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ADDENDUM REMEDIAL INVESTIGATION REPORT FOR SITE INVESTIGATION NEAR THE TINIUS OLSEN PROPERTY

PHASE II REMEDIAL INVESTIGATION
NAVAL AIR STATION JOINT RESERVE BASE
WILLOW GROVE, PENNSYLVANIA

Northern Division
Naval Facilities Engineering Command
Contract No. N62472-90-D-1298
Contract Task Order 277

SEPTEMBER 1997

BROWN & ROOT ENVIRONMENTAL

R-51-9-7-4

ADDENDUM REMEDIAL INVESTIGATION REPORT FOR SITE INVESTIGATION NEAR TINIUS OLSEN PROPERTY PHASE 2 REMEDIAL INVESTIGATION

NAVAL AIR STATION JOINT RESERVE BASE WILLOW GROVE, PENNSYLVANIA

COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION - NAVY (CLEAN) CONTRACT

Submitted to:
Northern Division
Environmental Branch, Code 18
Naval Facilities Engineering Command
10 Industrial Highway, Mail Stop No. 82
Lester, Pennsylvania 19113-2090

Submitted by:
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Contract No. N62472-90-D-1298
Contract Task Order 277

September 1997

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Addendum Remedial Investigation Report For Site Investigation Near Tinius Olsen Property

Phase 2 Remedial Investigation NASJRB Willow Grove, Pennsylvania

INTRODUCTION

Brown & Root Environmental (B&R Environmental) submits this letter report for environmental site investigation on Naval Air Station Joint Reserve Base (NASJRB) Willow Grove property adjacent to the Tinius Olsen property in response to a request for change from the Navy for Contract Task Order No. 277 under Contract N62472-90-D-1298, Comprehensive Long - Term Environmental Action-Navy (CLEAN).

No previous environmental investigations have been performed in the area of NASJRB Willow Grove adjacent to the Tinius Olsen property. Tinius Olsen is a metal working manufacturing facility (machine shop) located on the eastern boundary of NASJRB Willow Grove, west of Route 611 in Horsham Township. The Tinius Olsen property is surrounded on three sides by NASJRB Willow Grove property. Figure 1 shows the study area location and Figure 2 shows sample locations on the site plan. The location, description, and physical characteristics of the other NASJRB Willow Grove Phase 2 RI study areas are contained in Section 1.0 of the Phase 2 RI Work Plan (B&R Environmental, May 1997).

B&R Environmental conducted preliminary site investigations consisting of installation and sampling of 2 soil borings, construction and groundwater sampling of 4 monitoring wells, water level measurements, survey of investigation features (for mapping), and chemical analysis of soil and groundwater samples collected. This "letter report" has been prepared to present preliminary investigation results for Navy review.

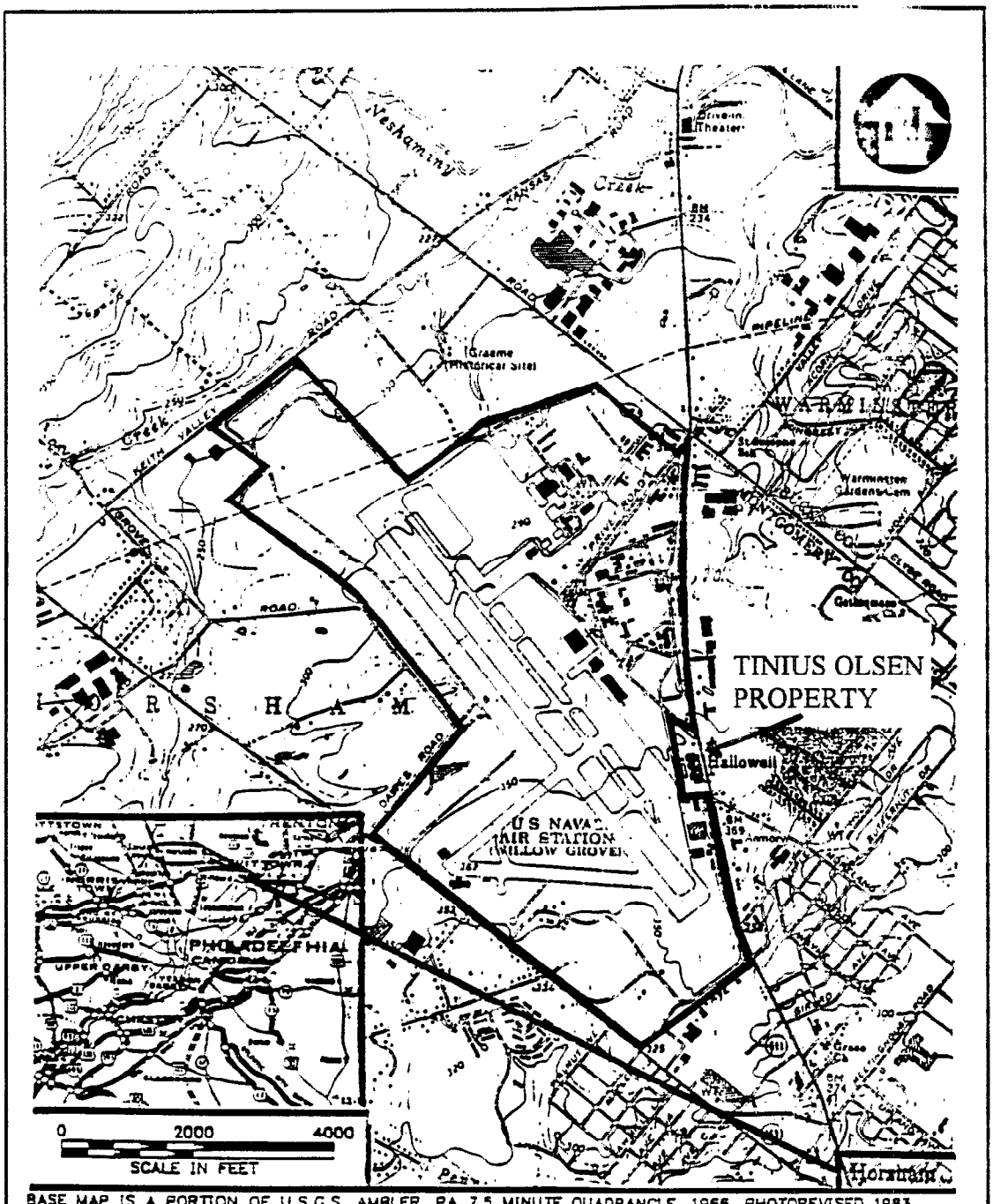
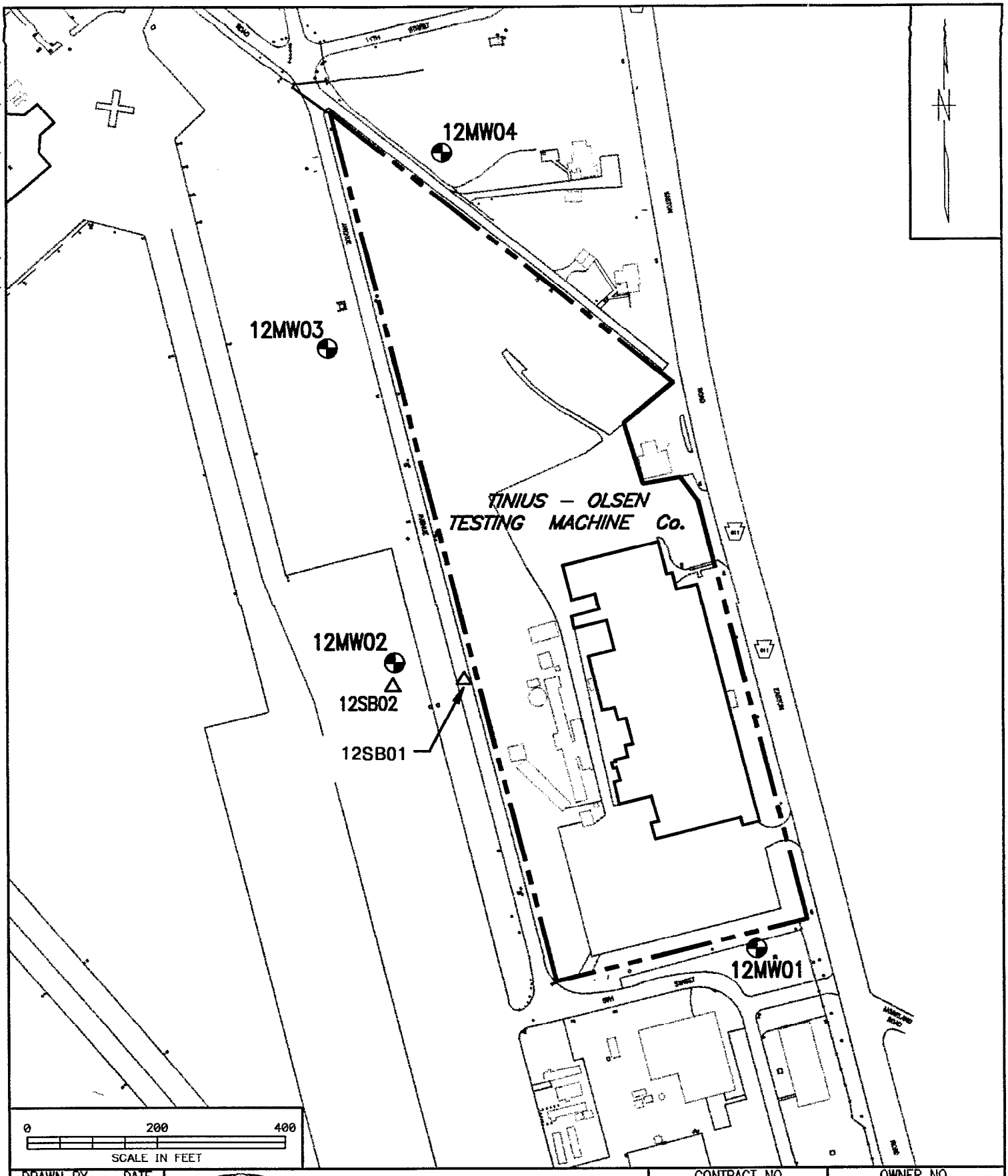


FIGURE 1

LOCATION OF TINIUS OLSEN PROPERTY
NASJRB WILLOW GROVE
HORSHAM TOWNSHIP, PA

Brown & Root Environmental



DRAWN BY A.S.M. DATE 8/18/'97	Brown & Root Environmental	CONTRACT NO.	OWNER NO.
CHECKED BY RET DATE 9/10/97	SAMPLE LOCATIONS NEAR TINIUS OLSON PROPERTY	APPROVED BY	DATE
COST/SCHED.-AREA	NASJRB, WILLOW GROVE	APPROVED BY	DATE
SCALE 1" = 200'	HORSHAM TOWNSHIP, PENNSYLVANIA	DRAWING NO. FIGURE 2	REV.

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SUMMARY OF FIELD INVESTIGATION

The objective of this study was to conduct a preliminary environmental investigation of soil and groundwater quality on the Navy's property near the Tinius Olsen facility. It was reported to the Navy that a groundwater contaminant, methyl tertiary butyl ether (MTBE), was detected in the water supply at the Tinius Olsen Machine Company, which owns property adjacent to NASJRB Willow Grove, to the east, along Easton Road. Further, the Navy was informed that the Pennsylvania Department of Environmental Protection (PADEP) was conducting an investigation at a former gas station site located on Easton Road southeast of the Tinius Olsen facility and NASJRB Willow Grove. It was suspected that the groundwater contamination found at Tinius Olsen could be emanating from the former gas station because of the past presence of a leaking underground storage tank. Since it was believed that groundwater flow in that area of NASJRB was toward the northwest, the Navy determined that it would be in their best interest to determine if groundwater quality on the Navy's property may also have been adversely impacted. Therefore, B&R Environmental was directed to initiate field investigations on May 27, 1997 to determine if any potential contamination was impacting Navy property. This report presents the preliminary results of the assessment of soil and groundwater.

Soil Investigation

Two soil borings were advanced from the ground surface to refusal on bedrock to obtain a detailed description of subsurface materials, and to obtain soil samples for laboratory analysis. The location of one soil boring, 12SB01, was selected to evaluate soils form a natural surface water drainage pathway draining the parking lot south of the facility and a large portion of the manufacturing complex near the central area of the Tinius Olsen facility. The second boring, 12SB02, was at the location of one of the monitoring wells, 12MW02. Figure 2 shows the locations of the borings.

Soil boring 12SB01 was advanced with a stainless steel hand auger to a depth of 4.25 feet deep. Soil boring 12SB02 was drilled by Advanced Drilling Inc. of Washington, New Jersey using a hollow stem auger drill rig with continuous split-spoon sampling from the surface to a spoon sample refusal depth of 10 feet. Boring 12SB02 was drilled to a total depth of 18.5 feet to provide a description of the subsurface material and determine the local depth to water. The hand auger and split spoon samples were logged by a B&R Environmental geologist and screened with a photoionization detector (PID). No PID readings significantly above background were encountered in the soil samples.

Surface soil samples for laboratory analysis were obtained from a depth of 0 to 6 inches at each of the two soil boring locations and subsurface soil samples were obtained from depth intervals 0.5 to 2 feet and 2 to 4 feet for submission to the laboratory. Two additional depth intervals, 4 to 6 feet and 6 to 8 feet, were sampled from boring 12SB02 and submitted to the laboratory. Sample intervals are shown on the boring logs which are contained in Appendix A. Appendix B contains the sample log forms. Soil boring locations were surveyed to obtain horizontal coordinates.

Samples were submitted to Applied Research and Development Laboratory (ARDL, Inc.) in Mount Vernon, Illinois. All soil samples were analyzed for TCL VOCs, SVOCs, PCB/pesticides, and TAL metals and cyanide.

Ground Water Quality Investigation

Four groundwater monitoring wells were installed. One monitoring well, 12MW01, was installed in the expected upgradient area as determined from local topography. Two wells, 12MW02, and 12MW03, were placed in the central area of the Tinius Olsen western boundary in order to determine potential impact to groundwater at the site. Monitoring well 12MW04 was installed at the downgradient area north of the Tinius Olsen property.

Well 12MW01 also serves to monitor groundwater downgradient of a retail gasoline station located along Route 611 approximately 1/4 mile to the southeast. The station is reported to be undergoing environmental action for leaking underground storage tanks (UST).

Four monitoring well boreholes were drilled using air rotary drilling to a maximum depth of 30 feet. A B&R Environmental field geologist logged the drill cuttings and recorded all drilling information, geologic/hydrogeologic characteristics and any unusual occurrences. The borehole and cuttings were screened with a PID and readings were recorded in the site logbook and documented on boring logs. Boring logs are included in Appendix A.

