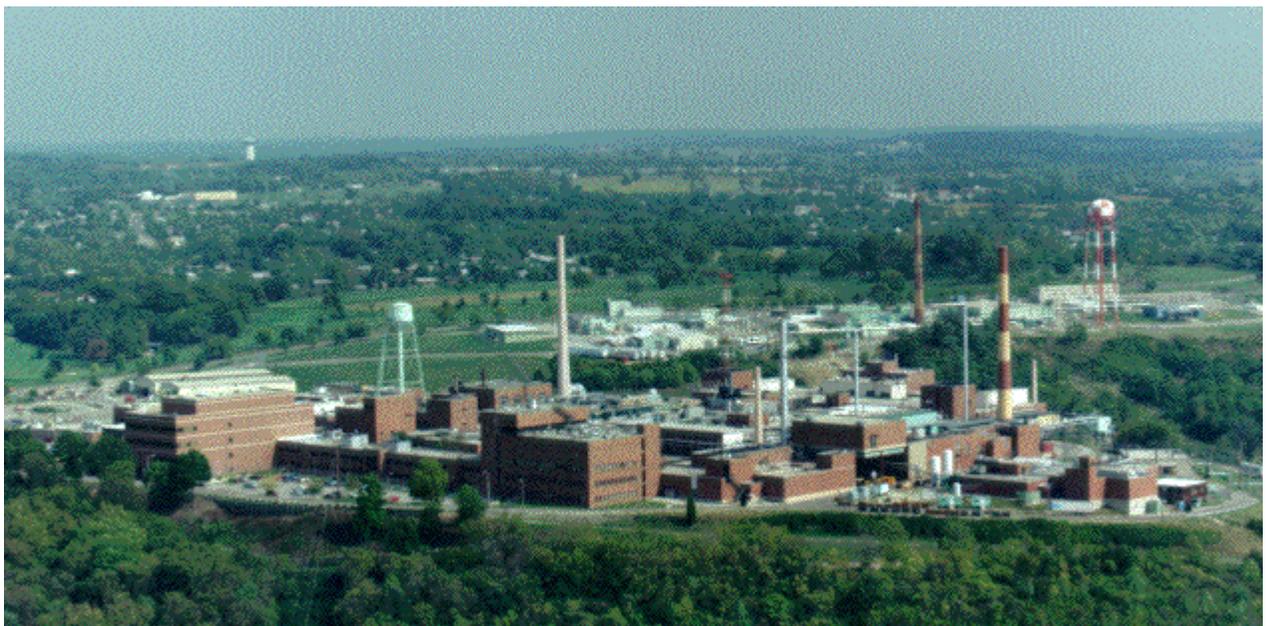


MOUND



Environmental
Restoration
Program





MOUND PLANT PRS DATA PACKAGE

Notice of Public Review Period



The following Potential Release site (PRS) Data Packages will be available for public review in the CERCLA Public Reading Room, 305 E. Central Ave., Miamisburg, Ohio beginning April 15, 1998. Public comment will be accepted on these packages from April 15, 1998, through May 15, 1998.

PRS 412: Soil Contamination - Radiological

Written comments may be sent to U.S. Department of Energy, c/o Jane Greenwalt, P.O. Box 66, Miamisburg, Ohio 45343-0066 or by E-Mail to: jane.greenwalt@em.doe.gov
Questions can be referred to DOE Office of Public Affairs at (937) 865-3116



The Mound Core Team
P.O. Box 66
Miamisburg, Ohio 45343-0066

July 22, 1998

Mr. Tim Taulbee
120 Fairfield Court
Springboro, Ohio
45066

Dear Mr. Taulbee:

Thank you for your comments on PRS 412. The Core Team, consisting of the U.S. Department of Energy Miamisburg Environmental Management Project (DOE-MEMP), U.S. Environmental Protection Agency (USEPA), and the Ohio Environmental Protection Agency (OEPA), appreciates the input provided by the public stakeholders of the Mound facility. The public stakeholders have significantly contributed to the forward progress that has been made establishing the safety of the Mound property prior to its return to public use after remediation and residual risk evaluation.

Should the responses to comments require additional detail, please contact Art Kleinrath at (937) 865-3597 and we will gladly arrange a meeting or telephone conference.

Sincerely,

DOE/MEMP: *Arthur W. Kleinrath*
Arthur W. Kleinrath, Remedial Project Manager

USEPA: *Timothy J. Fischer*
Timothy J. Fischer, Remedial Project Manager

OHIO EPA: *Brian K. Nickel*
Brian K. Nickel, Project Manager

Comment:

From the provided picture of this PRS, it appears to be in the middle of the road. Is the actual boundary of PRS 412 an area encompassing the Underground Radioactive Material Area?

Response:

PRS 412 was created due to the presence of 42 pCi of thorium at the core sample location of C00033. The location of C0033 is within the Underground Radioactive Material Area. In the actual design of clean up all available information will be used including that used in the designating of the Underground Radioactive Material Area.

Comment:

A strip of elevated gamma readings were observed by the INEEL warthog in the ditchline just east of the PRS 412 location, will the remedial action include this area?

Thanks for bringing these data to our attention. The information obtained from INEEL is attached. The information will be used in the design of this remedial action.

Comment:

Since further assessment sampling will not be performed before the removal action, how will Mound insure that the extent of the subsurface contamination will be known before removal for cost estimates and personnel protective equipment.

Response:

The Core Team shares your concern about the extent of contaminants and personal protection equipment,. Real time field monitoring that allows remediation workers to evaluate the extent and nature of contamination, along with appropriate personnel protection equipment, will be needed for this action. In addition, the action will be designed to address the questions raised by the fact that the full extent of the contamination is not known at this time. These topics will be addressed in the Action Memo (which will be available for public comment), the Work Plan, and the Verification Sampling Plan for the Removal Action.

Comment:

If I recall correctly, there was some discussion as to the origin of the contamination. Some suspicions were that it was due to migration from the Building 31 area. If precursor core sampling is planned, will the core sampling focus on locating the source term?

Response:

Characterization sampling would focus on isolating the thorium in the vicinity of PRS 412 and the hot spot C0033. If the characterization information or data generated during the removal action field work indicates the origin or direction of origin of PRS 412, that information will be pursued as appropriate. There is a great deal of sampling information from the vicinity of Building 31. PRS 266 and PRS 267 are located nearby. PRS 267 has been designated Further Assessment. The Further Assessment of PRS 267 may resolve the speculation that Building 31 is the source of the contamination near PRS 412.

INTERDEPARTMENTAL COMMUNICATION

Date: March 20, 1997

To: Reva Hyde MS 3765 6-0741

From: Nick Josten MS 2107 6-7691

Subject: PRELIMINARY SUMMARY OF IN SITU Pu-238 MAPPING AT MOUND PLANT - NEJ-01-97

This letter has been prepared to provide a summary of data and preliminary conclusions stemming from two days of field work at the Pu-238 contaminated Miami-Erie Canal adjacent to the DOE Mound Plant in Ohio. Our objective in this work was to establish a performance baseline for in situ mapping of Pu-238 contamination using a CaF₂ radiation sensor. A Final Report is being prepared.

Background

The INEEL constructed a custom radiation sensor based on six 2 in x 2 in CaF₂ detectors supplied by the WAG-7 Environmental Restoration Program. CaF₂ exhibits good sensitivity to L x-ray radiation in the vicinity of the 17 keV x-ray emitted by Pu-238, with little sensitivity to higher energy x-rays or gamma radiation. The six CaF₂ detectors were set up with two energy windows, one near 17 keV to detect Pu-238, and a second to measure changes in background radiation. The sensor was shipped to Mound Plant along with a four-wheeled deployment cart (Figure 1).

Upon arrival at Mound Plant, the cart and sensor were assembled and checked out using available test sources. During this testing, it was discovered that four of the six CaF₂ detectors were not correctly tuned for Pu-238 detection and were contributing substantial noise to the system. The cause of this problem could not be determined so the four malfunctioning detectors were disconnected and the sensor was operated with the remaining two.

Field work was conducted in a portion of the canal designated as Grid 15S. Grid 15S originally contained soil mounds from historic dredging of the canal. The dredge piles were recently removed by excavation under the ongoing Canal remediation, but surveys indicated that residual Pu-238 remained. The field testing procedure was to map the in situ distribution of residual Pu-238 using the cart mounted CaF₂ sensor and to collect samples as necessary to verify mapping results.

For the field testing, the CaF₂ sensor was mounted on the cart six inches above the ground and traversed along 32 ft long scan lines parallel to the Miami-Erie Canal. A total of 21 lines were scanned 1 ft apart giving a total survey area of 32 ft x 20 ft. A second survey was conducted over the same area but with scan lines running perpendicular to the canal. The purpose of the second survey was to verify that the in situ measurements were repeatable. The CaF₂ sensor

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continuously measured the ambient x-ray radiation field and produced two channels of output in counts/sec. The measured values were displayed as they were acquired, once per second, on a console in view of the cart operator.

Following the work at Grid 15S, a gross gamma-ray sensor was mounted on the cart in place of the CaF_2 sensor. This system was used to survey a 45 ft x 16 ft area near Mound Plant's Building 88 that was suspected to contain Th-232 contamination.

