1.03E-02
5	P-5S	0.788	3.67E-01
6	P-6S	0.875	4.80E-01
7	SB-11	0.910	5.29E-01
8	SB-12	1.082	8.08E-01
	d =		4.92E+00

a1 =	0.6052
a2 =	0.3164
a3 =	0.1743
a4 =	0.0561

Ln x(i)	Ln x(n-i+1)		b(i)
-1.661	1.082		1.660
-0.612	0.910		0.482
0.000	0.875		0.153
0.082	0.788		0.040
0.788	0.082	b	2.334
0.875	0.000		
0.910	-0.612		
1.082	-1.661		

W = 1/d(b)^2

W = 1.107

W(0.05) 0.818

W(Calculated) is greater than W(0.05) therefore FITS A LOGNORMAL DISTRIBUTION

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SINCE THE LOGNORMAL 95%UCL IS GREATER THAN THE MAXIMUM DATA VALUE, A NORMAL DISTRIBUTION WILL BE ASSUMED

AR 05381