Wells were completed in the boreholes using 2-inch diameter PVC well screen and riser pipe to monitor the water table aquifer. Factory machined 0.020 inch slotted screens were used. Water levels detected in the borings, field assessment of the soil and rock materials and information on the local water table were used to determine the interval of screen placement. Each monitoring well was developed by pumping, and each was surveyed for vertical elevation and horizontal location. Table 1 summarizes the monitoring well construction data and Appendix A contains the well completion logs.

Survey

The horizontal locations and the elevations (at the top of casing for monitoring wells) relative to mean sea level for the four monitoring wells and two borings were measured by GEO-Technical Services, Inc. of Harrisburg, Pennsylvania.

Monitoring Well Water Level Measurements

The monitoring wells were gauged by B&R Environmental on 7/2/97 and 8/7/97. Piezometric elevations were calculated to determine the groundwater flow direction and gradient. Appendix D contains the surveyors data report.

Groundwater Sampling

Groundwater samples and a field duplicate were collected from the monitoring wells three weeks after well development. No free product was observed in any of the wells.

Groundwater sampling was conducted in accordance with the low-flow sampling procedure based on USEPA Region III amended Groundwater Sampling Procedure Low-Flow Purge and Sampling Guidance. Monitoring wells were purged and sampled using a low-flow submersible pump and disposable polyethylene tubing. Groundwater was directed into a flow-through cell with a multi-probe water quality meter. Each well was purged until the monitored parameters (pH, temperature, conductivity, turbidity, and dissolved oxygen) of three consecutive readings were within 10 percent.

All groundwater samples were submitted to ARDL and analyzed for TCL VOCs plus methyl tertiary butyl ether (MTBE), SVOCs, PCB/pesticides, TAL metals, cyanide, and total petroleum hydrocarbons-gasoline range organics/diesel range organics (TPH-GRO/DRO). All pertinent field data were recorded in the field logbook and on the appropriate sample log sheet. The groundwater sample log sheets are included in Appendix B.

TABLE 1

SITE 12 MONITORING WELL CONSTRUCTION DETAILS
NASJRB WILLOW GROVE, PENNSYLVANIA

Well Number	Total Depth (feet bgs [1])	Screened Interval (feet bgs)	Top of Filter Pack (feet bgs)	Top of Bentonite Seal (feet bgs)	Completion Date
12MW01	30	10-30	8	6	5/28/97
12MW02	30	6-26	4.5	3	5/29/97
12MW03	27	6-26	4.5	3	5/28/97
12MW04	26	6-26	4.5	3	5/29/97

[1] bgs = below ground surface

Field Decontamination

All major drilling equipment and sampling equipment was decontaminated before sampling, between individual samples, and after drilling and sampling activities.

The down-hole drilling equipment and sampling tools were cleaned using a high pressure steam generator (steam jenny) before beginning work, between boring and well locations, and at the end of the drilling/well installation program. A temporary decontamination pad was constructed at the study area in a vacant parking area to the south of the Tinius Olsen property to complete this work. NASJRB provided potable water for decontamination.

The sampling equipment used for collecting samples was decontaminated before field sampling and between samples. The following decontamination steps were followed:

- Alconox or liquinox detergent solution wash.
- Potable water rinse.
- Deionized water rinse.
- Air dry.

Field analytical equipment such as pH, conductivity, temperature, and turbidity instrument probes were first rinsed with Deionized water and then with a portion of the sample liquid.

Investigation Derived Waste

Investigation derived wastes including drill cuttings, development water, purge water, and decontamination fluids were handled and disposed in accordance with procedures described in the Phase 2 RI Work Plan.

Drill Cuttings

Drill cuttings generated during the soil boring and well installation program were field screened with a PID. No elevated organic vapor readings were generated at the boreholes. The soil borings were backfilled with soil cuttings. Drill cuttings from the well boring locations did not indicate any significant PID readings and the cuttings were spread around the immediate area of the well.

Development Water

Development water from the newly installed monitoring wells was directed away from the wellhead and discharged to the ground surface and allowed to infiltrate the soil. Elevated (above background) PID readings were noted during drilling at the water table in well boring 12MW01, therefore, the development water from that well was containerized, sampled and stored on site pending test results for disposal.

Purge Water

Purge water was directed away from the wellhead and discharged to the ground surface and allowed to infiltrate the soil. Very small quantities of purge water were generated during groundwater sampling due to the low-flow sampling procedure. The quantities of purge water removed from each well is listed on the groundwater sample log sheets located in Appendix B.

RESULTS OF INVESTIGATION

This section describes the results of the field investigation, including a description of the geology, hydrogeology and laboratory analysis results of soil and groundwater samples from the site.

Regional Geology

Geology at the NASJRB site area near Tinius Olsen consists of the middle member of the Triassic age Stockton Formation overlain by silty clay soil. The soil survey of Montgomery County (United States Department of Agriculture, 1967) indicates that mapped within the boundaries of NASJRB at the site area is termed as: made land, shale and sandstone materials. This soil is the result of altering and mixing of soil formed in material weathered from shale and sandstone. This land type is often dusky-red to yellowish-brown shaly silt loam. The soil survey indicates that in the Willow Grove area the soil material is very silty and poorly suited to engineering purposes.

The Stockton Formation is composed of fine- to coarse-grained arkosic sandstones and conglomerates that are interbedded with finer grained shales and siltstones. Beds commonly pinch out or form gradational contacts with overlying or underlying beds over lateral distances greater than

several hundred feet (Rima et al., 1962). Based principally on dominant grain size and lithology, the Stockton Formation is divided into lower, middle, and upper members.

The middle member of the Stockton Formation is present at the site and consists of fine- to medium-grained arkosic sandstone interbedded with shale. Beds of shale and siltstone are common in the upper portion of the member, and coarser grained units are more common in the lower portion of the member. The rocks of the middle member are well sorted and weakly cemented, which creates a relatively high porosity compared to the lower and upper members of the formation (Rima et al., 1962). The middle member of the Stockton Formation typically weathers to a depth of 15 to 35 feet.

Regionally, the sedimentary beds of the Stockton Formation strike to the northeast and dip at an average rate of 12 degrees to the northwest. At another government installation located approximately 3 miles northeast of the site, strikes ranging from north 64 degrees east to north 71 degrees east and dips ranging from 5 degrees to 9 degrees to the northwest were calculated from subsurface correlation of geophysical borehole logs for the middle member of the Stockton Formation (HNUS, 1995).

Site Hydrogeology

A water table aquifer exists within the top portion of the rock formation beneath the site. The water table surface appears to freely move between the rock aquifer and adjoining weathered sediments and soil overlying rock.

Depth that groundwater was encountered during the soil boring 12SB02 was used to determine screen intervals and potential saturated zone for wells at the site. Gauging results and the calculated piezometric elevations for two dates are shown in Table 2. Figure 3 and Figure 4 are piezometric contour maps for the site water table as measured on July 2, 1997 and August 7, 1997. The data from July 2, 1997 indicates a groundwater flow to the northwest with a gradient of approximately 0.01 (i.e., approximately 1.0 foot of drop per 100 feet of run). Data from the four wells taken on August 7, 1997 confirm the gradient of 0.01 with groundwater flow direction to the north-northwest.

TABLE 2
SITE 12 STATIC-WATER-LEVEL MEASUREMENTS
NASJRB WILLOW GROVE, PENNSYLVANIA

Well Number	TOC Elevation	Date and Time of Measurement	Depth to Water (feet below TOC[1])	Groundwater Elevation
12MW01	363.65	07/02/97 1115	17.18	346.47
12MW02	353.69	07/02/97 1131	11.89	341.80
12MW03	348.92	07/02/97 1118	12.52	336.40
12MW04	349.27	07/02/97 1125	13.28	335.99

Well Number	TOC Elevation	Date and Time of Measurement	Depth to Water (feet below TOC[1])	Groundwater Elevation
12MW01	363.65	08/07/97 1728	18.47	345.18
12MW02	353.69	08/07/97 1715	11.76	341.93
12MW03	348.92	08/07/97 1724	12.78	336.14
12MW04	349.27	08/07/97 1720	13.76	335.51

[1] TOC = Top of Casing

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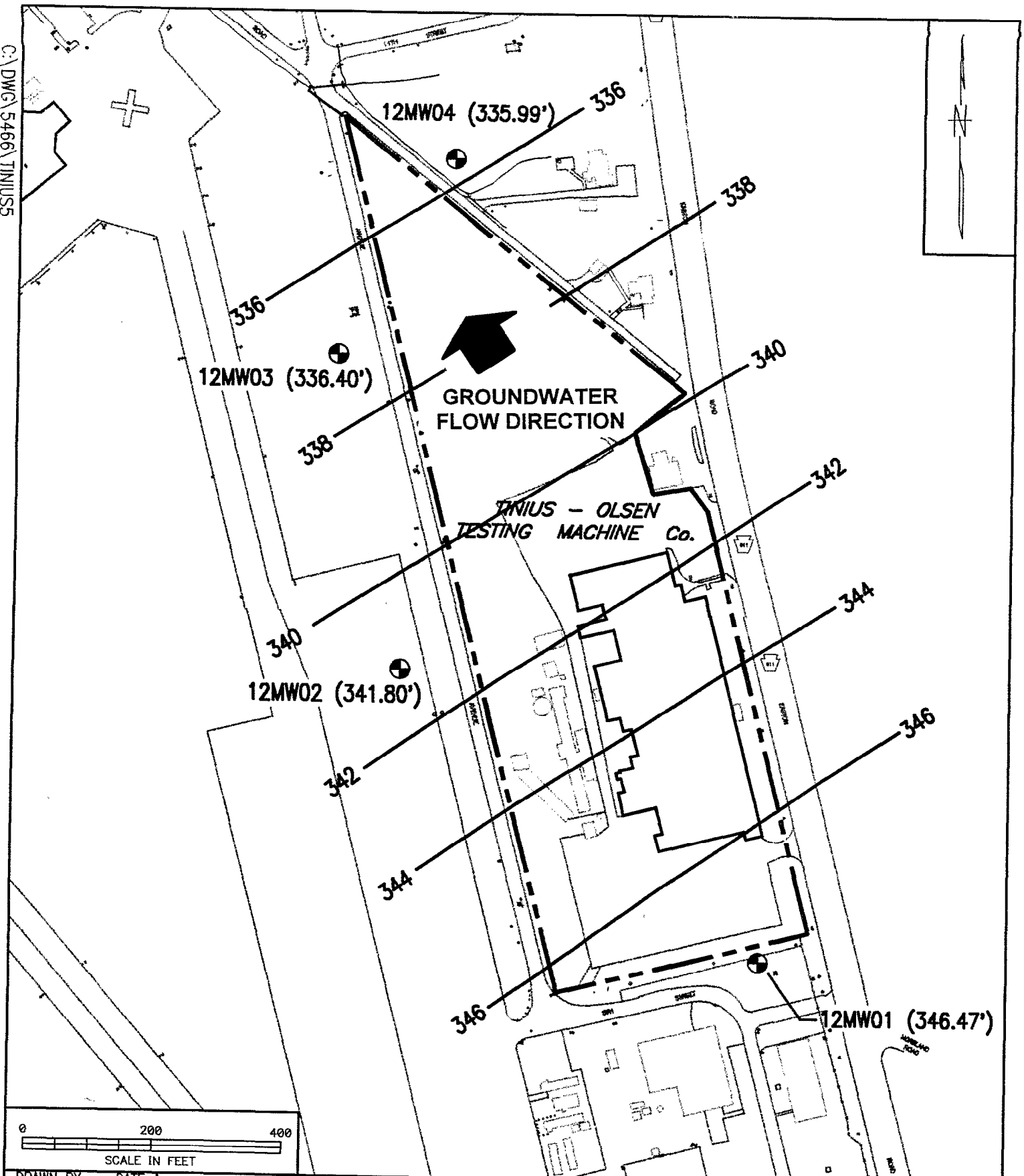

DRAWN BY A.S.M. DATE 8/18/'97	Brown & Root Environmental	CONTRACT NO.	OWNER NO.
CHECKED BY RET DATE 9/10/97	SITE 12 GROUNDWATER CONTOUR MAP JULY 2, 1997 NASJRB, WILLOW GROVE HORSHAM TOWNSHIP, PENNSYLVANIA	APPROVED BY	DATE
COST/SCHED.-AREA		APPROVED BY	DATE
SCALE 1" = 200'		DRAWING NO. FIGURE 3	REV.

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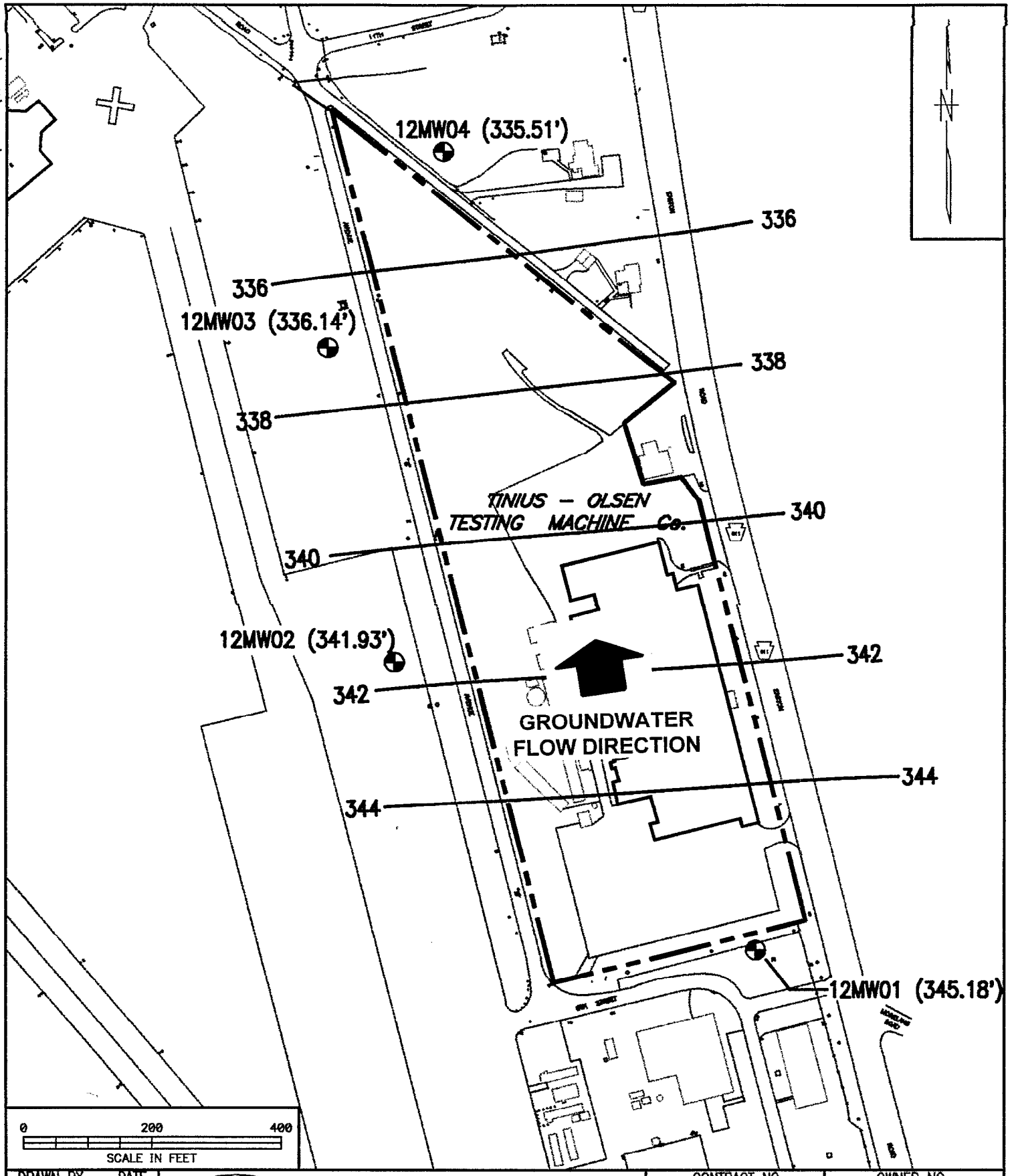

DRAWN BY A.S.M. DATE 8/18/'97	Brown & Root Environmental	CONTRACT NO.	OWNER NO.
CHECKED BY RET DATE 9/10/97	SITE 12 GROUNDWATER CONTOUR MAP AUGUST 7, 1997 NASJRB, WILLOW GROVE HORSHAM TOWNSHIP, PENNSYLVANIA	APPROVED BY	DATE
COST/SCHED.-AREA		APPROVED BY	DATE
SCALE 1" = 200'		DRAWING NO. FIGURE 4	REV.