Results

1. The INEEL CaF_2 detector measured increased Pu-238 L x-ray radiation over an area approximately 4 - 6 ft wide near the edge of and parallel to the Miami-Erie canal (Figure 2). In this area, x-ray fields were measured at 16 - 20 c/s (± 5 c/s) compared with 9 - 14 c/s (± 5 c/s) in background areas. The signal to noise ratio is low, suggesting that this feature represents the approximate detection limit of the CaF_2 detector. By averaging data within 2 ft x 2 ft squares, which is effectively the same as increasing detector count times, noise levels were reduced with only a minor loss in spatial resolution. Figure 3 shows the smoothed data, which accentuate the area of high L x-ray flux.
2. The approximate detection limit for the CaF_2 detector in pCi/g was estimated based on 16 samples collected within the survey area (Figure 4). The 9 samples within the high L x-ray flux zone have a median Pu-238 activity concentration of 117 pCi/g and a mean activity concentration of 384 pCi/g. If the median Pu-238 activity concentration from the samples is taken as the best approximation of bulk Pu-238 levels throughout the contaminated zone, we can conclude that the detection limit of the current CaF_2 detector is in the range of 100 - 150 pCi/g.
3. A more detailed comparison between the in situ x-ray measurements and sampling results implies a complex relationship between the two assay methods. Figure 4 compares CaF_2 detector response with sample activity concentrations along lines perpendicular and parallel to the high Lx-ray zone. The perpendicular profile (Figure 5a) shows background Lx-ray fields at 10 - 12 c/s and maximum x-ray fields at 18 - 19 c/s, i.e. a factor of two increase. Corresponding Pu-238 levels from samples increase from a background 13 - 19 pCi/g to a maximum of 1793 pCi/g, i.e. a factor of more than 100 increase. The parallel profile (Figure 5b) shows x-ray fields varying between 14 - 20 c/s or between 1.5 to 2 times background. Sampled Pu-238 levels show the same general pattern of highs and lows along this trend but the activity concentrations range from 1 to over 100 times background. These large variations in activity concentrations occur over short distances and suggest an element of random or chaotic distribution of Pu-238. On the other hand, in situ measurements made with the CaF_2 detector imply more uniform or smoothly varying Pu-238 distribution.
4. Mapping of the high flux area was achieved in real time, with the CaF_2 sensor mounted on the hand pushed cart and scanned across the area at a line scan rate averaging 0.5 ft/s. The initial scan required 63.6 minutes, covered 640 ft², and produced 1146 independent measurements of the L x-ray radiation field (Figure 6). This corresponds to an average of about 6 seconds and two

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independent measurements per square foot. We estimate that 2/3 of the scan time was used for turning and aligning the cart as required to use its internal navigation system. An optimized data collection system could easily reduce scan times to about 2 seconds per square foot without reducing sensitivity or spatial resolution.

5. The in situ gross gamma-ray map generated from data collected with the plastic scintillator near Building 88 is shown in Figure 7. The map image reveals the Th-232 to be highly localized in a series of hot spots along a linear trend with the most prominent hot spot occupying approximately 175 sq ft. The INEEL plastic scintillator is heavily shielded, which enhances the sharpness of the measured gamma-ray field changes as the sensor moves on or off contaminated soils. This factor, combined with the fact that over 350 independent measurements were made uniformly on the site (Figure 8) suggests that the map images are accurate representations of Th-232 distribution. If the scintillator was calibrated for Th-232 it would be possible to estimate the Th-232 activity concentration in pCi/g.

Conclusions

Field tests with the INEEL CaF₂ sensor at the Miami-Erie Canal suggest that the difficult problem of detecting Pu-238 in situ and in real time should be achievable at levels low enough to be useful as a field screening tool. Demonstrated advantages of the in situ method include 1) the higher speed at which results are available for review and use, and 2) vastly improved spatial resolution of Pu-238 distribution because of the greatly increased data density.

The detection limit of the CaF₂ detector in pCi/g is not clearly discernible from sample results because sample activity concentrations varied erratically over short distances. Nonetheless, it is reasonable to conclude that this limit is in the 100 - 150 pCi/g range. Perhaps more important is the observation that the in situ sensor tends to respond to bulk changes in contamination levels averaged over large surface areas (~4 sq ft) while sampling can be sensitive to very localized changes. This difference, which is fundamental to the two methods, should be at the core of discussions concerning their most beneficial use in the remediation process.

The INEEL CaF₂ sensor performance can be further improved by retuning the 4 defective detectors and refining the method used to measure the Pu-238 window and the background window. Theoretically, detection limits should be decreased nearly a factor of two through addition of the four detectors alone.

The much easier problem of detecting high energy gamma-rays in situ was illustrated by data collected for Th-232 contamination near Building 88. The large area, heavily shielded INEEL plastic scintillator was a clear improvement over the plastic scintillator used during the Area 7 Removal Action in 1995. The new sensor is capable of very rapid, high resolution characterization of contaminant distribution and is very amenable to quantitative analysis because of its high sensitivity and narrow focus.

Figure 7

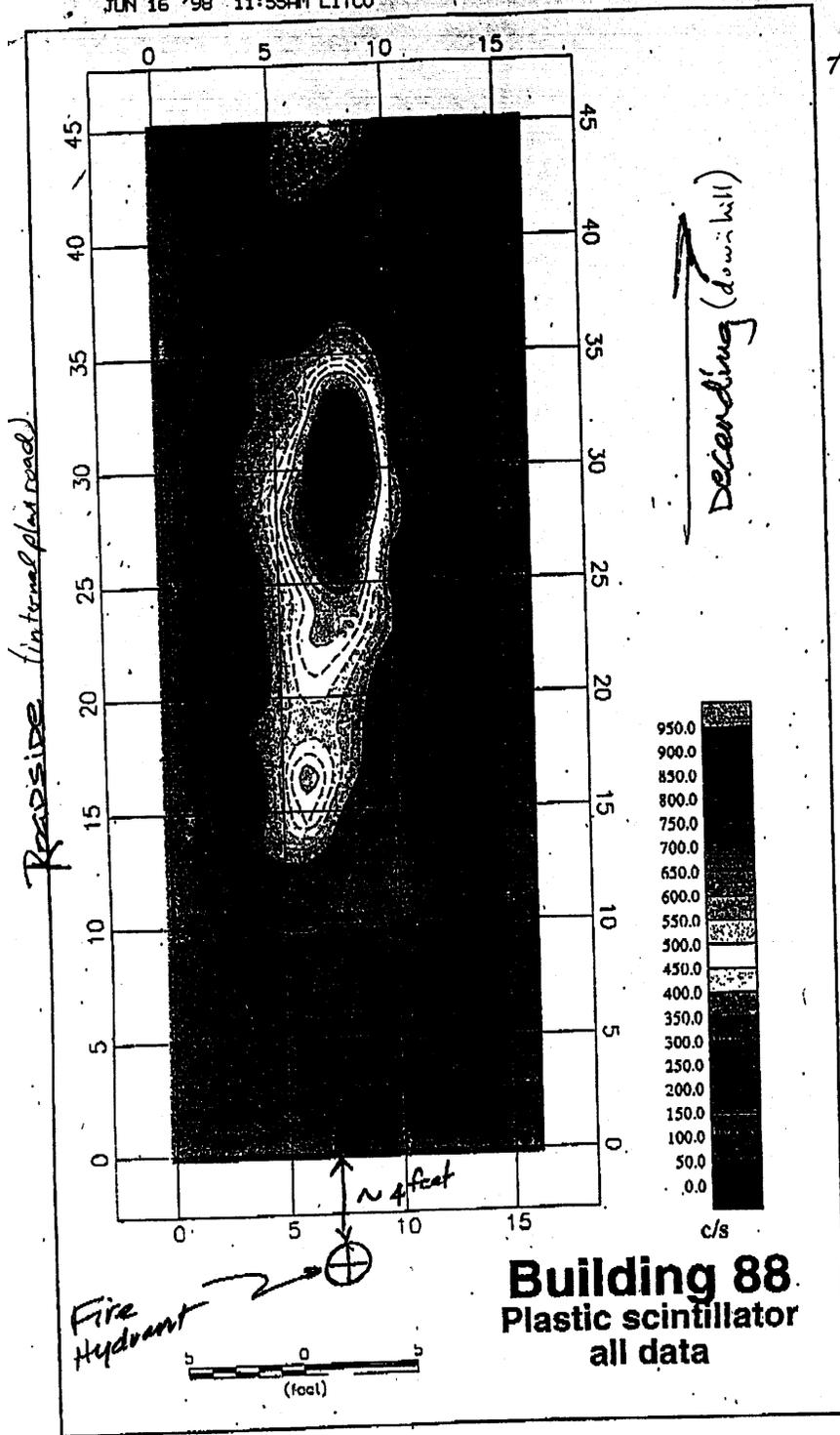
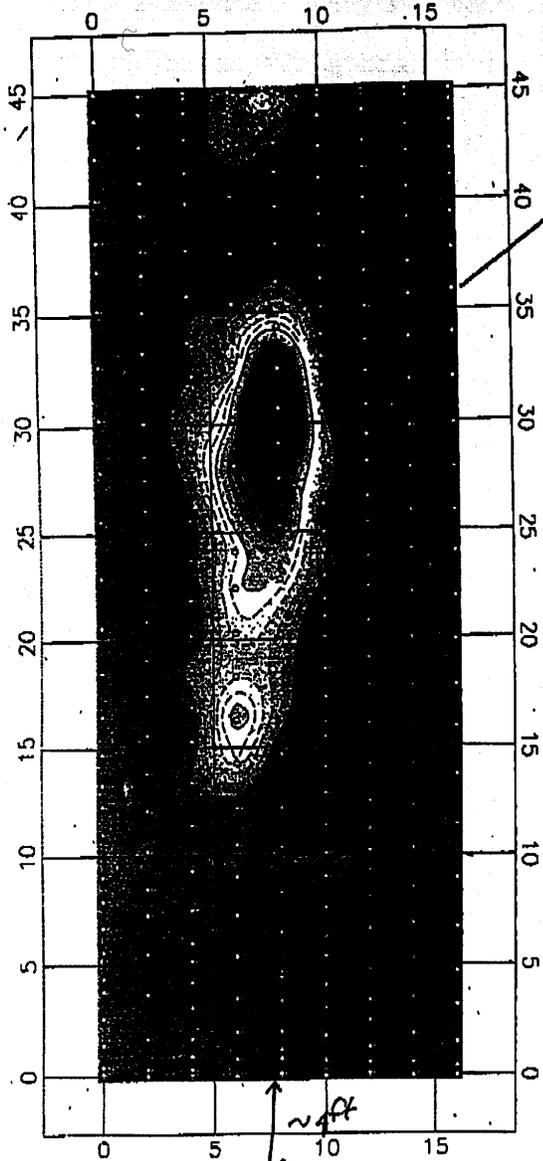