Summary of Soil Sample Analysis

On-site screening of soil samples and cuttings from well borings was performed with a Photoionization Detector (PID). The PID readings for each sample interval are presented on the boring logs in Appendix A and on appropriate sample log sheets. Soil screened at the two soil boring locations did not reveal elevated PID readings. Positive PID readings were recorded in vapor from cuttings at monitoring well borehole 12MW01 at depths 16 to 18 feet, near the top of the water table.

Laboratory analysis results are summarized in Table 3 (surface soils) and Table 4 (subsurface soil) with comparison columns for reference criteria. Sample location 12SS03, presented in Table 3, is a field duplicate of surface soil sample 12SS01 sampled at 0 to 6 inches deep. Table 5 presents analytical data for surface soil samples collected at NASJRB locations proposed as background for comparison. These background samples were collected away from known or suspected waste-handling or waste disposal sites.

Surface soil samples from 12SS01 and 12SS02 exceeded direct contact criteria for arsenic, beryllium, benzo(a)pyrene(BAP), and dieldrin (see Table 3). Concentrations of these compounds in the sample from 12SS02 were below background soil concentrations (see Table 5) with the exception of BAP which was 1500 μg/kg in 12SS02 and 1100 μg/kg in the highest background sample, BGSS12. Surface soil sample 12SS01 also resulted with concentrations of three additional SVOCs (benzo(a)anthracene, benzo(b)fluoranthene, and dibenz(a,h)anthracene) over the direct contact residential and/or non-residential criteria. Sample results at 12SS01 were elevated over the background concentrations for arsenic, dieldrin, and four SVOCs. This sample was collected at the western property boundary of Tinius Olsen between an on-base roadway and the property line fence (see Figure 2).

Subsurface soil samples from borings 12SB01 and 12SB02 resulted with arsenic concentrations above the Pennsylvania and EPA Region III direct contact criteria (see Table 4) but below several of the background soil samples collected at NASJRB (see Table 5). Beryllium was detected at 1.1 mg/kg in sample 12SB020608 collected from a weathered mudstone/siltstone at 6 to 8 feet deep. This sample result is above the Pennsylvania Residential Direct Contact criteria of 1.0 mg/kg but is below several of the background soil sample results for beryllium. Soil sample 12SB020002 (6 inches to 2 feet deep) resulted with 1200 μg/kg BAP which is above the Pennsylvania and EPA Region III direct contact criteria (see Table 5). BAP was detected in one background soil sample (BGSS12) at 1100 μg/kg.

09/04/97

TABLE 3

COMPARISON OF SURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCs - Site 12

NASJRB, WILLOW GROVE, PENNSYLVANIA

SAMPLE NUMBER:	12SS01	12SS01-DUP	12SS02	---	---	ARARS & TBCs			
LOCATION:	12SS01	12SS01	12SS02	---	---	Risk-Based Concentration for Residential Soil Ingestion	Risk-Based Concentration for Industrial Soil Ingestion	PADEP Soil Residential Direct Contact MSC	PADEP Soil Non-residential Direct Contact MSC
DATA SOURCE:	Surface Soil	Surface Soil	Surface Soil						
SAMPLE DATE:	05/30/97	05/30/97	05/27/97						
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**			**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
aluminum	9860	9550	10400			78000	1000000	-	-
arsenic	27.7 E L	39.3 E L	4.5 E			0.430	3.80	3.00	4.00
barium	101	87	135			5500	140000	5000	70000
beryllium	0.84 E	0.77 E	1.2 E			0.150	1.30	1.00	1.30
cadmium	2.3 K	2.2 K	1.3 U			39.0	1000	20.0	500
calcium	13200	7510	1430			-	-	-	-
chromium, total	40.1	28.4	20.5			390	10000	-	-
cobalt	8.4	8	8.3			4700	120000	-	-
copper	26	31.6	18.6			3100	82000	700	37000
iron	18700	19400	18600			23000	610000	-	-
lead	189	321	88.7			400	-	500	1000
magnesium	8630	5140	1730			-	-	-	-
manganese	502	485	841			1800	47000	-	-
mercury	0.14 K	0.15 K	0.16 K			23.0	610	20.0	300
nickel	26.6	21.6	11.6 K			1600	41000	200	20000
potassium	791	520	696			-	-	-	-
sodium	106	98.8 U	105 U			-	-	-	-
vanadium	34.3	34.4	32.5			550	14000	-	-
zinc	246 L	293 L	83.1			23000	610000	-	-
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**			**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
acenaphthene	410 U	150 J	77 J			4700000	120000000	5000000	60000000
acenaphthylene	210 J	230 J	430 U			-	-	-	-
anthracene	1700	590	290 J			23000000	610000000	23000000	300000000
benzo(a)anthracene	7500 E	3800 E	1300 E			880	7800	6000	8000
benzo(a)pyrene	6900 E	4300 E	1500 E			88.0	780	600	800
benzo(b)fluoranthene	9300 E	6000 E	2200 E			880	7800	6000	8000
benzo(g,h,i)perylene	3600 J	2200	540			-	-	-	-
benzo(k)fluoranthene	5200	3100	860			8800	78000	60000	80000

TABLE 3

COMPARISON OF SURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCs - Site 12

NASJRB, WILLOW GROVE, PENNSYLVANIA

SAMPLE NUMBER:	12SS01	12SS01-DUP	12SS02	---	---	ARARS & TBCs			
LOCATION:	12SS01	12SS01	12SS02	---	---	Risk-Based Concentration for Residential Soil Ingestion	Risk-Based Concentration for Industrial Soil Ingestion	PADEP Soil Residential Direct Contact MSC	PADEP Soil Non-residential Direct Contact MSC
DATA SOURCE:	Surface Soil	Surface Soil	Surface Soil						
SAMPLE DATE:	05/30/97	05/30/97	05/27/97						
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**			**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
bis(2-ethylhexyl)phthalate	220 J	270 J	120 J			46000	410000	300000	400000
butylbenzylphthalate	410 UJ	110 J	430 U			16000000	410000000	16000000	200000000
carbazole	680	520 J	240 J			32000	290000	-	-
chrysene	8300	4700	1800			88000	780000	600000	800000
di-n-butylphthalate	510	260 J	430 U			7800000	200000000	-	-
dibenz(a,h)anthracene	970 E J	470 E J	190 E J			88 0	780	600	800
dibenzofuran	240 J	100 J	47 J			310000	8200000	-	-
fluoranthene	17000	8400	3700			3100000	82000000	3000000	40000000
fluorene	580	250 J	100 J			3100000	82000000	3000000	40000000
indeno(1,2,3-cd)pyrene	4500 E	2800 E	850			880	7800	6000	8000
phenanthrene	9900	4400	1800			-	-	-	-
pyrene	16000	7800	2900			2300000	61000000	2000000	30000000
VOLATILES	**ug/kg**	**ug/kg**	**ug/kg**			**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
methylene chloride	10 B	20 B	11 B			85000	760000	600000	800000
PESTICIDES	**ug/kg**	**ug/kg**	**ug/kg**			**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
4,4'-DDE	230	150	8 7 U			1900	17000	10000	17000
4,4'-DDT	350 J	260	24			1900	17000	10000	17000
alpha-chlordane	250 J	180	110 J			490	4400	3000	4000
dieldrin	3400 E	2800 E	480 E			40 0	360	300	400
gamma-chlordane	260 J	190	59			490	4400	3000	4000
heptachlor epoxide	21 U	21 U	28			70 0	630	500	600

MSC - Medium Specific Concentration.
K - Result is Biased High.
L - Result is Biased Low.
E - Result Exceeds ARAR or TBC Reference Criterion.

TABLE 4

COMPARISON OF SUBSURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCs - Site 12

NASJRB, WILLOW GROVE, PENNSYLVANIA

SAMPLE NUMBER:	12SB01-0002	12SB01-0204	12SB02-0002	12SB02-0204	12SB02-0406	ARARS & TBCs			
LOCATION:	12SB01	12SB01	12SB02	12SB02	12SB02	Risk-Based Concentration for Residential Soil Ingestion	Risk-Based Concentration for Industrial Soil Ingestion	PADEP Soil Residential Direct Contact MSC	PADEP Soil Non-residential Direct Contact MSC
DATA SOURCE:	Subsurface Soil	Subsurface Soil	Subsurface Soil	Subsurface Soil	Subsurface Soil				
SAMPLE DATE:	05/30/97	05/30/97	05/27/97	05/27/97	05/27/97				
INORGANICS	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
aluminum	9530	11900	9760	13500	8100	78000	1000000	-	-
arsenic	3.9 E L	5.3 E L	6.2 E L	4.4 E L	3.9 E	0.430	3.80	3.00	4.00
barium	57	72.2	94.2	75	31.3	5500	140000	5000	70000
beryllium	0.68 E	0.74 E	0.89 E	0.75 E	0.43 E	0.150	1.30	1.00	1.30
calcium	1290	2460	1760	1270	598	-	-	-	-
chromium, total	16.4	22	15.4	18	11.5	390	10000	-	-
cobalt	7.2	8.3	6.3	6	3.9	4700	120000	-	-
copper	9.6 L	10.4 L	20.2	8.1 L	8.5 L	3100	82000	700	37000
iron	14400	17600	13900	17000	12300	23000	610000	-	-
lead	19.3	24.6	70.8	9.7	5.1	400	-	500	1000
magnesium	1850	2320	1760	1880	1100	-	-	-	-
manganese	298	418	661	318	54.4	1800	47000	-	-
nickel	11.2	13.4	9.8 K	13.2 K	7.8 K	1600	41000	200	20000
potassium	442	655	362 U	478	469	-	-	-	-
selenium	1.2 UL	1.2 UL	0.29 L	1.2 UL	0.23 UL	390	10000	60.0	5000
vanadium	29.6	30.8	23.4	28.8	18.7	550	14000	-	-
zinc	51.8 L	46.6 L	45.4	35.7	19.4	23000	610000	-	-
SEMIVOLATILES	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
acenaphthene	400 U	410 U	70 J	400 U	380 U	4700000	120000000	5000000	60000000
acenaphthylene	400 U	410 U	70 J	400 U	380 U	-	-	-	-
anthracene	400 U	53 J	210 J	400 U	380 U	23000000	610000000	23000000	300000000
benzo(a)anthracene	62 J	300 J	830	400 U	380 U	880	7800	6000	8000
benzo(a)pyrene	80 J	350 E J	1200 E	400 U	380 U	88.0	780	600	800
benzo(b)fluoranthene	110 J	450	1600 E	400 U	380 U	880	7800	6000	8000
benzo(g,h,i)perylene	400 U	190 J	610	400 U	380 U	-	-	-	-
benzo(k)fluoranthene	88 J	300 J	970	400 U	380 U	8800	78000	60000	80000
bis(2-ethylhexyl)phthalate	400 U	410 U	210 J	73 J	84 J	46000	410000	300000	400000
carbazole	400 UJ	410 UJ	300 J	400 U	380 U	32000	290000	-	-

TABLE 4

COMPARISON OF SUBSURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCs - Site 12

NASJRB, WILLOW GROVE, PENNSYLVANIA

SAMPLE NUMBER:	12SB01-0002	12SB01-0204	12SB02-0002	12SB02-0204	12SB02-0406	ARARS & TBCs			
LOCATION:	12SB01	12SB01	12SB02	12SB02	12SB02	Risk-Based Concentration for Residential Soil Ingestion	Risk-Based Concentration for Industrial Soil Ingestion	PADEP Soil Residential Direct Contact MSC	PADEP Soil Non-residential Direct Contact MSC
DATA SOURCE:	Subsurface Soil	Subsurface Soil	Subsurface Soil	Subsurface Soil	Subsurface Soil				
SAMPLE DATE:	05/30/97	05/30/97	05/27/97	05/27/97	05/27/97				
SEMIVOLATILES	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
chrysene	89 J	380 J	1500	400 U	380 U	88000	780000	600000	800000
di-n-butylphthalate	39 J	200 J	29 J	400 U	380 U	7800000	200000000	-	-
dibenz(a,h)anthracene	400 U	54 J	270 E J	400 U	380 U	88.0	780	600	800
dibenzofuran	400 U	410 U	59 J	400 U	380 U	310000	8200000	-	-
fluoranthene	140 J	800	3000	46 J	380 U	3100000	82000000	3000000	40000000
fluorene	400 U	410 U	110 J	400 U	380 U	3100000	82000000	3000000	40000000
indeno(1,2,3-cd)pyrene	58 J	230 J	870	400 U	380 U	880	7800	6000	8000
phenanthrene	54 J	450	2100	400 U	380 U	-	-	-	-
pyrene	150 J	700	2400	38 J	380 U	2300000	61000000	2000000	30000000
VOLATILES	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
methylene chloride	11 B	9 B	12 B	10 B	11 B	85000	760000	600000	800000
PESTICIDES	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
4,4'-DDE	5.1	7.6	8.5	4 U	3.8 U	1900	17000	10000	17000
4,4'-DDT	10	12	15 J	4 U	3.8 U	1900	17000	10000	17000
alpha-chlordane	4.1	6.4	9.3 J	2 U	1.9 U	490	4400	3000	4000
dieldrin	41 E	110 E	51 E J	4 U	3.8 U	40.0	360	300	400
gamma-chlordane	4.4	6.9	8.5	2 U	1.9 U	490	4400	3000	4000

MSC - Medium Specific Concentration.
K - Result is Biased High.
L - Result is Biased Low.
E - Result Exceeds ARAR or TBC Reference Criterion.

TABLE 4

COMPARISON OF SUBSURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCs - Site 12

NASJRB , WILLOW GROVE, PENNSYLVANIA

SAMPLE NUMBER:	12SB02-0608	---	---	---	---	ARARS & TBCs			
LOCATION:	12SB02	---	---	---	---	Risk-Based Concentration for Residential Soil Ingestion	Risk-Based Concentration for Industrial Soil Ingestion	PADEP Soil Residential Direct Contact MSC	PADEP Soil Non-residential Direct Contact MSC
DATA SOURCE	Subsurface Soil								
SAMPLE DATE:	05/27/97								
INORGANICS	**mg/kg**					**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
aluminum	15600					78000	1000000	-	-
antimony	6 R					31 0	820	30 0	400
arsenic	5 3 E					0 430	3 80	3 00	4 00
barium	79					5500	140000	5000	70000
beryllium	1 1 E					0.150	1 30	1 00	1 30
calcium	2400					-	-	-	-
chromium, total	17 9					390	10000	-	-
cobalt	12 9					4700	120000	-	-
copper	26					3100	82000	700	37000
iron	30500 E					23000	610000	-	-
lead	4 9					400	-	500	1000
magnesium	5120					-	-	-	-
manganese	292					1800	47000	-	-
nickel	20 3					1600	41000	200	20000
potassium	2830					-	-	-	-
selenium	0 24 UL					390	10000	60 0	5000
vanadium	26 8					550	14000	-	-
zinc	93 4					23000	610000	-	-
SEMIVOLATILES	**ug/kg**					**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
acenaphthene	400 U					4700000	120000000	5000000	60000000
acenaphthylene	400 U					-	-	-	-
anthracene	400 U					23000000	610000000	23000000	300000000
benzo(a)anthracene	400 U					880	7800	6000	8000
benzo(a)pyrene	400 U					88.0	780	600	800
benzo(b)fluoranthene	400 U					880	7800	6000	8000
benzo(g,h,i)perylene	400 U					-	-	-	-
benzo(k)fluoranthene	400 U					8800	78000	60000	80000
bis(2-ethylhexyl)phthalate	400 U					46000	410000	300000	400000

TABLE 4

COMPARISON OF SUBSURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCs - Site 12

NASJRB, WILLOW GROVE, PENNSYLVANIA

SAMPLE NUMBER.	12SB02-0608	---	---	---	---	ARARS & TBCs			
LOCATION	12SB02	---	---	---	---	Risk-Based Concentration for Residential Soil Ingestion	Risk-Based Concentration for Industrial Soil Ingestion	PADEP Soil Residential Direct Contact MSC	PADEP Soil Non-residential Direct Contact MSC
DATA SOURCE	Subsurface Soil								
SAMPLE DATE	05/27/97								
SEMIVOLATILES	**ug/kg**					**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
carbazole	400 U					32000	290000	-	-
chrysene	400 U					88000	780000	600000	800000
di-n-butylphthalate	400 U					7800000	200000000	-	-
dibenz(a,h)anthracene	400 U					88 0	780	600	800
dibenzofuran	400 U					310000	8200000	-	-
fluoranthene	400 U					3100000	82000000	3000000	40000000
fluorene	400 U					3100000	82000000	3000000	40000000
indeno(1,2,3-cd)pyrene	400 U					880	7800	6000	8000
phenanthrene	400 U					-	-	-	-
pyrene	400 U					2300000	61000000	2000000	30000000
VOLATILES	**ug/kg**					**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
methylene chloride	14 B					85000	760000	600000	800000
PESTICIDES	**ug/kg**					**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
4,4'-DDE	4 U					1900	17000	10000	17000
4,4'-DDT	4 U					1900	17000	10000	17000
alpha-chlordane	2 U					490	4400	3000	4000
dieldrin	4 U					40.0	360	300	400
gamma-chlordane	2 U					490	4400	3000	4000

MSC - Medium Specific Concentration.
K - Result is Biased High.
L - Result is Biased Low.
E - Result Exceeds ARAR or TBC Reference Criterion.

TABLE 5

COMPARISON OF SURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCs - SITE Background

NASJRB, WILLOW GROVE, PENNSYLVANIA

SAMPLE NUMBER:	BGSS01	BGSS01-DUP	BGSS02	BGSS03	BGSS04	ARARS & TBCs			
LOCATION:	BGSS01	BGSS01	BGSS02	BGSS03	BGSS04	Risk-Based Concentration for Residential Soil Ingestion	Risk-Based Concentration for Industrial Soil Ingestion	PADEP Soil Residential Direct Contact MSC	PADEP Soil Non-residential Direct Contact MSC
DATA SOURCE:	Surface Soil	Surface Soil	Surface Soil	Surface Soil	Surface Soil				
SAMPLE DATE:	04/07/97	04/07/97	04/07/97	04/07/97	04/07/97				
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
aluminum	10500	8570	9090	12300	12800	78000	1000000	-	-
antimony	5.6 UJ	5.2 UJ	8.4 R	5.8 UJ	7.5 R	31.0	820	30.0	400
arsenic	6.1 E J	7 E	3.7 E K	10.6 E	4.4 E K	0.430	3.80	3.00	4.00
barium	95.7	89.9	77.8	108	111	5500	140000	5000	70000
beryllium	0.89 E	0.86 E	0.75 E	1.2 E	1.2 E	0.150	1.30	1.00	1.30
calcium	766	690	1530	914	685	-	-	-	-
chromium, total	16.3	14	20.8	15.7	15.9	390	10000	-	-
cobalt	8.1	8.2	9.3	6.8	7.8	4700	120000	-	-
copper	11.3	10.2	11.9	11.7	8	3100	82000	700	37000
iron	13200	11500	15700	13200	14100	23000	610000	-	-
lead	37.2	29.8	22.9	29.9	64.7	400	-	500	1000
magnesium	1430	1210	1670	1450	1370	-	-	-	-
manganese	621	644	514	527	1190	1800	47000	-	-
nickel	9	9.2	9.8	10.3	11.2	1600	41000	200	20000
potassium	418 U	392 U	627	433 U	402 U	-	-	-	-
thallium	0.28 U	0.26 U	0.26 U	0.3	0.27 U	6.30	160	6.00	80.0
vanadium	25.4	22.1	28.2	24.4	24.9	550	14000	-	-
zinc	53.1	42.9	49.4	54.2	597	23000	610000	-	-
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
anthracene	460 U	430 U	420 U	46 J	440 U	23000000	610000000	23000000	300000000
benzo(a)anthracene	460 U	430 U	96 J	220 J	100 J	880	7800	6000	8000
benzo(a)pyrene	460 U	430 U	110 E J	350 E J	110 E J	88.0	780	600	800
benzo(b)fluoranthene	460 U	430 U	160 J	540	160 J	880	7800	6000	8000
benzo(g,h,i)perylene	460 U	430 U	52 J	180 J	440 U	-	-	-	-
benzo(k)fluoranthene	460 U	430 U	420 U	310 J	98 J	8800	78000	60000	80000
bis(2-ethylhexyl)phthalate	67 B	130 B	100 B	480 B	60 B	46000	410000	300000	400000
butylbenzylphthalate	460 U	430 U	280 J	480 U	180 J	16000000	410000000	16000000	200000000
carbazole	460 U	430 U	420 U	140 J	440 U	32000	290000	-	-

TABLE 5

COMPARISON OF SURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCs - SITE Background

NASJRB, WILLOW GROVE, PENNSYLVANIA

SAMPLE NUMBER:	BGSS01		BGSS01-DUP		BGSS02		BGSS03		BGSS04		ARARS & TBCs			
LOCATION:	BGSS01		BGSS01		BGSS02		BGSS03		BGSS04		Risk-Based Concentration for Residential Soil Ingestion	Risk-Based Concentration for Industrial Soil Ingestion	PADEP Soil Residential Direct Contact MSC	PADEP Soil Non-residential Direct Contact MSC
DATA SOURCE:	Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil					
SAMPLE DATE:	04/07/97		04/07/97		04/07/97		04/07/97		04/07/97					
SEMIVOLATILES	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	ug/kg	ug/kg	ug/kg
chrysene	460	U	430	U	130	J	470	J	130	J	88000	780000	600000	800000
di-n-butylphthalate	820	B	790	B	400	B	840	B	1100	B	7800000	200000000	-	-
dibenz(a,h)anthracene	460	U	430	U	420	U	52	J	440	U	88.0	780	600	800
dibenzofuran	460	U	430	U	420	U	51	J	440	U	310000	8200000	-	-
fluoranthene	62	J	51	J	270	J	1200		270	J	3100000	82000000	3000000	40000000
fluorene	460	U	430	U	420	U	59	J	440	U	3100000	82000000	3000000	40000000
indeno(1,2,3-cd)pyrene	460	U	430	U	62	J	240	J	49	J	880	7800	6000	8000
phenanthrene	460	U	430	U	120	J	990		110	J	-	-	-	-
pyrene	51	J	46	J	220	J	870		250	J	2300000	61000000	2000000	30000000
PESTICIDES	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	ug/kg	ug/kg	ug/kg
dieldrin	13		14		4.2	U	760	E	13	J	40.0	360	300	400
gamma-chlordane	2.4	U	2.2	U	2.2	U	10	J	2.3	U	490	4400	3000	4000

TABLE 5

COMPARISON OF SURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCs - SITE Background

NASJRB, WILLOW GROVE, PENNSYLVANIA

SAMPLE NUMBER:	BGSS05	BGSS06	BGSS07	BGSS08	BGSS09	ARARS & TBCs			
LOCATION:	BGSS05	BGSS06	BGSS07	BGSS08	BGSS09	Risk-Based Concentration for Residential Soil Ingestion	Risk-Based Concentration for Industrial Soil Ingestion	PADEP Soil Residential Direct Contact MSC	PADEP Soil Non-residential Direct Contact MSC
DATA SOURCE:	Surface Soil	Surface Soil	Surface Soil	Surface Soil	Surface Soil				
SAMPLE DATE:	04/07/97	04/07/97	04/07/97	04/07/97	04/07/97				
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
aluminum	9240	15000	11900	10500	12000	78000	1000000	-	-
antimony	7.6 R	9.6 R	8.2 R	5.6 R	8.7 R	31.0	820	30.0	400
arsenic	5.6 E	5.6 E J	7.5 E	8 E	6.1 E J	0.430	3.80	3.00	4.00
barium	79.5	111	97.9	96.4	89.7	5500	140000	5000	70000
beryllium	0.79 E	1.2 E	0.84 E	0.98 E	0.79 E	0.150	1.30	1.00	1.30
calcium	939	1500	763	1010	614	-	-	-	-
chromium, total	13.2	17.9	14.5	13.5	12.4	390	10000	-	-
cobalt	8.3	8.3	8.5	7.1	8.2	4700	120000	-	-
copper	9.8	10.7	10.7	10.1	13.4	3100	82000	700	37000
cyanide	0.67 U	0.64 U	0.66 U	0.64 U	3.8	1600	41000	1000	20000
iron	13900	17600	16900	12800	15700	23000	610000	-	-
lead	25.2	19.5	18.1	56.7	16.3	400	-	500	1000
magnesium	1480	1940	1500	1410	1530	-	-	-	-
manganese	538	684	538	667	429	1800	47000	-	-
nickel	9.3	10.4	10.4	9.5	10.4	1600	41000	200	20000
potassium	771	750	436	618	460	-	-	-	-
sodium	109 U	103 U	105 U	106 U	120	-	-	-	-
thallium	0.27 U	0.28	0.34	0.27 U	0.25	6.30	160	6.00	80.0
vanadium	23.8	28.2	25.3	23	20.9	550	14000	-	-
zinc	38.7	47.2	31.7	53	21.7	23000	610000	-	-
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
acenaphthene	450 U	420 UJ	430 UJ	61 J	390 U	4700000	120000000	5000000	60000000
acenaphthylene	450 U	420 UJ	430 UJ	57 J	390 U	-	-	-	-
anthracene	68 J	420 UJ	65 J	110 J	390 U	23000000	610000000	23000000	300000000
benzo(a)anthracene	310 J	33 J	270 J	480	390 U	880	7800	6000	8000
benzo(a)pyrene	400 E J	420 UJ	270 E J	720 E	390 U	88.0	780	600	800
benzo(b)fluoranthene	550	420 UJ	340 J	990 E	390 U	880	7800	6000	8000
benzo(g,h,i)perylene	180 J	420 UJ	110 J	300 J	390 U	-	-	-	-

TABLE 5

COMPARISON OF SURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCs - SITE Background

NASJRB, WILLOW GROVE, PENNSYLVANIA

SAMPLE NUMBER:	BGSS05		BGSS06		BGSS07		BGSS08		BGSS09		ARARS & TBCs			
LOCATION:	BGSS05		BGSS06		BGSS07		BGSS08		BGSS09		Risk-Based Concentration for Residential Soil Ingestion	Risk-Based Concentration for Industrial Soil Ingestion	PADEP Soil Residential Direct Contact MSC	PADEP Soil Non-residential Direct Contact MSC
DATA SOURCE:	Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil					
SAMPLE DATE:	04/07/97		04/07/97		04/07/97		04/07/97		04/07/97					
SEMIVOLATILES	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	ug/kg	ug/kg	ug/kg
benzo(k)fluoranthene	310	J	420	UJ	270	J	660		390	U	8800	78000	60000	80000
bis(2-ethylhexyl)phthalate	130	B	160	B	150	B	240	B	92	B	46000	410000	300000	400000
butylbenzylphthalate	83	J	420	UJ	430	UJ	440	U	390	U	16000000	410000000	16000000	200000000
carbazole	80	J	420	UJ	430	UJ	270	J	390	U	32000	290000	-	-
chrysene	460		43	J	320	J	790		390	U	88000	780000	600000	800000
di-n-butylphthalate	1100	B	420	UJ	430	UJ	81	B	460	B	7800000	200000000	-	-
dibenz(a,h)anthracene	52	J	420	UJ	430	UJ	83	J	390	U	88.0	780	600	800
dibenzofuran	450	U	420	UJ	430	UJ	120	J	390	U	310000	8200000	-	-
fluoranthene	1000		49	J	670	J	2000		390	U	3100000	82000000	3000000	40000000
fluorene	450	U	420	UJ	430	UJ	160	J	390	U	3100000	82000000	3000000	40000000
indeno(1,2,3-cd)pyrene	220	J	420	UJ	140	J	400	J	390	U	880	7800	6000	8000
phenanthrene	650		420	UJ	490	J	1500		390	U	-	-	-	-
pyrene	810		56	J	610	J	1600		390	U	2300000	61000000	2000000	30000000
PESTICIDES	ug/kg		ug/kg		ug/kg		ug/kg		ug/kg		ug/kg	ug/kg	ug/kg	ug/kg
4,4'-DDT	4.5	U	4.2	U	4.3	U	6.2	J	3.9	U	1900	17000	10000	17000
dieldrin	220	E	14		86	E	420	E	3.9	U	40.0	360	300	400
gamma-chlordane	2.3	U	2.2	U	2.2	U	34		2	U	490	4400	3000	4000
heptachlor epoxide	2.3	U	2.2	U	2.2	U	33		2	U	70.0	630	500	600

MSC - Medium Specific Concentration.
K - Result is Biased High.
L - Result is Biased Low.
E - Result Exceeds ARAR or TBC Reference Criterion.