Figure 8

In situ measurement points for plastic scintillator (382 total)

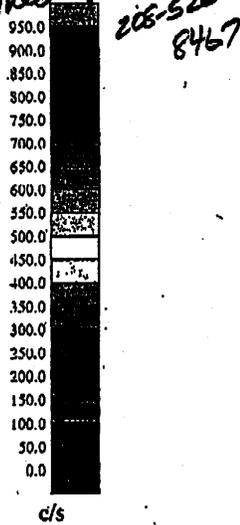
Rearside



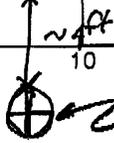
Dick NEFF - X-4219

From Mike Carpenter

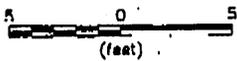
"I'll call you"



208-526-8467



Fire Hydrant

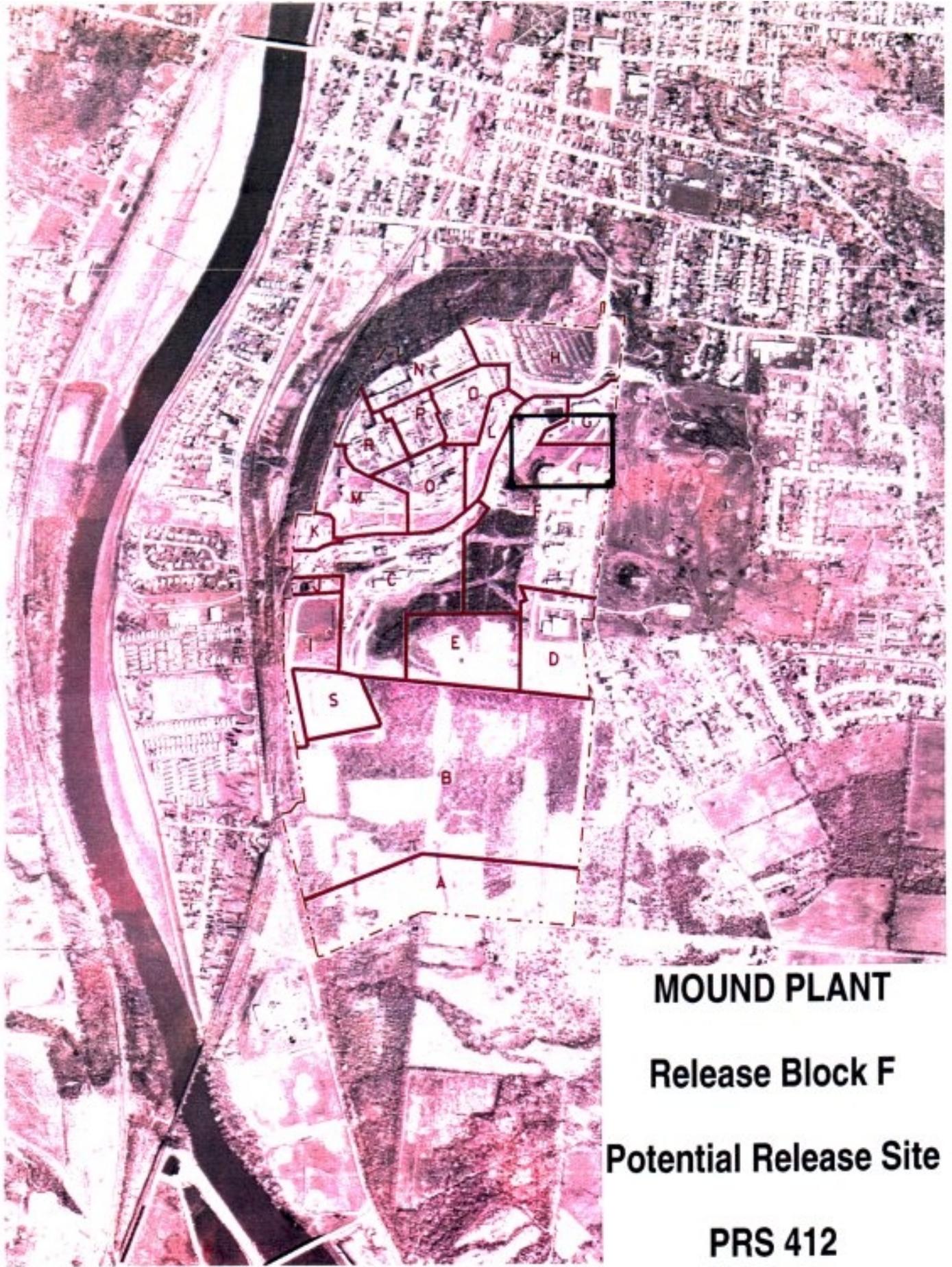


Building 88
Plastic scintillator
all data

175 sq ft, ~350 data points

PRS 412

REV	DESCRIPTION	DATE
0 PUBLIC RELEASE	Available for comments.	Mar. 25, 1998
1 FINAL RELEASE	Comment period expired. Comments. Recommendation page annotated.	Aug. 27, 1998



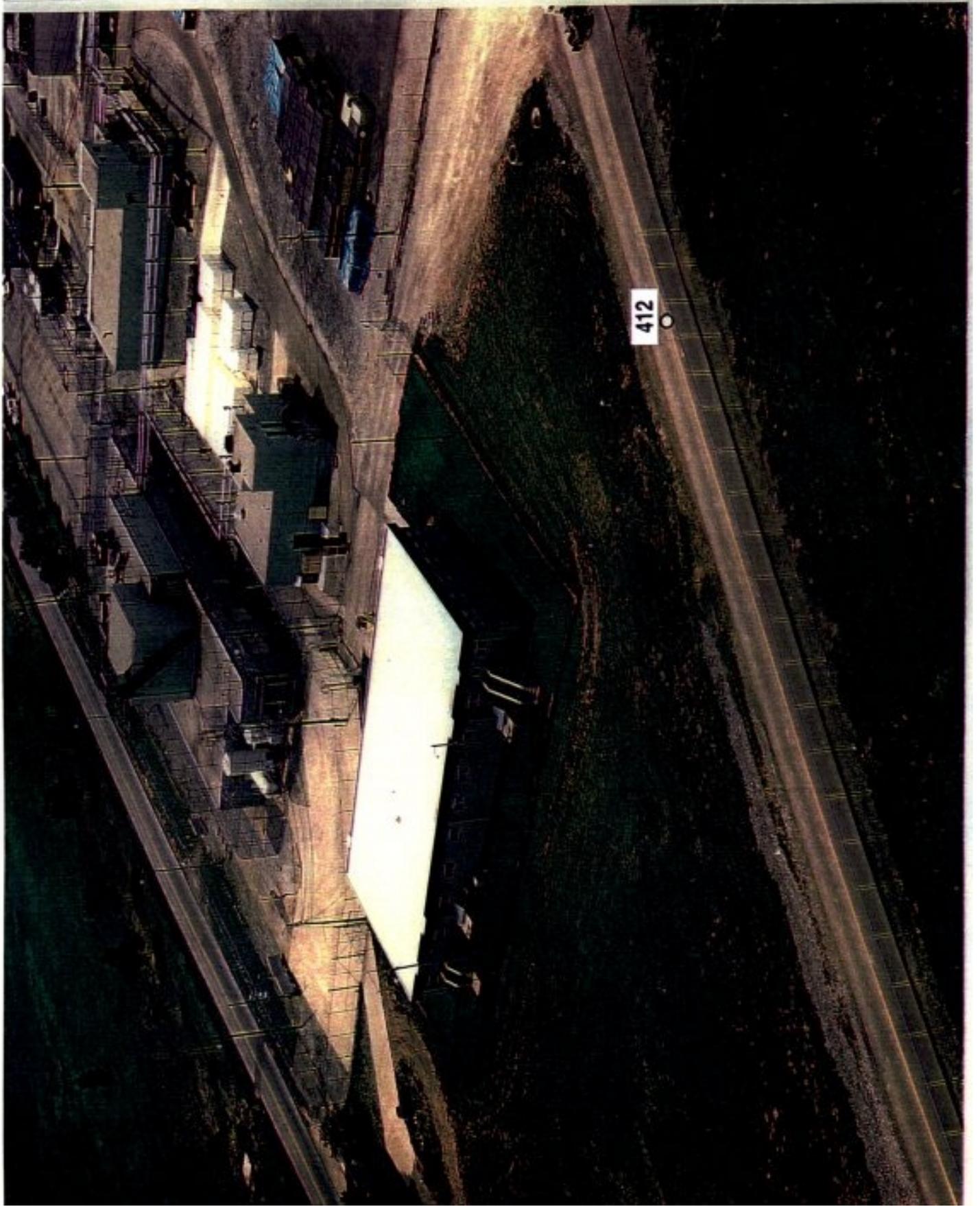
MOUND PLANT

Release Block F

Potential Release Site

PRS 412





PRS 412

PRS HISTORY:

PRS 412 (previously known as PRS 393) is identified as a radiological hot spot located near the eastern boundary of the Mound plant on the SM hill. PRS 412 (hot spot C0033) was identified as a result of the Radiological Site Survey Project.¹

CONTAMINATION:

1. In 1983, the *Radiological Site Survey*¹ investigated radionuclides in the soils at the Mound site via Mound Soil Screening, radiochemistry, and gamma spectroscopy. The *Radiological Site Survey* map on page 7 shows the locations of PRS 412 to pertinent *Radiological Site Survey* samples. Results showed:

PRS	No. of Samples	Sample Type and Location	Results (Maximum)	Guideline Criteria
412	4	2 surface soil samples (one at S0253 and one at S0314) and 2 core samples (both at C0033) taken within 50 ft. of PRS 412	Plutonium-238 at 0.97 pCi/g	25 pCi/g (Mound ALARA)
			Thorium at 42.4 pCi/g at 3 ft (C0033)	15 pCi/g
			Tritium 2.07 pCi/ml	20 pCi/ml

2. In 1994, the *OU5, Operational Area Phase I Investigation*² analyzed the Mound site for volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) via a qualitative PETREX soil gas survey. The OU5 investigation also analyzed surface soil for radiological contamination via Mound FIDLER (field instrument for detecting low energy radiation) and Mound soil screening. Results showed:

PRS	PETREX Qualitative Results	Mound Soil Screened Sample
412	Relatively elevated halogenated hydrocarbons	9 pCi/g plutonium-238 (ALARA guideline = 25 pCi/g) 0.5 pCi/g thorium-232 (guideline = 5 pCi/g)

3. In 1996, the quantitative *Soil Gas Confirmation Sampling*⁵ investigation sampled the *PETREX* soil gas locations with the highest *PETREX* ion counts in the northern sector of the Mound plant. These locations were identified as *Soil Gas Confirmation Sampling* locations 2 and 4 (the corresponding *PETREX* sample locations are 974 and 890) respectively).

PRS 412 (*PETREX* sample location 868), also located in Mound's northern sector had lower ion counts than *Soil Gas Confirmation Sampling* locations 974 and 890. Hence, the quantitative *Soil Gas Confirmation* results taken at the locations with the highest ion counts provide evidence about the risk of contamination at other locations with similar or lower ion counts such as PRS 412. The map on page 22 shows the locations of PRS 412 relative to the *Soil Gas Confirmation Sampling* locations 2 and 4).

The following table lists the qualitative (*PETREX*) and quantitative (*Soil Gas Confirmation Sampling*) results for the locations with the highest ion counts. The table also compares these results to the relative ion counts for PRS 412.

PETREX Soil Gas Contaminant Family	Maximum Ion Count⁴	Confirm Sample #	Confirmation Sample Results that Exceed Guideline Criteria (GC)	Ion Counts at PRS 412
Total Aromatic Hydrocarbons	7,780,673	2	None	22,326
Total Semivolatile Hydrocarbons	7,015,960	2	1300 ug/kg Benzo(a)pyrene (GC = 410 ug/kg ^{ref 3})	Non-detect
Total C5-C11 Petroleum Hydrocarbons	24,166,931	2	None	43,566
Total Halogenated Hydrocarbons	1,370,283	4	None	51,737

The above table and discussion make no conclusions about individual contaminant concentrations at PRS 412 only that the overall health risk from PRS 412 is expected to be similar to or less than that of the *PETREX* locations with the highest measured ion counts (*Confirmation Sample* locations 2 and 4).

READING ROOM REFERENCES:

- 1) OU9, Site Scoping Report: Volume 3 - Radiological Site Survey, June 1993. (pages 6-10)
- 2) OU5, Operational Area Phase I Investigation, Non-AOC Field Report, Volumes I and II, Final (Revision 0), June 1995. (pages 11-17)
- 3) Risk Based Guideline Values, Final, (Revision 0), December 1995.

OTHER REFERENCES:

- 4) Code of Federal Regulations, 40 CFR 192.41 and 40 CFR 192.12.
- 5) Soil Gas Confirmation Sampling, (Revision 0), May 1996. (pages 18-26)

PREPARED BY:

Dennis J. Gault, Member of EG&G Technical Staff

**MOUND PLANT
PRS 412
Contaminated Soil**

RECOMMENDATION:

PRS 412 (hot spot C0033) was identified as a result of the Radiological Site Survey Project. Thorium was found at 42 pCi/g at this location.

The Core Team originally recommended Further Assessment for PRS 412. Subsequently, the cost of further investigation versus the cost of removing the potentially contaminated soils was evaluated. Cost estimates indicate that the cost of removal is not significantly greater than the cost of further assessment at PRS 412. Additionally Further Assessment findings may indicate the need for a Response (removal) Action, resulting in costs associated with both Further Assessment and Response Action. Therefore, the Core Team recommends a RESPONSE ACTION as a more cost-effective course of action for PRS 412.

CONCURRENCE:

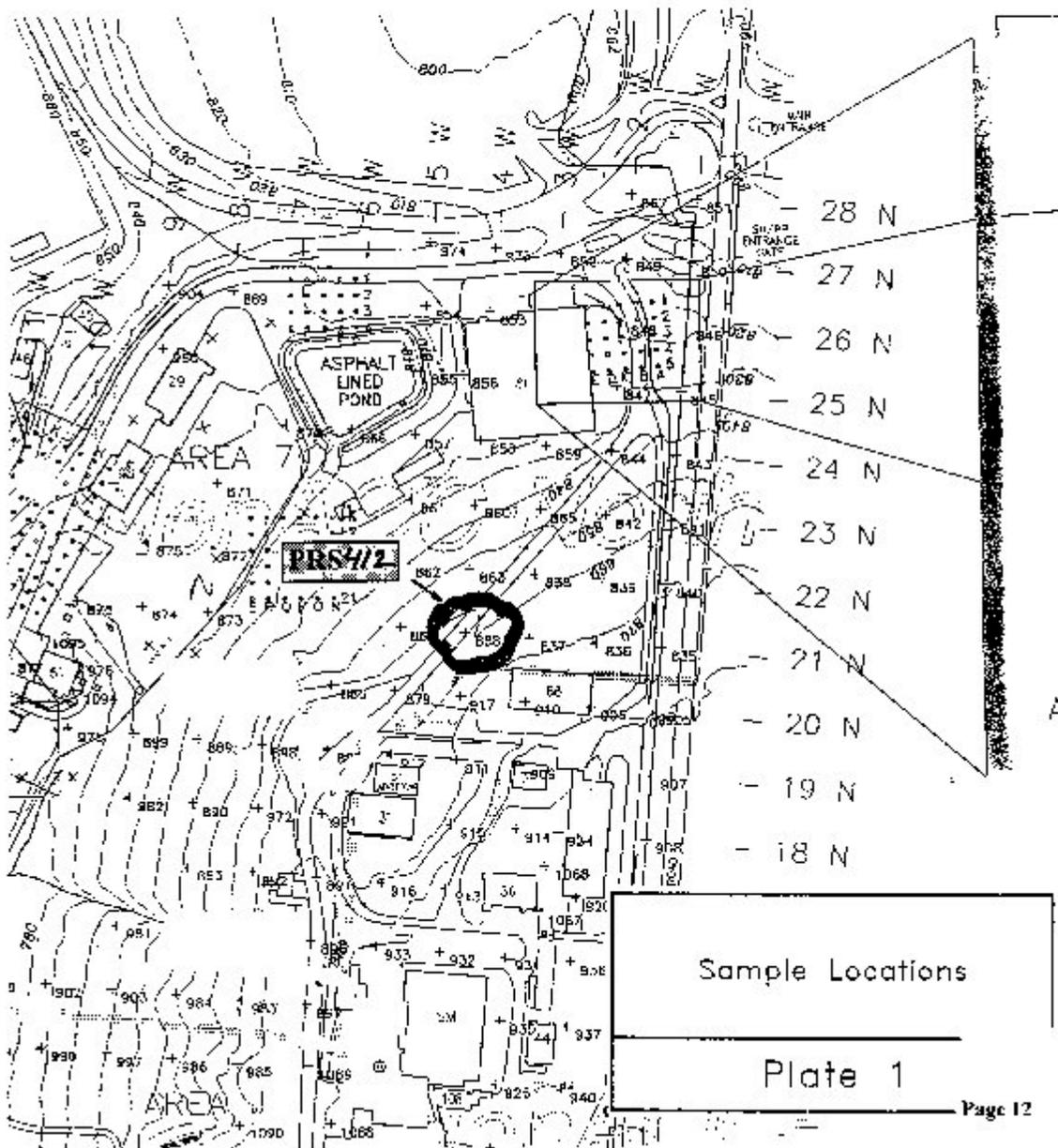
DOU/MEMP:	<u>Arthur W. Kleinmuth</u> Arthur W. Kleinmuth, Remedial Project Manager	<u>3/14/98</u> (date)
USEPA:	<u>Timothy J. Fischer</u> Timothy J. Fischer, Remedial Project Manager	<u>3/19/98</u> (date)
OEPA:	<u>Brian K. Nickel</u> Brian K. Nickel, Project Manager	<u>3/17/98</u> (date)

SUMMARY OF COMMENTS AND RESPONSES:

Comment period from 4/15/98 to 4/15/98

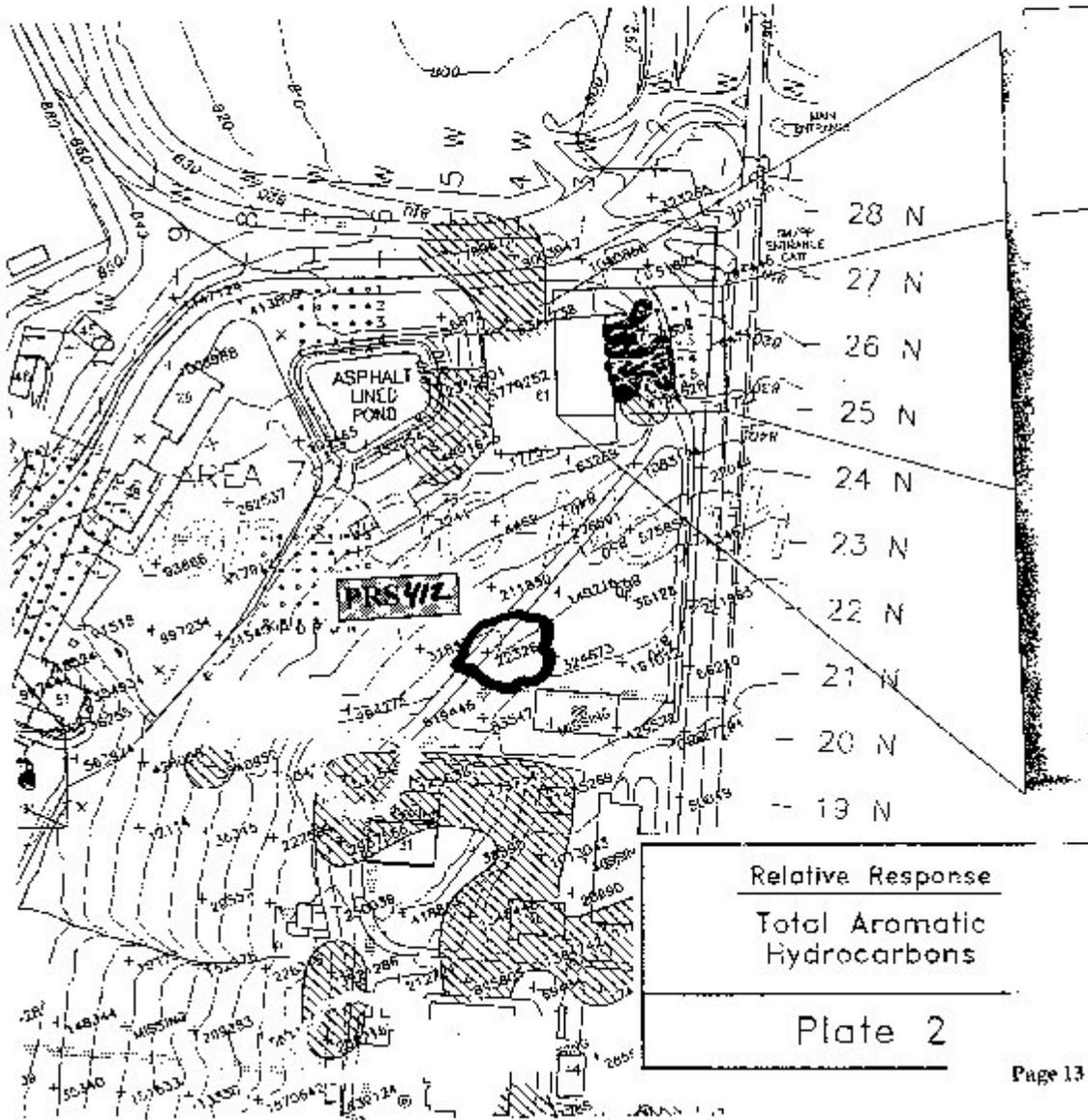
- No comments were received during the comment period.
- Comment responses can be found on page C1-C8 of this package.