TABLE 5

COMPARISON OF SURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCs - SITE Background

NASJRB, WILLOW GROVE, PENNSYLVANIA

SAMPLE NUMBER:	BGSS10	BGSS11	BGSS12	---	---	ARARS & TBCs			
LOCATION:	BGSS10	BGSS11	BGSS12	---	---	Risk-Based Concentration for Residential Soil Ingestion	Risk-Based Concentration for Industrial Soil Ingestion	PADEP Soil Residential Direct Contact MSC	PADEP Soil Non-residential Direct Contact MSC
DATA SOURCE:	Surface Soil	Surface Soil	Surface Soil						
SAMPLE DATE:	04/07/97	04/07/97	04/07/97						
INORGANICS	**mg/kg**	**mg/kg**	**mg/kg**			**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
aluminum	10700	11900	10300			78000	1000000	-	-
antimony	6.4 R	8.1 R	8.8 R			31.0	820	30.0	400
arsenic	7.4 E	8 E	6.3 E			0.430	3.80	3.00	4.00
barium	90	111	83.7			5500	140000	5000	70000
beryllium	1 E	1.3 E	0.92 E			0.150	1.30	1.00	1.30
calcium	762	1160	1600			-	-	-	-
chromium, total	13.8	15.3	16			390	10000	-	-
cobalt	6.9	8.5	7			4700	120000	-	-
copper	9.3	9.3	12.7			3100	82000	700	37000
cyanide	0.7	0.64 U	0.66 U			1600	41000	1000	20000
iron	13300	16700	15500			23000	610000	-	-
lead	29 K	20.5	31.4			400	-	500	1000
magnesium	1300	1480	1550			-	-	-	-
manganese	667	844	477			1800	47000	-	-
nickel	7.4	9.6	10.1			1600	41000	200	20000
potassium	531	388 U	396 U			-	-	-	-
sodium	106 U	103 U	112			-	-	-	-
thallium	0.3	0.29	0.28			6.30	160	6.00	80.0
vanadium	23.7	26.2	26.5			550	14000	-	-
zinc	44.6	49.4	45.8			23000	610000	-	-
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**			**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
acenaphthene	64 J	430 U	55 J			4700000	120000000	5000000	60000000
acenaphthylene	54 J	430 U	62 J			-	-	-	-
anthracene	130 J	430 U	160 J			23000000	610000000	23000000	300000000
benzo(a)anthracene	590	430 U	940 E			880	7800	6000	8000
benzo(a)pyrene	830 E	430 U	1100 E			88.0	780	600	800
benzo(b)fluoranthene	1000 E	430 U	1500 E			880	7800	6000	8000
benzo(g,h,i)perylene	320 J	430 U	490			-	-	-	-

TABLE 5

COMPARISON OF SURFACE SOIL ANALYTICAL DATA TO ARARS AND TBCs - SITE Background

NASJRB, WILLOW GROVE, PENNSYLVANIA

SAMPLE NUMBER:	BGSS10	BGSS11	BGSS12	---	---	ARARS & TBCs			
LOCATION	BGSS10	BGSS11	BGSS12	---	---	Risk-Based Concentration for Residential Soil Ingestion	Risk-Based Concentration for Industrial Soil Ingestion	PADEP Soil Residential Direct Contact MSC	PADEP Soil Non-residential Direct Contact MSC
DATA SOURCE:	Surface Soil	Surface Soil	Surface Soil						
SAMPLE DATE:	04/07/97	04/07/97	04/07/97						
SEMIVOLATILES	**ug/kg**	**ug/kg**	**ug/kg**			**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
benzo(k)fluoranthene	820	430 U	920			8800	78000	60000	80000
bis(2-ethylhexyl)phthalate	110 B	110 B	130 B			46000	410000	300000	400000
carbazole	310 J	430 U	260 J			32000	290000	-	-
chrysene	860	430 U	1200			88000	780000	600000	800000
di-n-butylphthalate	1000 B	740 B	660 B			7800000	200000000	-	-
dibenz(a,h)anthracene	96 E J	430 U	160 E J			88 0	780	600	800
dibenzofuran	120 J	430 U	61 J			310000	8200000	-	-
fluoranthene	2300	430 U	2600			3100000	82000000	3000000	40000000
fluorene	160 J	430 U	120 J			3100000	82000000	3000000	40000000
indeno(1,2,3-cd)pyrene	420 J	430 U	640			880	7800	6000	8000
phenanthrene	1600	430 U	1700			-	-	-	-
pyrene	1700	430 U	2100			2300000	61000000	2000000	30000000
PESTICIDES	**ug/kg**	**ug/kg**	**ug/kg**			**ug/kg**	**ug/kg**	**ug/kg**	**ug/kg**
4,4'-DDT	8 3 J	4.3 U	4 3 U			1900	17000	10000	17000
dieldrin	550 E	4 3 U	63 E J			40.0	360	300	400
gamma-chlordane	48 J	2.2 U	3 2			490	4400	3000	4000
heptachlor epoxide	47	2.2 U	3 4 J			70 0	630	500	600

MSC - Medium Specific Concentration.
K - Result is Biased High.
L - Result is Biased Low.
E - Result Exceeds ARAR or TBC Reference Criterion.

Summary of Groundwater Sample Analysis

On-site screening of monitoring well head space was carried out with a PID during groundwater sampling. The PID readings for each sample are presented on the appropriate sample log sheets (Appendix B). Groundwater at 12MW01 showed some indication of organic compounds by PID screening.

Laboratory analysis results are summarized in Table 6 with comparison columns for reference criteria. Sample 12MW05 is a field duplicate of sample 12MW04.

Compounds found at concentrations above reference criteria include four exceedences in 12MW01, nickel at 125 ug/L, benzene at 93 ug/L, methyl tertiary-butyl ether (MTBE) at 3,700 ug/L and dieldrin at 0.2 ug/L; and one exceedence in 12MW02, carbon tetrachloride at 12 ug/L.

CONCLUSIONS

Surface soil at the area along the western boundary of Tinius Olsen (from 12SS01) was detected with elevated concentrations of four SVOC compounds, arsenic, and dieldrin. Arsenic was found in this surface soil sample at a concentration approximately three times the typical background concentration. Dieldrin (a pesticide) appears to be prevalent in many areas at NASJRB and dieldrin in soil samples from Site 12 are within expected concentration range.

Elevated field PID readings in drill cuttings at boring 12MW01 are likely related to VOCs in groundwater at that area. Well 12MW01 groundwater results indicated benzene at 93 ug/L and MTBE, a common gasoline additive, at 3,700 ug/L. The location of this monitoring well, downgradient of a gasoline service station, suggests an off-site source of benzene and MTBE, possibly from the station's USTs. Well 12MW01 is positioned upgradient of the Tinius Olsen property.

Groundwater sampled at the western area of Site 12, from well 12MW02, was found to have a concentration of 12 ug/l of carbon tetrachloride from an unknown source.

TABLE 6

COMPARISON OF GROUNDWATER ANALYTICAL DATA TO ARARS AND TBCs - Site 12

NASJRB, WILLOW GROVE, PENNSYLVANIA

SAMPLE NUMBER:	12MW01	12MW02	12MW03	12MW04	12MW04-DUP	ARARS & TBCs			
LOCATION:	12MW01	12MW02	12MW03	12MW04	12MW04	Maximum Contaminant Level (MCL)	Drinking Water Health Advisory (Lowest Criterion Shown)	PADEP Groundwater MSC <2500 TDS	Risk-Based Concentration for Tap Water Consumption
DATA SOURCE:	Monitoring Well	Monitoring Well	Monitoring Well	Monitoring Well	Monitoring Well				
SAMPLE DATE:	06/30/97	06/30/97	06/30/97	06/30/97	06/30/97				
INORGANICS	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
aluminum	50 U	50 U	1930	50 U	50 U	-	-	-	37000
barium	115	110	132	82	85.6	2000	2000 a	2000	2600
calcium	26100	20400	33400	27400	26900	-	-	-	-
chromium, total	5 K	9.2 K	20.4	5 U	5 U	100 *	100 a	100	180
cobalt	5.1 K	6.3 K	5 U	5 U	5 U	-	-	-	2200
copper	115	10 U	19 K	10 U	10 U	1300	-	1000	1500
iron	126 B	154 B	3230	57.9 B	55.6 B	-	-	-	11000
lead	4.3 B	1.4 B	1.1 B	1 U	1 U	15.0	-	5.00	15.0
magnesium	11200	5960	9890	14800	14400	-	-	-	-
manganese	136	14.1 K	182	5 U	5 U	-	-	-	840
nickel	126 E	20 U	20 U	20 U	20 U	100	100 a	100	730
potassium	2200	1500 U	4570	7340	6840	-	-	-	-
sodium	43900	17200	23100	12500	12600	-	-	-	-
zinc	147	20.8 B	13.5 B	5 U	5 U	-	2000 a	-	11000
SEMIVOLATILES	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
di-n-butylphthalate	2 B	1 B	10 U	10 U	10 U	-	-	-	3700
VOLATILES	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
benzene	93 E J	10 U	10 U	10 U	10 U	5.00	200 d	5.00	0.360
carbon tetrachloride	10 U	12 E	10 U	10 U	10 U	5.00	70.0	5.00	0.160
methyl tert-butyl ether	3700 E	11	10 U	10 U	10 U	-	-	20.0	180
methylene chloride	5 B	6 B	3 B	6 B	4 B	5.00	2000 d	5.00	4.10
PESTICIDES	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
dieldrin	0.2 E	0.1 U	0.1 E	0.1 U	0.1 U	-	0.500 e	0.00200	0.00420

MSC - Medium Specific Concentration.
K - Result is Biased High.
L - Result is Biased Low.
E - Result Exceeds ARAR or TBC Reference Criterion.

APPENDICES

APPENDIX A

BORING LOGS AND WELL CONSTRUCTION DIAGRAMS

BORING LOG 12 MW01

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT Willow Grove - NAS
PROJECT NO. 5466
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. 12 MW01
DATE 5/28/97
DRILLER Advanced Drilling INC (Rick Empson)
FIELD GEOLOGIST Tobin Lounsbury

SAMPLE NO. / TIME	DEPTH (FT.)	BLOWS 6"	SAMPLE REC LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
	0								
12:32	4				Soft	Moderate yellowish Brown	0'-5' SILTY CLAY with fill Stone(0-3') moist soft		PID = 0
12:37	8				Soft	Moderate yellowish Brown	6'-8' CLAY trace of silt moist, soft		
12:40	12				Soft	Dark yellowish ORANGE	8'-10' SAND, medium grained, well sorted, slight moist loose, soft		PID = 1.0 - 1.8
12:42 12:44	16				Soft Soft	Dark yellowish BRN	12' SAME 13'-15' CLAY, very moist to DAMP		PID = 4.0
12:48 12:50	20				Soft loose	Lt BRN to moderate Brown	16-17' SAND, fine to med. grained, slight moist, loose, 18' SAND, fine grained, sl. moist		PID = 5.0 PID = 8.0
12:52	24				HARD	Grayish Red	20' SILTstone to MUDstone with trace very fine SAND (5%) slight weathering.		HARDER AT 19' water at 19' 21' = 3 GPM
12:59 13:02	28				med. HARD to HARD	Grayish Red	23' Siltstone, trace CLAY 25' MUDstone, with SAND, very fine grained Fracture poss. 4-5 GPM		PID = 8 PPM
13:10 13:15	32				HARD	Grayish Red	27' SAME water ~ 7 GPM 29' SANDY(20%) SILTSTONE, slight weathering.		PID = 6 (in water)
							END Borehole AT 30'		
							PID IN Borehole = 15 ppm.		