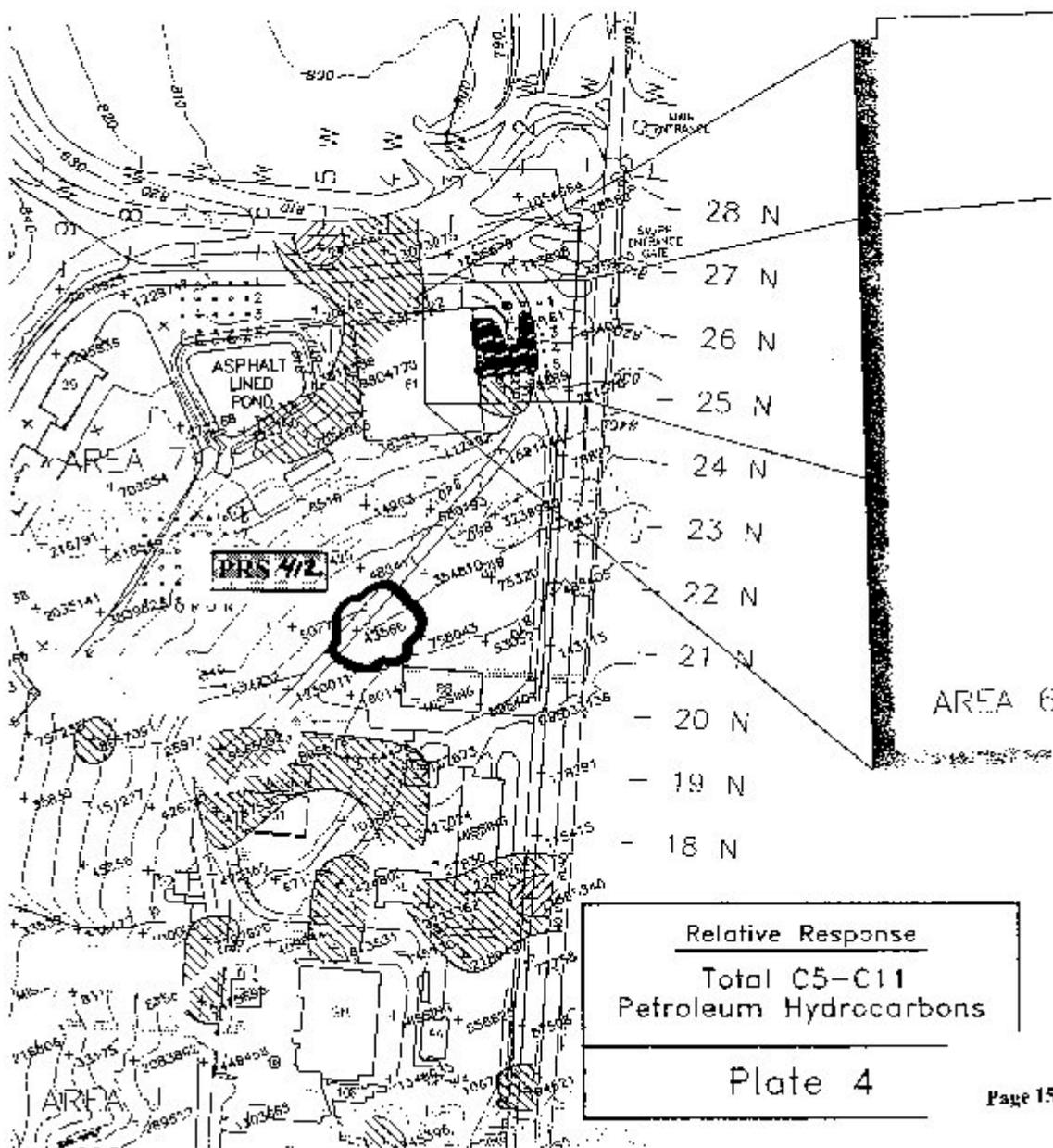
REFERENCE MATERIAL
PRS 412

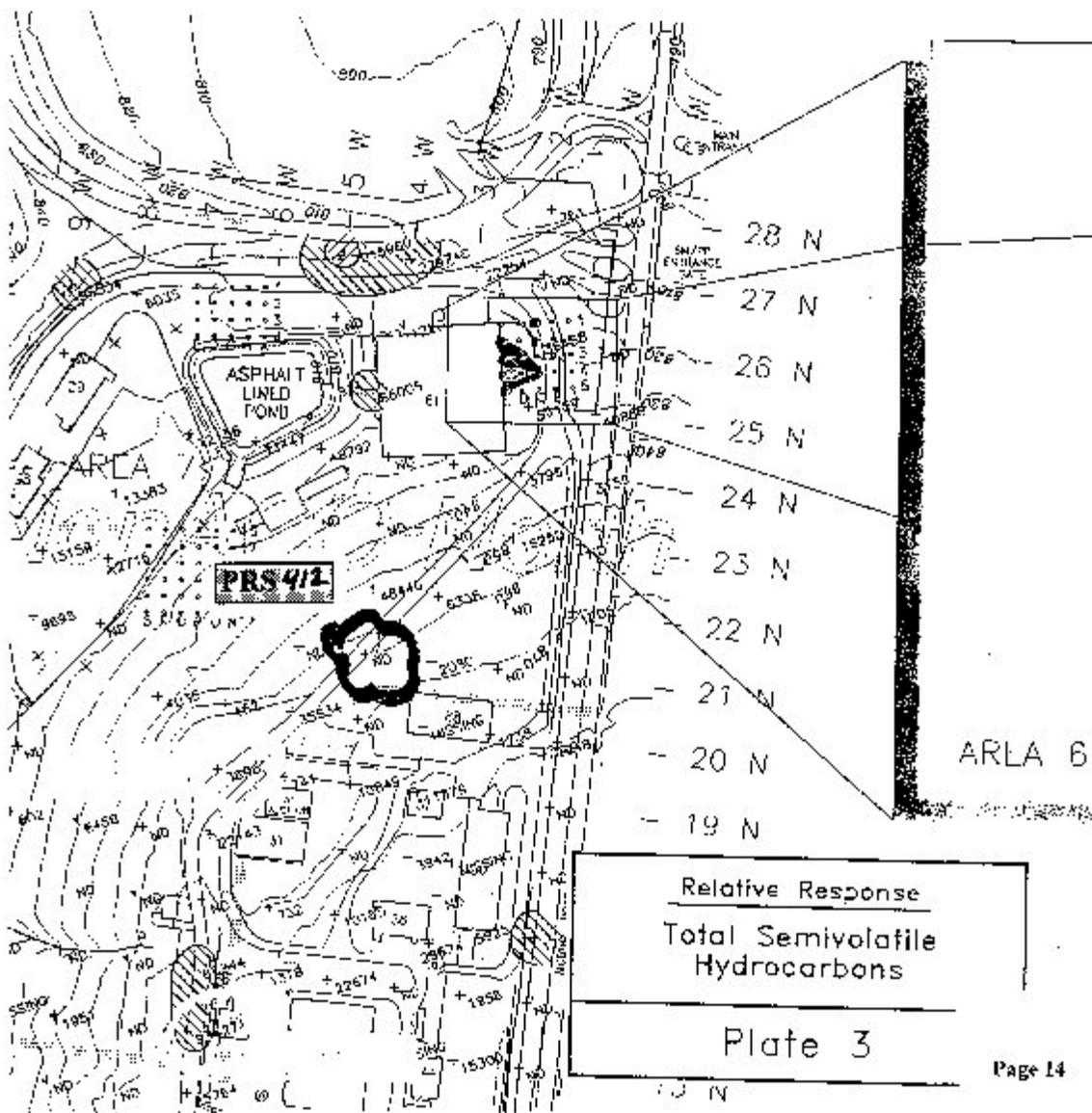


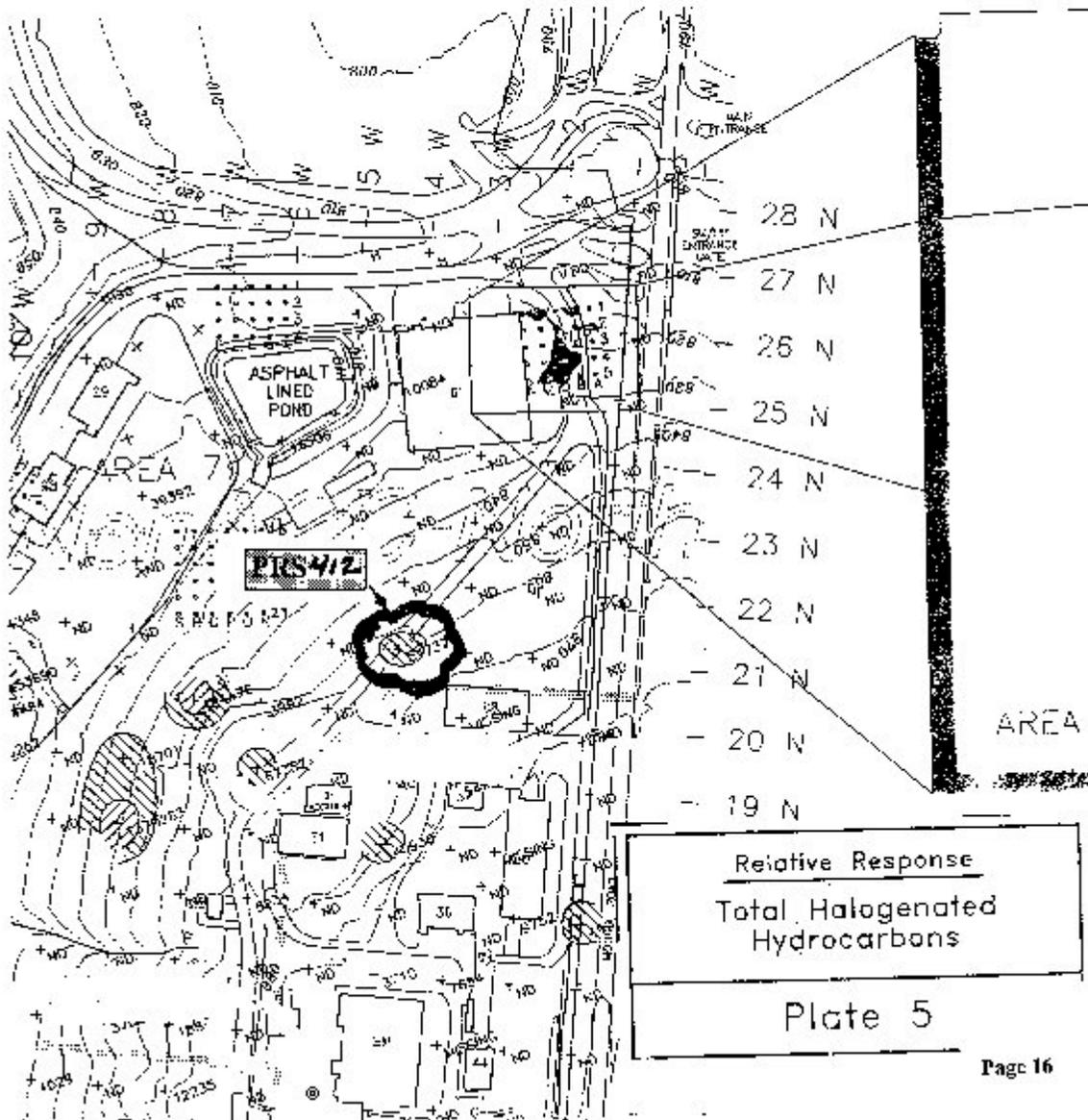
Sample Locations

Plate 1









Relative Response
 Total Halogenated
 Hydrocarbons

Plate 5

APPENDIX D
RADIOLOGICAL DATA (FIDLER SURVEY MOUND SOIL SCREENING FACILITY DATA) FOR NON-AOC POINTS

SMPID	FIDLER SURVEY DATA				MOUND SOIL SCREENING FACILITY DATA			
	Contamination Criteria CH1	FIDLER Readings CH1	Contamination Criteria CH2	FIDLER Readings CH2	FIDLER Readings Out Channel	Plutonium - 238	Thorium - 232	
	Units: CPM RESULTS	Units: CPM RESULTS	Units: KCPM RESULTS	Units: KCPM RESULTS	Units: KCPM RESULTS	Units: pCi/g RESULTS	Units: pCi/g RESULTS	
20N03	120	100	6.5	6.5	NC	0	0.3	
20N04	176.8	110	8.97	7.5	NC	0	1.1	
20N05	176.8	85	8.97	4.5	NC	WIPB	WIPB	
20N06	176.8	375	8.97	22.0	30	27	2.6	
20N07	176.8	325	8.97	22.5	45	37	14.7	
20N10	157.3	95	8.45	4.5	NC	0	0.6	
20N11	157.3	80	8.45	4.0	NC	WIPB	WIPB	
21N01	253.5	140	12.48	9.5	NC	15	0.8	
21N02	176.8	140	8.97	6.5	NC	7	0.7	
21N03	176.8	160	8.97	8.0	NC	20	1.0	
21N04	176.8	100	8.97	5.0	NC	9	0.5	
21N05	152.1	110	8.45	10.0	NC	11	1.8	
21N08	176.8	85	8.97	4.5	NC	WIPB	WIPB	
21N09	176.8	75						
21N10	157.3	90						
22N01	253.5	145						
22N02	176.8	135						
22N03	176.8	115						
22N04	152.1	100						
22N05	152.1	105						
22N08	176.8	115						
22N09	176.8	95						
23N01	253.5	170						
23N02	176.8	160						

NC - No sample collected because location not an original grid point
 NA - Reading not taken; contamination criteria not exceeded.
 NS - Sample collected but not analyzed.
 * Mound Soil Screening Facility detection level not exceeded.
 c - Results of the wipe sample were less than 20 disintegrations per minute.
 CPM - Counts per minute
 KCPM - Counts per minute x 1000
 pCi/g - Picocuries per gram