REMARKS

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BORING LOG 12 SB 02

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT Willow Grove - NAS
PROJECT NO. 5466
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO 12 SB 02
DATE 5/27/97
DRILLER Advanced Drilling INC (Rick Empson)
FIELD GEOLOGIST Tobin Lounsbury

SAMPLE NO	DEPTH (FT)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
	0								
	1.0	2 / 3			Soft	Pale Brown	Silty Clay, some fill stone included. Roots/grass		PID=0
12SB02 0002	2.0	5 / 5	70%		Soft	Light Brown to Moderate Brown	Silt with Clay (10-20%) Dry		
	3.0	5 / 8			Soft	Dark yellowish Brown	Clayey silt (30% Clay) with trace very fine grained sand, slightly moist to Dry		PID = 0.2
12SB02 0204	4.0	10 / 10	80%		Soft				-
	5.0	6 / 12			medium ~~Soft~~ HARD	Moderate Reddish Brown	Weathered Sandstone with silt (10%)		PID=0
12SB02 0406	6.0	11 / 10	100%						
	7.0	7 / 8			Medium Soft	Grayish Red	Weathered Mudstone/Siltstone with trace very fine grained sand (<5%) Some Shaley Structure		PID=0
12SB02 0608	8.0	11 / 14	95%						
	9.0				Medium HARD	Pale Red to Grayish Brown	Shale to Silty Shale, weathered, Dry		PID=0
12SB02 0810	10.0		90%						
12SB02 1012		100/5"	5"		HARD	Grayish Red	Sandstone, Fine grained well sorted, slight moist, slight weathering to weathered		PID=0
							SPLIT SPOON Refusal At 10.5'		
									—

REMARKS

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BORING LOG 12 MW 02

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT Willow Grove - NAS
PROJECT NO. 5466
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. 12 MW 02
DATE 5/29/97
DRILLER Advanced Drilling INC (Rick Empson)
FIELD GEOLOGIST Tobin Lounsbury

~~SAMPLE NO.~~ TIME	DEPTH (FT.) 0	BLOWS 6"	SAMPLE REC LENGTH	LITHO CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
1151	4				Soft Firm	Mod Yellow BRN Dark Yllo-orange	0-3' Clayey SILT with minor SAND, moist 4' Silty Clay, slight moist compacted		PID=0 PID=2.5
1156	8				Med. HARD	PALE BRN	6' Claystone, weathered PALE Brown - Grayish Brown		PID=4.0
1157 12 00	12				medium HARD Medium Soft	Grayish Brown Grayish Red	8' Mudstone, 50% silt 50% clay weathered 11' Claystone, medium soft		PID=1 PID=0
12:02 12:07	16				Med. soft Med Hard Medium HARD	Lt Gray PALE Red	13' Sandstone, medium grained, weathered, much silt included (PALE BRN), MOIST 15' Claystone, silty, dry		PID=0 PID=0
12:10	20				Med HARD	Moderate Red	20' Mudstone, weathered, Dry		PID=0
12:14 12:16	24				Very HARD	Grayish Red to Blackish Red	21' SANDY(10%) SILTSTONE, Fresh Dry, very HARD 23- SAME		HARD drilling AT 21' WATER AT 23'
12:20	28				Very Hard	PALE Red to Grayish Red	24' SANDSTONE Silty (20%) SAND is fine grained, well sorted, slight weathering		PID=0 WATER Approx 3 GPM
12:37 12:46	32			END HOLE 30'	VERY HARD	Grayish Red	27' SANDSTONE, Fine grained, well sorted, Fresh, 29.5 - Fracture / Rock - SAME		WATER ~ 4 GPM PID=0
							End of Borehole/30'		

REMARKS

BORING NO.

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BORING LOG 12 MW 03

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT Willow Grove – NAS
PROJECT NO. 5466
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. 12 MW 03
DATE 5/28/97
DRILLER Advanced Drilling INC (Rick Empson)
FIELD GEOLOGIST Tobin Lounsbury

SAMPLE NO. / TIME	DEPTH (FT)	BLOWS 6"	SAMPLE REC. LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
	0								
15:12	4				Soft	Moderate Yellowish BRN	0-4 SILTY CLAY, slight moist		PID=0
15:14					Loose	Dark yellowish orange	5' SAND, medium grained, well sorted, loose, slight moist		PID=0
15:16	8				Loose		7' Gray-orange SAND, Coarse grained		PID=0
15:14	12				Med HARD	Lt Gray Orange	9-10' SANDSTONE, weathered coarse grained, some silt		10'- Water From Borehole
1523					HARD	Gray yellow	12' SANDstone, very coarse grained weathered		PID=5.0
1530	16				Very HARD	Gray Orange PINK	14' SANDstone, very coarse grained, quartz rich, WET.		Water ~0.5 GPM PID=3.5
15 36	20				Very HARD	PINKish Gray	18' SANDstone, very coarse grained with some Pebbles (10 mm) quartz Fresh 19' Water turn color - Mod. Red BRN		PID=0 Water ~3 GPM
1543	24				Med. Soft to Med HARD	Pale/Red BRN to Mod. Red BRN	20' Claystone, med soft to med. HARD		PID=3
1551	28			END	Medium HARD	Moderate Reddish Brown	26' Claystone with trace very fine SAND. water ≈ 4-5 GPM		PID=2.0
							END Borehole 27'		
							PID in Borehole = 0		

REMARKS

BORING NO.

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BORING LOG 12 MW 04

BROWN AND ROOT ENVIRONMENTAL
A Division of Halliburton NUS

PROJECT Willow Grove – NAS
PROJECT NO. 5466
ELEVATION
WATER LEVEL DATA
(DATE, TIME & CONDITIONS)

BORING NO. 12 MW 04
DATE 5/29/97
DRILLER Advanced Drilling INC (Rick Empson)
FIELD GEOLOGIST Tobin Lounsbury

SAMPLE NO. / TIME	DEPTH (FT)	BLOWS 6"	SAMPLE REC LENGTH	LITHO. CHANGE	MATERIAL DESCRIPTION* SOIL DENSITY HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
1423	0				SOFT	Moderate Yellowish BRN	0-3 SILTY CLAY, moist		PID=0
	4								
1424					Soft	Moderate Brown	4' Clayey SILT with trace very fine sand slight moist.		PID=4.0
1428	8				HARD	Lt BRN Gray	7' SANDSTONE, med-coarse grained,		PID=0
					HARD		8' SAME		PID=0
14:35	12				Soft	Dark Reddish Brown	11' MUDSTONE, with very fine sand (10%) weathered		PID=0
14:37	16				Soft to Medium Soft	Grayish Red	14' Claystone, Trace of silt, weathered; moist, wavy texture		PID=0 Water in Borehole 15'
14:42	20				medium HARD	Grayish Red	17' Sandy (20%) MUDSTONE, sand is fine grained, weathered,		PID=0 Water ~3 GPM
1450					HARD to VERY HARD	Pale Red to Very Lt. Gray	20' SANDSTONE, medium grained, well sorted, slight weathering		PID=0
1503	24						22' Grayish Red SANDSTONE med		PID=0
15:15					HARD		grained, weathered, HARD, micaceous, with silt (10%)		
1524	28			26' END of Borehole			25' SAME 26' SAME		
							END Borehole At 26'		

REMARKS

BORING NO.

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BROWN & ROOT ENVIRONMENTAL

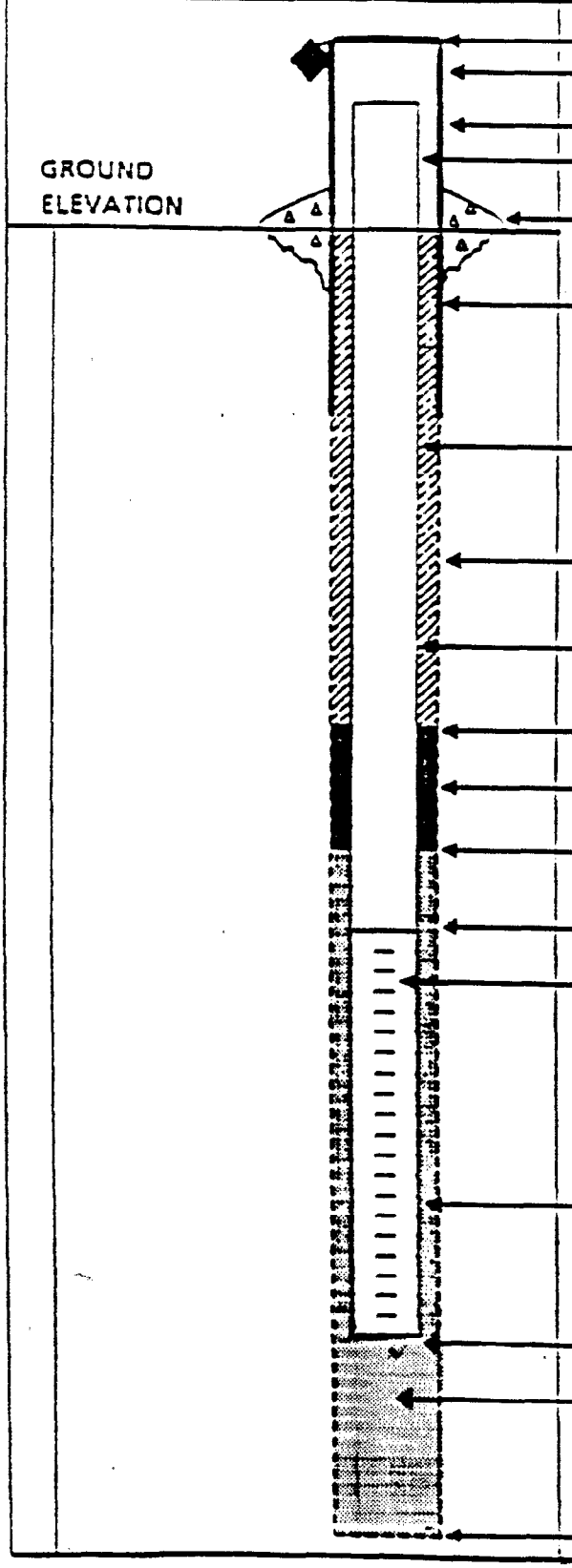
MONITORING WELL SHEET

BORING NO 12 MW 01

PROJECT Willow Grove - NAS
PROJECT NO. 5466
ELEVATION
FIELD GEOLOGIST Tobin Lounsbury

LOCATION Site 12
BORING 12 MW 01
DATE 5/28/97

DRILLER Advanced Drilling INC (Rick Emerson)
DRILLING METHOD Air Rotary
DEVELOPMENT METHOD Pumping



ELEVATION OF TOP OF SURFACE CASING:
ELEVATION OF TOP OF RISER PIPE:
STICK - UP TOP OF SURFACE CASING: 2.5' ags
STICK - UP RISER PIPE: 2' ags
TYPE OF SURFACE SEAL: 2' x 2' Concrete pad
I.D. OF SURFACE CASING:
TYPE OF SURFACE CASING: 6" Protective Steel well cover - stick up
RISER PIPE I.D. 12 MW 01
TYPE OF RISER PIPE: PVC - solid 2 in diameter
BOREHOLE DIAMETER: 6"
TYPE OF BACKFILL: Cement/bentonite grout
ELEVATION / DEPTH TOP OF SEAL: 6' bgs
TYPE OF SEAL: Bentonite
DEPTH TOP OF SAND PACK: 8' bgs
ELEVATION / DEPTH TOP OF SCREEN: 10' bgs
TYPE OF SCREEN: PVC - 2 in. diam
SLOT SIZE x LENGTH: 0.02 inch 20'
I.D. OF SCREEN:
TYPE OF SAND PACK: No. 2 Morie SAND
ELEVATION / DEPTH BOTTOM OF SCREEN: 30' bgs
ELEVATION / DEPTH BOTTOM OF SAND PACK: 30' bgs
TYPE OF BACKFILL BELOW OBSERVATION WELL:
ELEVATION / DEPTH OF HOLE: 30' bgs

BROWN & ROOT ENVIRONMENTAL

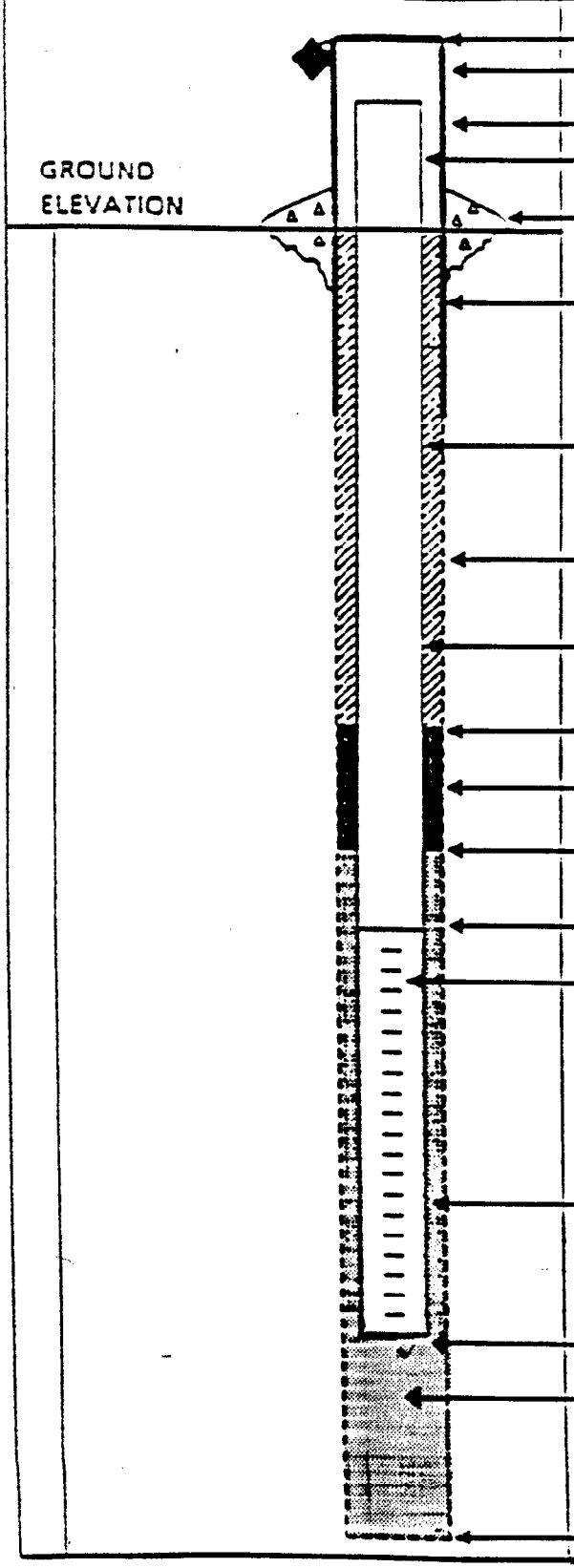
MONITORING WELL SHEET

BORING NO 12 MW 02

PROJECT Willow Grove - NAS
PROJECT NO. 5466
ELEVATION
FIELD GEOLOGIST Tobin Lounsbury

LOCATION Site 12
BORING 12 MW 02
DATE 5/29/97

DRILLER Advanced Drilling INC (Rick Emerson)
DRILLING METHOD Air Rotary
DEVELOPMENT METHOD Pumping



ELEVATION OF TOP OF SURFACE CASING:
ELEVATION OF TOP OF RISER PIPE:
STICK - UP TOP OF SURFACE CASING: 2.5' above grou
STICK - UP RISER PIPE: 2' above grou
TYPE OF SURFACE SEAL: 2' x 2' Concrete pad
I.D. OF SURFACE CASING:
TYPE OF SURFACE CASING: 6" Protective Steel well cover · stick up
RISER PIPE I.D. 12 MW 02
TYPE OF RISER PIPE: PVC - Solid 2 in diameter
BOREHOLE DIAMETER: 6"
TYPE OF BACKFILL: Cement/bentonite grout
ELEVATION / DEPTH TOP OF SEAL: 3' bgs
TYPE OF SEAL: Bentonite
DEPTH TOP OF SAND PACK: 4.5' bgs
ELEVATION / DEPTH TOP OF SCREEN: 6' bgs
TYPE OF SCREEN: PVC - 2 in. diam
SLOT SIZE x LENGTH: 0.02 inch x 20'
I.D. OF SCREEN:
TYPE OF SAND PACK: No. 2 Morie SAND
ELEVATION / DEPTH BOTTOM OF SCREEN: 26' bgs
ELEVATION / DEPTH BOTTOM OF SAND PACK: 30' bgs
TYPE OF BACKFILL BELOW OBSERVATION WELL: No. 2 Morie SAND to 30'
ELEVATION / DEPTH OF HOLE: 30' bgs

BROWN & ROOT ENVIRONMENTAL

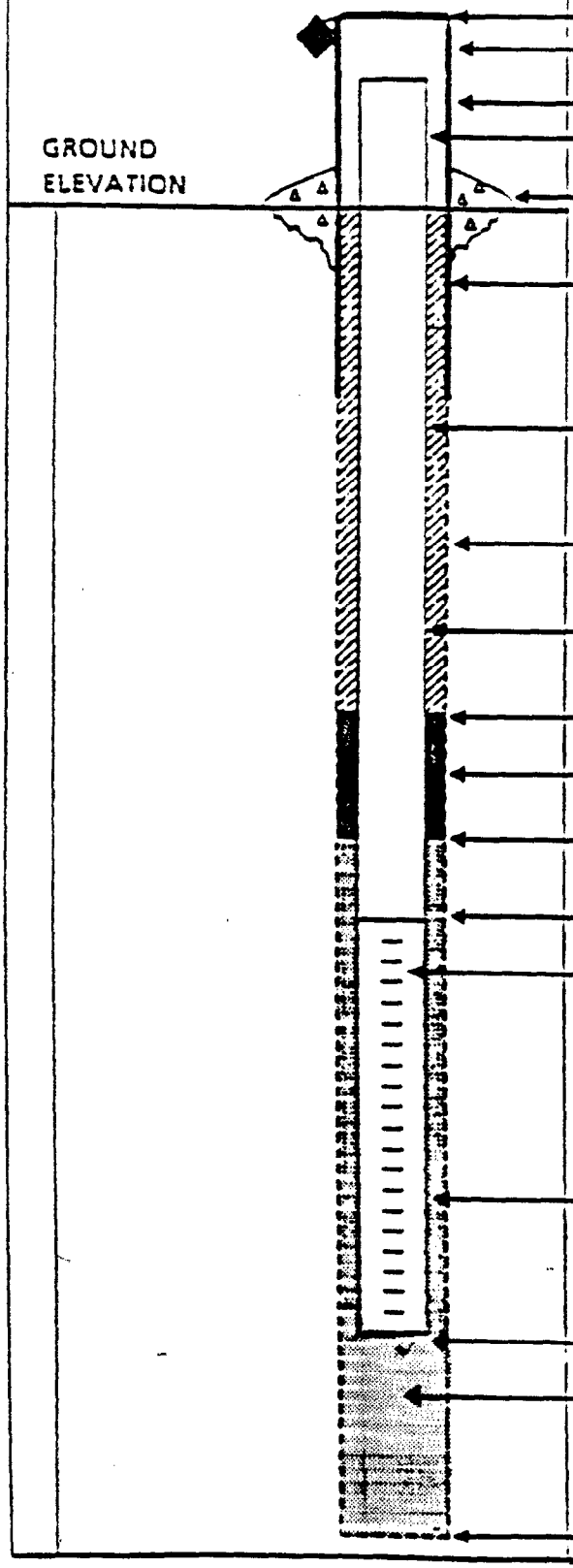
BORING NO 12 MW 03

MONITORING WELL SHEET

PROJECT Willow Grove - NAS
PROJECT NO. 5466
ELEVATION
FIELD GEOLOGIST Tobin Lounsbury

LOCATION Site 12
BORING 12 MW 03
DATE 5/28/97

DRILLER Advanced Drilling Inc (Rick Emerson)
DRILLING METHOD Air Rotary
DEVELOPMENT METHOD Pumping



ELEVATION OF TOP OF SURFACE CASING:
ELEVATION OF TOP OF RISER PIPE:
STICK - UP TOP OF SURFACE CASING: 2.5' above ground
STICK - UP RISER PIPE: 2' above grun
TYPE OF SURFACE SEAL: 2' x 2' Concrete pad
I.D. OF SURFACE CASING:
TYPE OF SURFACE CASING: 6" Protective Steel well cover - stick up
RISER PIPE I.D. 12 MW 03
TYPE OF RISER PIPE: PVC - solid 2 in diameter
BOREHOLE DIAMETER: 6"
TYPE OF BACKFILL: Cement/bentonite grout 3' to 0' below ground surface
ELEVATION / DEPTH TOP OF SEAL: 3' bgs
TYPE OF SEAL: Bentonite
DEPTH TOP OF SAND PACK: 4.5' bgs
ELEVATION / DEPTH TOP OF SCREEN: 6' bgs
TYPE OF SCREEN: PVC - 2 in. diam
SLOT SIZE x LENGTH: 0.02 inch
I.D. OF SCREEN:
TYPE OF SAND PACK: No. 2 Morie SAND
ELEVATION / DEPTH BOTTOM OF SCREEN: 26' bgs
ELEVATION / DEPTH BOTTOM OF SAND PACK: 27' bgs
TYPE OF BACKFILL BELOW OBSERVATION WELL: SAND (No. 2 SAND)
ELEVATION / DEPTH OF HOLE: 27 bgs

BROWN & ROOT ENVIRONMENTAL

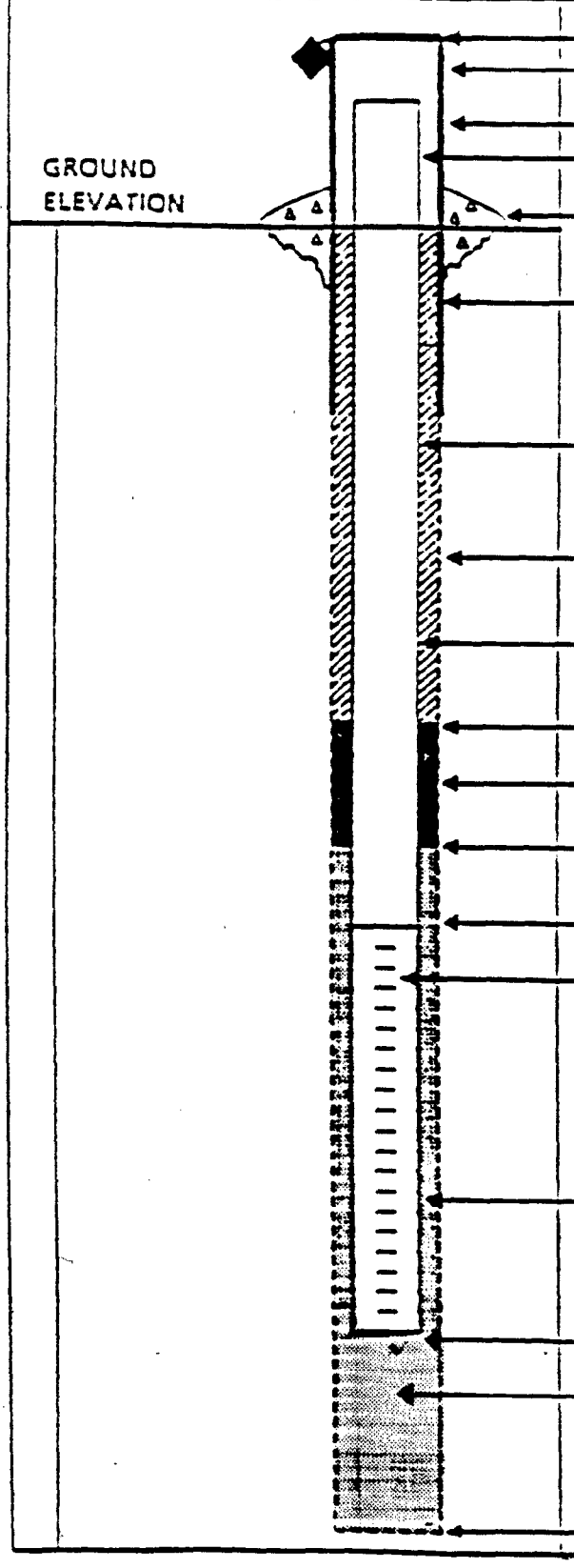
MONITORING WELL SHEET

BORING NO 12 MW 04

PROJECT Willow Grove - NAS
PROJECT NO. 5466
ELEVATION
FIELD GEOLOGIST Tobin Lounsbury

LOCATION Site 12
BORING 12 MW 04
DATE 5/29/97

DRILLER Advanced Drilling INC (Rick Emason)
DRILLING METHOD Air Rotary
DEVELOPMENT METHOD Pumping



ELEVATION OF TOP OF SURFACE CASING
ELEVATION OF TOP OF RISER PIPE:

STICK - UP TOP OF SURFACE CASING. 2.5' above ground
STICK - UP RISER PIPE : 2' above ground

TYPE OF SURFACE SEAL: 2' x 2' Concrete pad

I.D. OF SURFACE CASING.
TYPE OF SURFACE CASING
6" Protective Steel well cover - stick up

RISER PIPE I.D. 12 MW 04
TYPE OF RISER PIPE: PVC - solid 2 in diameter

BOREHOLE DIAMETER: 6"

TYPE OF BACKFILL: Cement/bentonite grout

ELEVATION / DEPTH TOP OF SEAL: 3' bgs

TYPE OF SEAL: Bentonite

DEPTH TOP OF SAND PACK: 4.5' bgs

ELEVATION / DEPTH TOP OF SCREEN: 6' bgs

TYPE OF SCREEN: PVC - 2 in. diam

SLOT SIZE x LENGTH: 0.02 inch x 20'

I.D. OF SCREEN:

TYPE OF SAND PACK: No. 2 Morie SAND

ELEVATION / DEPTH BOTTOM OF SCREEN: 26' bgs

ELEVATION / DEPTH BOTTOM OF SAND PACK: 26' bgs

TYPE OF BACKFILL BELOW OBSERVATION WELL: Sand to 26'

ELEVATION / DEPTH OF HOLE: 26' bgs

APPENDIX B

SAMPLE LOG SHEETS

GROUNDWATER
SAMPLE LOG SHEET

Brown & Root Environmental

- [x] Monitoring Well Data
- [ ] Domestic Well Data
- [ ] Other _____

Project Site Name: NAS JRB - Willow Grove

Project Site Number: 5466

Source Number: 12MW01

Source Location: Site #12 - Tinius Olsen

Total Well Depth: 32'

Well Casing Size & Depth: ~~22~~

Static Water Level: 17.02

One Casing Volume:

Start Purge (hrs): 1133

End Purge (hrs.): 1147

Total Purge Time (min.): 14

Total Amount Purged (gal.): 3.5 Liters

Monitor reading: TL ~~No readings~~ 1 ppm

Purge Method: Low flow submersible pump

Sample Method: Low flow submersible pump

Depth Sampled: 24'

Sample Date & Time: 6/30/97 1147

Sampled by: Tobin Lounsbury

Signature(s): Tobin Lounsbury

Purge Data

~~Volume~~ Time	pH	S.C.	Temp (°C)	Color and Turbidity
1135	5.33	.501	18.77	55
1137	5.09	.460	19.24	73
1139	5.00	.445	19.90	81
1141	4.96	.444	20.50	92
1143	4.94	.448	21.30	104
1145	4.93	.446	21.58	118
1147	4.92	.450	21.99	137

SAMPLE DATA

pH	S.C.	Temp (°C)	Color and Turbidity
4.92	.450	21.99	137

Type of Sample

- [x] Low Concentration
- [ ] High Concentration
- [x] Grab
- [ ] Composite
- [ ] Grab - Composite

Analysis	Preservative:
[x] TCL VOAs - MTBE	HCl to pH<2, 4°C
[x] TCL SVOAs	4°C
[x] TCL Pest/PCBs	4°C
[x] TAL Metals	HNO_3 to pH<2
[x] Cyanide	NaOH to pH>12
[x] TPH - GRO	
[x] TPH - DRO	

Observations/Notes:

- [ ] Duplicate sample taken

Revised 4/3/96

GROUNDWATER
SAMPLE LOG SHEET

Brown & Root Environmental

- [x] Monitoring Well Data
- [ ] Domestic Well Data
- [ ] Other _____

Project Site Name NAS JRB - Willow Grove

Project Site Number 5466

Source Number 12MW02

Source Location Site #12 - Thius Olsen

	Purge Data				
Total Well Depth:					
Well Casing Size & Depth:	~~Volume~~ Time	pH	S.C.	Temp (°C)	Color and Turbidity
Static Water Level: 11.78'	1025	5.33	.227	16.37	240
One Casing Volume:					
Start Purge (hrs): 1023	1027	5.20	.230	17.01	144
End Purge (hrs.): 1035					
Total Purge Time (min.): 12	1029	5.16	.234	17.83	98
Total Amount Purged (gal.): 2.4 Liters					
Monitor reading:	1031	5.15	.236	18.31	88
No readings					
Purge Method: Low flow submersible pump	1033	5.14	.237	18.52	99.4
Sample Method: Low flow submersible pump					
Depth Sampled: 19'	1035	5.14	.237	18.41	149
Sample Date & Time: 6/30/97 1035					
Sampled by: Tobin Lounsbury					
Signature(s): Tobin Lounsbury					

SAMPLE DATA			
pH	S.C.	Temp (°C)	Color and Turbidity
5.14	.237	18.41	149

Type of Sample

- [x] Low Concentration
- [ ] High Concentration
- [x] Grab
- [ ] Composite
- [ ] Grab - Composite

Analysis	Preservative:
[x] TCL VOAs + MTBE	HCl to pH<2, 4°C
[x] TCL SVOAs	4°C
[x] TCL Pest/PCBs	4°C
[x] TAL Metals	HNO_3 to pH<2
[x] Cyanide	NaOH to pH>12
[x] TPH - GRO	
[x] TPH - DRO	

Observations/Notes:

- [ ] Duplicate sample taken

Revised 4/3/96

GROUNDWATER SAMPLE LOG SHEET

Brown & Root Environmental

☒ Monitoring Well Data
☐ Domestic Well Data
☐ Other _____

Project Site Name NAS JRB - Willow Grove

Project Site Number 5466

Source Number 12MW03

Source Location Site #12 - Tinius Olsen

Total Well Depth: 26'	**Purge Data**					
Well Casing Size & Depth: 2" PVC	~~Volume~~ Time	pH	S.C.	Temp (°C)	Color and Turbidity D.O.	
Static Water Level: 13.44'	1150	6.08	.250	14.73	4.35	1195.5
One Casing Volume: 2.05	1152	6.09	.256	15.30	4.11	1188.0
Start Purge (hrs): 1148	1154	6.10	.266	15.98	4.13	1182.7
End Purge (hrs.): 1210	1156	6.29	.304	16.25	4.66	1272.4
Total Purge Time (min.): 22	1158	6.30	.307	16.89	4.44	1272.2
Total Amount Purged (gal.): 2	1200	6.31	.308	17.42	4.39	1272.2
Monitor reading:	1202	6.31	.309	17.91	4.35	1272.0
No readings	1204	6.31	.309	18.06	4.28	1272.9
Purge Method: Low flow submersible pump	1206	6.31	.309	18.23	4.24	1272.1
Sample Method: Low flow submersible pump						
Depth Sampled: 20'						
Sample Date & Time: 6/30/97 1210						
Sampled by: Matt Woolford						
Signature(s): Matt Woolford	**SAMPLE DATA**					
	pH	S.C.	Temp (°C)	Color and Turbidity D.O.		
	6.31	.309	18.23	slight yellowish	1272.1	4.24