MOUND



**Environmental
Restoration
Program**

Further Assessment

Soil Gas Confirmation Sampling

**Mound Plant
Miamisburg, Ohio**

May 1996

Revision 0

Department of Energy
EG&G Mound Applied Technologies

Table I.1 Soil Analyte List

Volatile Organic Compounds

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

Semivolatile Organic Compounds

Acenaphthene	Chrysene	Hexachlorobenzene
Acenaphthylene	Dibenz(a,h)anthracene	Hexachlorobutadiene
Anthracene	Dibenzofuran	Hexachlorocyclopentadiene
Benzo(a)anthracene	1,2-Dichlorobenzene	Hexachloroethane
Benzo(a)pyrene	1,3-Dichlorobenzene	Indeno(1,2,3-cd)pyrene
Benzo(b)fluoranthene	1,4-Dichlorobenzene	Isophorone
Benzo(g,h,i)perylene	3,3-Dichlorobenzidine	2-Methylnaphthalene
Benzo(k)fluoranthene	2,4-Dichlorophenol	2-Methylphenol
bis(2-Chloroethoxy)methane	Diethylphthalate	4-Methylphenol
bis(2-Chloromethyl)ether	2,4-Dimethylphenol	Naphthalene
bis(2-Ethylhexyl)phthalate	Dimethylphthalate	2-Nitroaniline
4-Bromophenyl-phenylether	Di-n-butylphthalate	3-Nitroaniline
Butylbenzylphthalate	Di-n-octylphthalate	4-Nitroaniline
Carbazole	4,6-Dinitro-2-methylphenol	Nitrobenzene
4-Chloroaniline	2,4-Dinitrophenol	2-Nitrophenol
4-Chloro-3-methylphenol	2,4-Dinitrotoluene	4-Nitrophenol
2-Chloronaphthalene	2,6-Dinitrotoluene	N-Nitroso-di-n-propylamine
2-Chlorophenol	Fluoranthene	N-Nitroso-diphenylamine
4-Chlorophenyl-phenylether	Fluorene	2,2-oxybis(1-Chloropropane)
Pentachlorophenol	Pyrene	2,4,6-Trichlorobenzene
Phenanthrene	1,2,4-Trichlorobenzene	2,4,6-Trichlorobenzene
Phenol		

Table I.1 Soil Analyte List (Continued)

Pesticides/PCB's

Aroclor-1016	Delta-BHC	Endosulfan II
Aroclor-1221	Gamma-BHC	Endosulfan sulfate
Aroclor-1232	alpha-Chlordane	Endrin
Aroclor-1242	gamma-Chlordane	Endrin aldehyde
Aroclor-1248	4,4'-DDD	Endrin ketone
Aroclor-1254	4,4'-DDE	Heptachlor
Aroclor-1260	4,4'-DDT	Heptachlor epoxide
Aldrin	Dieldrin	Methoxychlor
Alpha-BHC	Endosulfan I	Toxaphene
Beta-BHC		

Inorganics

Aluminum	Copper	Potassium
Antimony	Cyanide	Selenium
Arsenic	iron	Silver
Barium	Lead	Sodium
Beryllium	Lithium	Thallium
Bismuth	Magnesium	Tin
Cadmium	Manganese	Vanadium
Calcium	Mercury	Zinc
Chromium	Molybdenum	Nitrate/Nitrite
Cobalt	Nickel	Explosives (USATHAMA,PETN)

Radionuclides

Americium-241	Plutonium-238	Thorium-230
Bismuth-207	Plutonium-239/240	Thorium-232
Bismuth-210	Potassium-40	Uranium-234
Cesium-137	Radium-226	Uranium-235
Cobalt-60	Thorium-228	Uranium-238

Table L2. Variance From 3-Foot Sampling Depth Specification

Location	Description of Variance
SGC-NAC-000001	Core sampler hit refusal at 2 feet.
SGC-NAC-000002	Relocated due to utilities.
SGC-NAC-000003	Core sampler hit refusal at 2 feet.
SGC-NAC-000004	Core sampler hit refusal at 18 inches.
SGC-NAC-000005	Drilled to 1 foot, hand-augered rest due to utilities.
SGC-NAC-000006	Drilled to 1 foot, hand-augered rest due to utilities.
SGC-NAC-000007	Core sampler hit refusal at 18 inches.
SGC-NAC-000008	Drilled to 2 feet due to utilities.
SGC-NAC-000010	Drilled to 1 foot; hand-augered rest due to utilities; flag against building, so sample taken 6 feet from flag.
SGC-NAC-000012	Drilled to 2 feet due to utilities.
SGC-SAN-000018	Core sampler hit refusal at 2 feet; relocated from inside clarifier.
SGC-NAC-000029	Core sampler hit refusal at 18 inches.
SGC-A61-000043	Sampled 1 foot from flag.
SGC-A61-000047	Drilled to 2 feet due to utilities.
SGC-A61-000048	Drilled to 2 feet due to utilities.
SGC-A61-000049	Relocated due to utilities.
SGC-A61-000051	Core sampler hit refusal at 18 inches.
SGC-A61-000062	Relocated due to utilities; core sampler hit refusal at 18 inches.
SGC-A61-000063	Core sampler hit refusal at 2 feet.
SGC-A13-000056	Core sampler hit refusal at 18 inches.
SGC-A13-000058	Drilled to 1 foot, hand-augered rest due to utilities.
SGC-A13-000060	Core sampler hit refusal at 1 foot.
SGC-AQJ-000064	Core sampler hit refusal at 2 - 3 inches.
SGC-AQJ-000066	Core sampler hit refusal at 4 inches.
SGC-AQJ-000067	Core sampler hit refusal at 6 inches.
SGC-AQJ-000068	Core sampler hit refusal at 2 feet.
SGC-A03-000080	Core sampler hit refusal at 20 inches.
SGC-A03-000061	Drilled to 2 feet due to utilities.
SGC-A03-000082	Drilled to 1 foot, hand-augered rest due to utilities.
SGC-A03-000083	Sampled 25 feet from original location due to storm sewer; core sampler hit refusal at 18 inches.
SGC-A03-000087	Core sampler hit refusal at 2 feet.
SGC-A21-000088	Core sampler hit refusal at 18 inches.
SGC-A21-000090	Core sampler hit refusal at 20 inches.
SGC-SDB-000097	Relocated due to utilities.
SGC-SDB-000098	Relocated from inside a building.
SGC-SDB-000101	Relocation of SGC-SDB-000098; first location surveyed incorrectly.
SGC-SDB-000102	Relocation of SGC-SDB-000100; first location surveyed incorrectly.

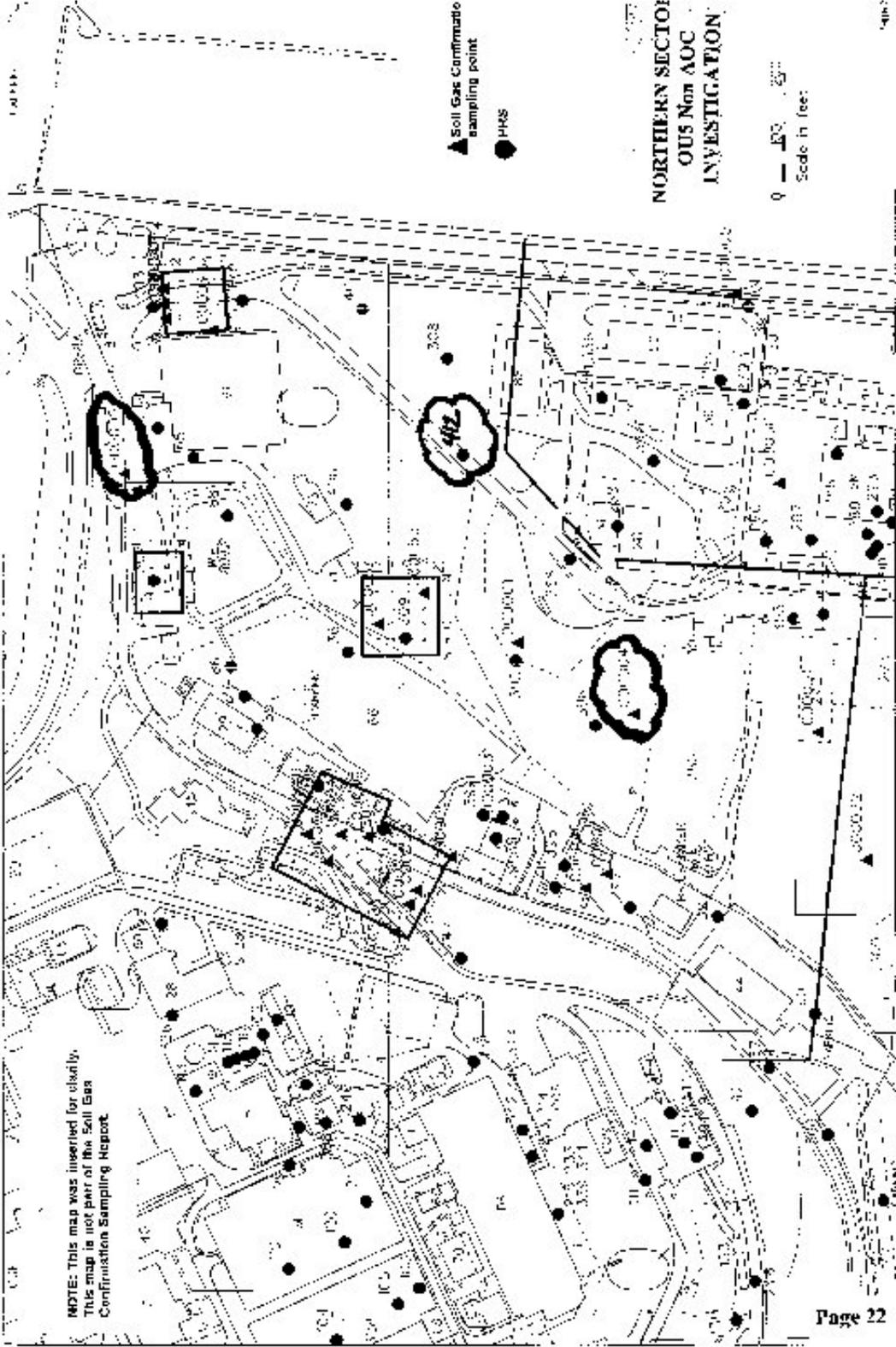


Table A.1

Detected Volatile Organic Compounds (µg/kg)