Type of Sample

☒ Low Concentration
☐ High Concentration
☒ Grab
☐ Composite
☐ Grab - Composite

Analysis	Preservative:
☒ TCL VOAs + MTBE	HCl to pH<2, 4°C
☒ TCL SVOAs	4°C
☒ TCL Pest/PCBs	4°C
☒ TAL Metals	HNO_3 to pH<2
☒ Cyanide	NaOH to pH>12
☒ TPH - GRO	
☒ TPH - DRO	

Observations/Notes:

☐ Duplicate sample taken

Revised 4/3/96

GROUNDWATER
SAMPLE LOG SHEET

Brown & Root Environmental

- [x] Monitoring Well Data
- [ ] Domestic Well Data
- [ ] Other _____

Project Site Name: NAS JRB - Willow Grove

Project Site Number: 5466

Source Number: 12MW04

Source Location: Site #12 - Tinius Olsen

Total Well Depth: 26'	Purge Data					
Well Casing Size & Depth: 2" PVC	~~Volume~~ Time	pH	S.C.	Temp (°C)	~~Color~~ and Turbidity DO	
Static Water Level: 14.19'	1020	6.07	.269	16.31	8.15	65.3
One Casing Volume: 1.93 gal.						
Start Purge (hrs): 1015	1022	6.07	.296	16.49	8.11	74.6
End Purge (hrs.): 1038						
Total Purge Time (min.): 23	1024	6.08	.299	16.86	8.03	83.0
Total Amount Purged (gal.): 2.5						
Monitor reading: No readings	1026	6.09	.300	16.99	7.97	96.4
Purge Method: Low flow submersible pump	1028	6.08	.304	17.49	8.29	114
Sample Method: Low flow submersible pump						
Depth Sampled: 20'	1030	6.10	.306	17.83	7.78	130
Sample Date & Time: 6/30/97 1038						
	1032	6.10	.308	18.42	7.66	182.6
Sampled by: Matt Woolford						
	1034	6.10	.307	18.47	7.63	193

Signature(s): Matt Woolford

SAMPLE DATA

pH	S.C.	Temp (°C)	Color and Turbidity	
6.10	.307	18.47	clear	193

Type of Sample

- [x] Low Concentration
- [ ] High Concentration
- [x] Grab
- [ ] Composite
- [ ] Grab - Composite

Analysis	Preservative:
[x] TCL VOAs + MTBE	HCl to pH<2, 4°C
[x] TCL SVOAs	4°C
[x] TCL Pest/PCBs	4°C
[x] TAL Metals	HNO_3 to pH<2
[x] Cyanide	NaOH to pH>12
[x] TPH - GRO	
[x] TPH - ORO	

Observations/Notes:

- [x] Duplicate sample taken - 12MW05

MS/MSD was also collected.

Revised 4/3/98

SOLID/SOIL/SEDIMENT SAMPLE LOG SHEET

Brown & Root Environmental

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Lagoon/Pond
- [ ] Other _____

Project Site Name NASJRB Willow Grove

Project Site Number 5466

Source Number 125B01

Source Location Tinius Olsen

Sample Method: Hand Auger and Stainless steel hand Trowel

Depth Sampled: 0" to 6"

Sample Date & Time: 5-30-97 0915

Sampled by: Vincent Shickora

Signature(s): [signature]

Sample Type

- [x] Low Concentration
- [ ] High Concentration
- [x] Grab
- [ ] Composite
- [ ] Grab - Composite

Analysis	Preservative:
[x] TCL VOAs	dark, 4°C
[x] TCL SVOAs	dark, 4°C
[x] TCL Pest/PCBs	dark, 4°C
[x] TAL Metals	4°C
[x] Cyanide	4°C
[ ] PCB Field Kit Immunoassay	

- [x] Duplicate sample taken

Dup # 125B03

Composite Sample Data

Sample	Time	Color and Description

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Dark Brown	Silty clay with grass roots (damp)

Observation/Notes

See Logbook #2312 for location

No HNU readings

REVISED 4/30/90

SOLID/SOIL/SEDIMENT SAMPLE LOG SHEET

Brown & Root Environmental

- [ ] Surface Soil
- [x] Subsurface Soil
- [ ] Sediment
- [ ] Lagoon/Pond
- [ ] Other_____

Project Site Name: NASJRB Willow Grove

Project Site Number: 5466

Source Number: 125B01-0002

Source Location: Tinius Olsen

Sample Method: Hand Auger and Stainless steel hand Trowel

Depth Sampled: 0.5 ft to 2.0 ft.

Sample Date & Time: 5-30-97 0930

Sampled by: Vincent Shickora

Signature(s): [signature]

Sample Type

- [x] Low Concentration
- [ ] High Concentration
- [ ] Grab
- [x] Composite
- [ ] Grab - Composite

Analysis	Preservative:
[x] TCL VOAs	dark, 4°C
[x] TCL SVOAs	dark, 4°C
[x] TCL Pest/PCBs	dark, 4°C
[x] TAL Metals	4°C
[x] Cyanide	4°C
[ ] PCB Field Kit Immunoassay	

- [ ] Duplicate sample taken

Composite Sample Data

Sample	Time	Color and Description

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Brown	Silty clay and gravel (moist)

Observation/Notes

See Logbook #2312 for location

No HNU readings.

Revised 4/3/90

SOLID/SOIL/SEDIMENT SAMPLE LOG SHEET

Brown & Root Environmental

- [ ] Surface Soil
- [x] Subsurface Soil
- [ ] Sediment
- [ ] Lagoon/Pond
- [ ] Other_____

Project Site Name NASJRB Willow Grove

Project Site Number 5466

Source Number 125B01-0204

Source Location Tinius Olsen

Sample Method: Hand Auger and Stainless steel hand Trowel

Depth Sampled: 2.0 ft to 4.0 ft

Sample Date & Time: 5-30-97 0940

Sampled by: Vincent Shickora

Signature(s): [signature]

Sample Type

- [x] Low Concentration
- [ ] High Concentration
- [ ] Grab
- [x] Composite
- [ ] Grab - Composite

Analysis	Preservative:
[x] TCL VOAs	dark, 4°C
[x] TCL SVOAs	dark, 4°C
[x] TCL Pest/PCBs	dark, 4°C
[x] TAL Metals	4°C
[x] Cyanide	4°C
[ ] PCB Field Kit Immunoassay	

[ ] Duplicate sample taken

Composite Sample Data

Sample	Time	Color and Description

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Brown	Silty clay and gravel (moist)

Observation/Notes

See Logbook #2312 for location

No HNU readings

Revised 4/3/96

SOLID/SOIL/SEDIMENT SAMPLE LOG SHEET

Brown & Root Environmental

- [x] Surface Soil
- [ ] Subsurface Soil
- [ ] Sediment
- [ ] Lagoon/Pond
- [ ] Other_____

Project Site Name NASJRB Willow Grove

Project Site Number 5466

Source Number 125502

Source Location Tinius Olsen

Sample Method: 3 inch Split Spoon and Stainless Steel Trowel

Depth Sampled: 0" to 6"

Sample Date & Time: 5-27-97 1420

Sampled by: Tobin Lounsbury

Signature(s): Tobin Lounsbury

Sample Type

- [x] Low Concentration
- [ ] High Concentration
- [ ] Grab
- [x] Composite
- [ ] Grab - Composite

Analysis	Preservative:
[x] TCL VOAs	dark, 4°C
[x] TCL SVOAs	dark, 4°C
[x] TCL Pest/PCBs	dark, 4°C
[x] TAL Metals	4°C
[ ] Cyanide	4°C

- [ ] Duplicate sample taken

Composite Sample Data

Sample	Time	Color and Description

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Brown	Silty clay (dry)

Observation/Notes

See logbook #1229 for location

No HNU readings.

Revised 4/2/96

SOLID/SOIL/SEDIMENT SAMPLE LOG SHEET

Brown & Root Environmental

- [ ] Surface Soil
- [x] Subsurface Soil
- [ ] Sediment
- [ ] Lagoon/Pond
- [ ] Other_____

Project Site Name NASJRB Willow Grove

Project Site Number 5466

Source Number 125B02-0002

Source Location Tinius Olsen

Sample Method: 3 inch Split Spoon and Stainless Steel Trowel

Depth Sampled: 0.5 Ft. to 2.0 ft

Sample Date & Time: 5-27-97 1328

Sampled by: Tobin Lounsbury

Signature(s): Tobin Lounsbury

Sample Type

- [x] Low Concentration
- [ ] High Concentration
- [ ] Grab
- [x] Composite
- [ ] Grab - Composite

Analysis	Preservative:
[x] TCL VOAs	dark, 4°C
[x] TCL SVOAs	dark, 4°C
[x] TCL Pest/PCBs	dark, 4°C
[x] TAL Metals	4°C
[ ] Cyanide	4°C

- [ ] Duplicate sample taken

Composite Sample Data

Sample	Time	Color and Description

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Brown	Silty Clay (Dry)

Observation/Notes

See logbook #1229 for location

No HNU readings

Revised 4/3/96

SOLID/SOIL/SEDIMENT SAMPLE LOG SHEET

Brown & Root Environmental

- [ ] Surface Soil
- [x] Subsurface Soil
- [ ] Sediment
- [ ] Lagoon/Pond
- [ ] Other_____

Project Site Name NASJRB Willow Grove

Project Site Number 5466

Source Number 125B02-0204

Source Location Tinius Olsen

Sample Method: 3 inch Split Spoon and Stainless Steel Trowel

Depth Sampled: 2.0 ft to 4.0 ft

Sample Date & Time: 5-27-97 1334

Sampled by: Tobin Lounsbury

Signature(s): Tobin Lounsbury

Sample Type

- [x] Low Concentration
- [ ] High Concentration
- [ ] Grab
- [x] Composite
- [ ] Grab - Composite

Analysis	Preservative:
[x] TCL VOAs	dark, 4°C
[x] TCL SVOAs	dark, 4°C
[x] TCL Pest/PCBs	dark, 4°C
[x] TAL Metals	4°C
[ ] Cyanide	4°C

- [ ] Duplicate sample taken

Composite Sample Data

Sample	Time	Color and Description

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Yellow-Brown	Clayey Silt (dry)

Observation/Notes

See logbook #1229 for location

No HNU readings

Revised 4/2/96

SOLID/SOIL/SEDIMENT SAMPLE LOG SHEET

Brown & Root Environmental

- [ ] Surface Soil
- [x] Subsurface Soil
- [ ] Sediment
- [ ] Lagoon/Pond
- [ ] Other_____

Project Site Name NASJRB Willow Grove

Project Site Number 5466

Source Number 125B02-0406

Source Location Tinius Olsen

Sample Method: 3 inch Split Spoon and Stainless Steel Trowel

Depth Sampled: 4.0 ft to 6.0 ft

Sample Date & Time:

Sampled by: Tobin Lounsbury

Signature(s): Tobin Lounsbury

Sample Type

- [x] Low Concentration
- [ ] High Concentration
- [ ] Grab
- [x] Composite
- [ ] Grab - Composite

Analysis	Preservative:
[x] TCL VOAs	dark, 4°C
[x] TCL SVOAs	dark, 4°C
[x] TCL Pest/PCBs	dark, 4°C
[x] TAL Metals	4°C
[ ] Cyanide	4°C

- [ ] Duplicate sample taken

Composite Sample Data

Sample	Time	Color and Description

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Red-Brown	Silt and weathered Sandstone (damp)

Observation/Notes

See logbook # 1229 for location

No HNU readings

Revised 4/5/96

SOLID/SOIL/SEDIMENT SAMPLE LOG SHEET

Brown & Root Environmental

- [ ] Surface Soil
- [x] Subsurface Soil
- [ ] Sediment
- [ ] Lagoon/Pond
- [ ] Other_____

Project Site Name NASJRB Willow Grove

Project Site Number 5466

Source Number 125B02-0608

Source Location Tinius Olsen

Sample Method: 3inch Split Spoon and Stainless Steel Trowel

Depth Sampled: 6.0 ft to 8.0 ft.

Sample Date & Time: 5-27-97 1342

Sampled by: Tobin Lounsbury

Signature(s): Tobin Lounsbury

Sample Type

- [x] Low Concentration
- [ ] High Concentration
- [ ] Grab
- [x] Composite
- [ ] Grab - Composite

Analysis	Preservative:
[x] TCL VOAs	dark, 4°C
[x] TCL SVOAs	dark, 4°C
[x] TCL Pest/PCBs	dark, 4°C
[x] TAL Metals	4°C
[ ] Cyanide	4°C

- [ ] Duplicate sample taken

Composite Sample Data

Sample	Time	Color and Description

Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Grey-Red	weathered Mudstone/Siltstone (damp)

Observation/Notes

See logbook #1229 for location

No HNU readings

Revised 4/2/96

APPENDIX C

SURVEYORS REPORT

GEO-Technical Services,Inc.

Date:7/23/97
File:NAS-WL2.XLS

Willow Grove - Soil Samples - Tinius Olsen

GTS #	Sample #	Northing	Easting	Ground Elevation
2181	12SB01	325624.56	2697473.96	351.61
2185	12SB02	325752.55	2697372.25	351.56

GEO-Technical Services,Inc.

Date:7/23/97
File:NAS-WL2.XLS

Willow Grove - Monitoring Wells - Tinius Olsen

GTS #	Well #	Northing	Easting	Top of steel casing	Notch in top PVC pipe	Ground Elevation
2178	12MW04	326497.59	2697401.92		349.27	
2179	12MW04	326497.59	2697401.92	349.45		
2180	12MW04	326497.59	2697401.92			347.47
2182	12MW03	326188.94	2697255.18			347.09
2183	12MW03	326188.94	2697255.18		348.92	
2184	12MW03	326188.94	2697255.18	349.29		
2186	12MW02	325753.42	2697375.13			351.73
2187	12MW02	325753.42	2697375.13		353.69	
2188	12MW02	325753.42	2697375.13	354.05		
2189	12MW01	325259.37	2697886.68		363.65	
2190	12MW01	325259.37	2697886.68	363.82		
2191	12MW01	325259.37	2697886.68			361.60