ANALYTE	Background Value	Industrial Scenario Guideline Criteria	SGC-NAC-000002 NORTH	SGC-NAC-000003 NORTH	SGC-NAC-000004 NORTH	SGC-NAC-000005 EAST	SGC-NAC-000006 EAST
PETREX SAMPLE AREA							
Acetone	NA	21000000	38				
1,2-Dichloroethene (total)	NA	43000000					
2-Butanone	NA	93000000	12				
Benzene	NA	8,90E+03	1 J				
Carbon Disulfide	NA	280000			67		
Chloroform	NA	3100					
Chloromethane	NA	NA					
Ethylbenzene	NA	480					
Methylene Chloride	NA	3,95E+05	6				
Tetrachloroethene	NA	21000000					
Toluene	NA	250000	1 J				
Trichloroethene	NA	41000					
Xylene (total)	NA	4300000000					

No entry - not detected

J - Numerical value is an estimated quantity

C - Identification confirmed by GC/MS

mg/kg - micrograms per kilogram

Red = above Guideline Criteria (GC)

Green = above GC and below Background

Magenta = above Background and Below GC

Blue = above Background (no GC)

Table A.2.

Detected Semivolatile Organic Compounds (ug/kg)

ANALYTE	Background Value	Industrial Scenario Guidelines Criteria	SGC-NAC-000002		SGC-NAC-000004		SGC-NAC-000006		SGC-NAC-000007	
			NORTH	DUPONT	NORTH	DUPONT	EAST	WEST	EAST	WEST
PETREX Sample Area										
Acenaphthene	NA	NA	180 J							
Acenaphthylene	NA	NA	730							
Anthracene	NA	64,000,000	1300							
Benz(a)anthracene	NA	4,100	1600							
Benz(a)pyrene	NA	410	1900							
Benz(b)fluoranthene	NA	4,100	1000							
Benz(b)fluoranthene	NA	NA	550							
Benz(k)fluoranthene	NA	41,000	1000							
Benzo(e)pyrene	NA	215,000								
Biphenyl	NA	43,000,000								
Biphenyl	NA	NA	800							
Carbazole	NA	410,000	1500							
Chrysene	NA	410,000	1200							
Dibenz(a,h)anthracene	NA	21,000,000								
Dibenz(a,h)anthracene	NA	4,300,000								
Dibenz(a,h)anthracene	NA	410	180 J							
Dibenz(a,h)anthracene	NA	NA	1100							
Dibenz(a,h)anthracene	NA	NA								
Dibenz(a,h)anthracene	NA	8,500,000								
Fluorene	NA	NA	42							
Fluorene	NA	4,100	890							
Indeno(1,2,3-cd)pyrene	NA	NA	970							
2-Methylanthracene	NA	NA	4000 D							
Naphthalene	NA	NA	4700 D							
Phenanthrene	NA	190,000,000								
Pyrene	NA	6,400,000	2700 D							

No entry - not detected
 J - Value is an est. quantity
 D - Sample was diluted
 NA - Value not available
 H - Analyzed outside holding time
 ug/kg - micrograms per kilogram
 Red = above Guideline Criteria (GC)
 Green = above GC and below Background
 Magenta = above Background and Below GC
 Blue = above Background (no GC)

Table A.A.
Detailed Inorganics

ANALYTE	Background Value	Industrial Emissions Value	Guideline Octah	SPC-NAC-000002 NORTH	SPC-NAC-000004 NORTH	SPC-NAC-000005 WEST	SPC-NAC-000006 WEST	SPC-NAC-000007 WEST	SPC-NAC-000008 WEST
TEL INORGANICS (mg/kg)									
ALUMINUM	19000	NA	NA	11000	4100	0.25 B	0.25 B	0.25 B	0.25 B
ANTHRACENE	NA	85	85	0.25 B	0.25 B	0.25 B	0.25 B	0.25 B	0.25 B
ARSENIC	16	64	64	2.1 B	1.4 B	1.4 B	1.4 B	1.4 B	1.4 B
BARIUM	180	18,000	18,000	47.1 B	47.1 B	47.1 B	47.1 B	47.1 B	47.1 B
BERYLLIUM	1.3	1.3	1.3	0.69	0.69	0.69	0.69	0.69	0.69
BISMUTH	NA	NA	NA						
CHROMIUM	21	210	210	0.25 B	0.25 B	0.25 B	0.25 B	0.25 B	0.25 B
CADMIUM	310000	NA	NA	15000	15000	15000	15000	15000	15000
CALCIUM	30	110,000	110,000	13.3	13.3	13.3	13.3	13.3	13.3
COPPER	18	18	18	2.3 B	2.3 B	2.3 B	2.3 B	2.3 B	2.3 B
COBALT	25	NA	NA	8.9	11.1	11.1	11.1	11.1	11.1
CYANIDE	10	4,000	4,000	0.13	0.13	0.13	0.13	0.13	0.13
IRON	52000	NA	NA	1.7	1.7	1.7	1.7	1.7	1.7
LEAD	45	NA	NA	12.6 B	12.6 B	12.6 B	12.6 B	12.6 B	12.6 B
LITHIUM	25	NA	NA	2.9	2.9	2.9	2.9	2.9	2.9
MANGANESE	40000	NA	NA	8160	8160	8160	8160	8160	8160
MERCURY	160	27,000	27,000	364	364	364	364	364	364
MOLYBDENUM	27	45.3	45.3	1.2 B	1.2 B	1.2 B	1.2 B	1.2 B	1.2 B
NICKEL	50	18.4	18.4	8.4 B	8.4 B	8.4 B	8.4 B	8.4 B	8.4 B
PHOSPHORUS	1900	NA	NA	742 B	742 B	742 B	742 B	742 B	742 B
SILICA	1.7	1,000	1,000	0.91	0.91	0.91	0.91	0.91	0.91
SODIUM	340	NA	NA	228 B	228 B	228 B	228 B	228 B	228 B
TITANIUM	0.46	NA	NA	1.1	1.1	1.1	1.1	1.1	1.1
ZINC	20	NA	NA	8.3	8.3	8.3	8.3	8.3	8.3
Vanadium	25	1,000	1,000	26.5	26.5	26.5	26.5	26.5	26.5
Zinc	140	64,000	64,000	1.8	1.8	1.8	1.8	1.8	1.8
OTHER INORGANICS									
Nitrate (M)	NA	NA	NA	85.9	85.9	85.9	85.9	85.9	85.9
% Sulfur (S)	NA	NA	NA	7.2	7.2	7.2	7.2	7.2	7.2
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1
NO ₃ - Nitrate	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO ₂ - Nitrogen Dioxide	NA	NA	NA	1.8	1.8	1.8	1.8	1.8	1.8
NO _x - Nitrogen Oxides	NA	NA	NA	2.1	2.1	2.1	2.1	2.1	2.1

Table A.5.

Detected Radionuclides (pCi/g)

ANALYTE	Background	Industrial Scenario Guideline Criteria	SGC-NAC-00001 NORTH	SGC-NAC-00002 NORTH	SGC-NAC-00003 NORTH	SGC-NAC-00004 NORTH	SGC-NAC-00005 EAST
PETREX Sample Area							
Americium-241	ND	4.95	1.42	0.069	0.5	0.087	0.543
Bismuth-207	ND	0.18	1.7	2.95	0.022	27.4	15.1
Bismuth-210	ND	NA	1.6	0.478	0.508	1.16	1.6
Cesium-137	0.42	0.46	1.6	0.277	0.37	1.24	1.19
Cobalt-60	NC	0.10	0.614	0.374	0.61	0.98	1.19
Plutonium-238	0.13	5.5	1.3	0.184	0.37	1.17	0.95
Plutonium-239/240	0.18	5.5	2.1	0.401	0.19	0.934	0.874
Potassium-40	37	NA	3.4	0.392	0.04	0.0348	0.328
Radium-228+D	2	0.14	1.3		0.12	0.818	0.91
Thorium-228+D	1.5	0.85	1.3				
Thorium-230	1.9	44	1.3				
Thorium-232	1.4	50	1.3				
Uranium-234	1.1	38	1.3				
Uranium-235+D	0.11	3.4	1.3				
Uranium-238+D	1.2	11.0	1.3				

No entry - not detected
 ND - No detections in background samples
 NA - Data not available
 NC - Background value not computed
 pCi/g - picocuries per gram
 Red = above Guideline Criteria (GC)
 Green = above GC and below Background
 Magenta = above Background and Below GC
 Blue = above Background (no GC)