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NCBC GULFPORT
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SOIL SAMPLING AND ANALYSIS PLAN NCBC GULFPORT MS
6/18/1991
VERSAR, INC

Versar INC.

SOIL SAMPLING AND ANALYSIS PLAN
NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

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JUNE 18, 1991

5036.9.2_Gulfport-Battalion_Center

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NOVEMBER 20, 1990
SOIL SAMPLING AND ANALYSIS PLAN
NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

1.0 BACKGROUND AND PURPOSE

In April of 1970 the suspension of certain uses of 2,4,5-trichloro-phenoxyacetic acid (2,4,5-T) was announced jointly by the Secretaries of Agriculture, Health, Education, and Welfare, and the Interior. This action was taken since research had indicated that 2,4,5-T was a teratogen. Further studies indicated that the teratogenicity was due to a contaminant, 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). Learning of these findings the Department of Defense suspended the use of Herbicide Orange (HO), a defoliant that was widely used in Viet Nam which comprised approximately 50 per cent by weight 2,4,5-T. During its use from 1965 to 1977 drums of HO had been staged and stored at the Naval Construction Battalion Center (NCBC), Gulfport, Mississippi. Specifically, three areas located on the northern end of NCBC had been used for storage: Area A was used for long term storage of HO between 1970 until 1977 when incineration was conducted, and Areas B and C which were used for short term storage during the 1960's. Subsequent to the at-sea incineration of all remaining HO inventories performed in 1977, the USAF Occupational and Environmental Health Laboratory began monitoring studies of chemical residues in soil, silt, water, and biological organisms associated with the former storage site where the HO had been stored since it was known that spills had occurred. In June 1980, the Secretary of the Air Force/Deputy for Environment and Safety received a proposed research protocol from the Air Force Surgeon General to return HO contaminated sites to full use. The protocol recommended that AFESC take the lead for monitoring and reclamation research.

In 1984 the former storage areas were initially characterized for contamination by 2,3,7,8-TCDD. In 1986 additional contamination within the storage areas was discovered and characterized. This characterization encompassed subdividing all areas where HO was known to have been stored into 20 foot by 20 foot grids, compositing samples from each grid center and corners, and analyzing these samples for the presence of 2,3,7,8-TCDD. Figure 1 depicts the locations, concentrations, and disposition of the 2,3,7,8-TCDD contamination found during these investigations.

Following a successful Verification Burn in 1986 and continuing through 1988 full scale incineration of approximately 30,000 cubic yards of soil contaminated with TCDD was performed. The ash or treated soil was routinely analyzed and was shown to pose no threat to human health or the environment. These test results were contained within a petition for final exclusion of the incinerator residues submitted in November of 1988. Based on these

results it was decided that the treated soil could be safely returned to the selected areas within Area A.

To meet the goal of returning the site to full and beneficial use, the site must now undergo site closure. As part of the closure process the Air Force must demonstrate the cleanliness of the site and provide subsequent detailed plans for additional monitoring and remedial action, if required. At issue is whether any contamination by residues of HO constituents and degradation products exists in the storage areas, and whether any contamination by heavy metals caused by inadvertent leakage and past vehicle servicing practices exists within the storage areas.

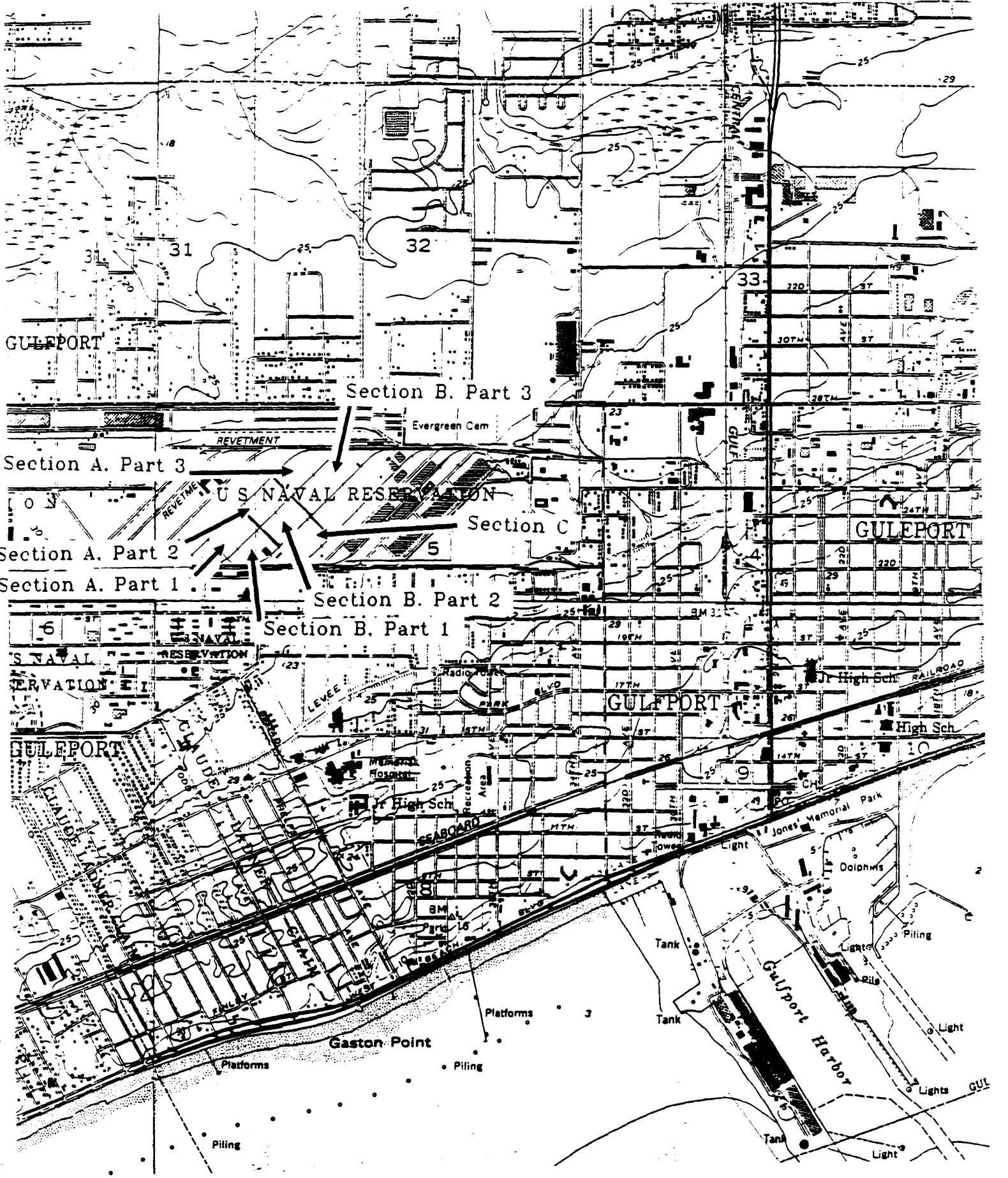
This sampling and analysis plan is primarily intended to generate sufficient and detailed analytical data that will characterize the site's degree of cleanliness. Secondarily, the sampling approach to HSA B and C characterization has been designed to generate samples that will be useful in directing additional remedial action if warranted.

2.0 SOIL SAMPLING STRATEGY OVERVIEW

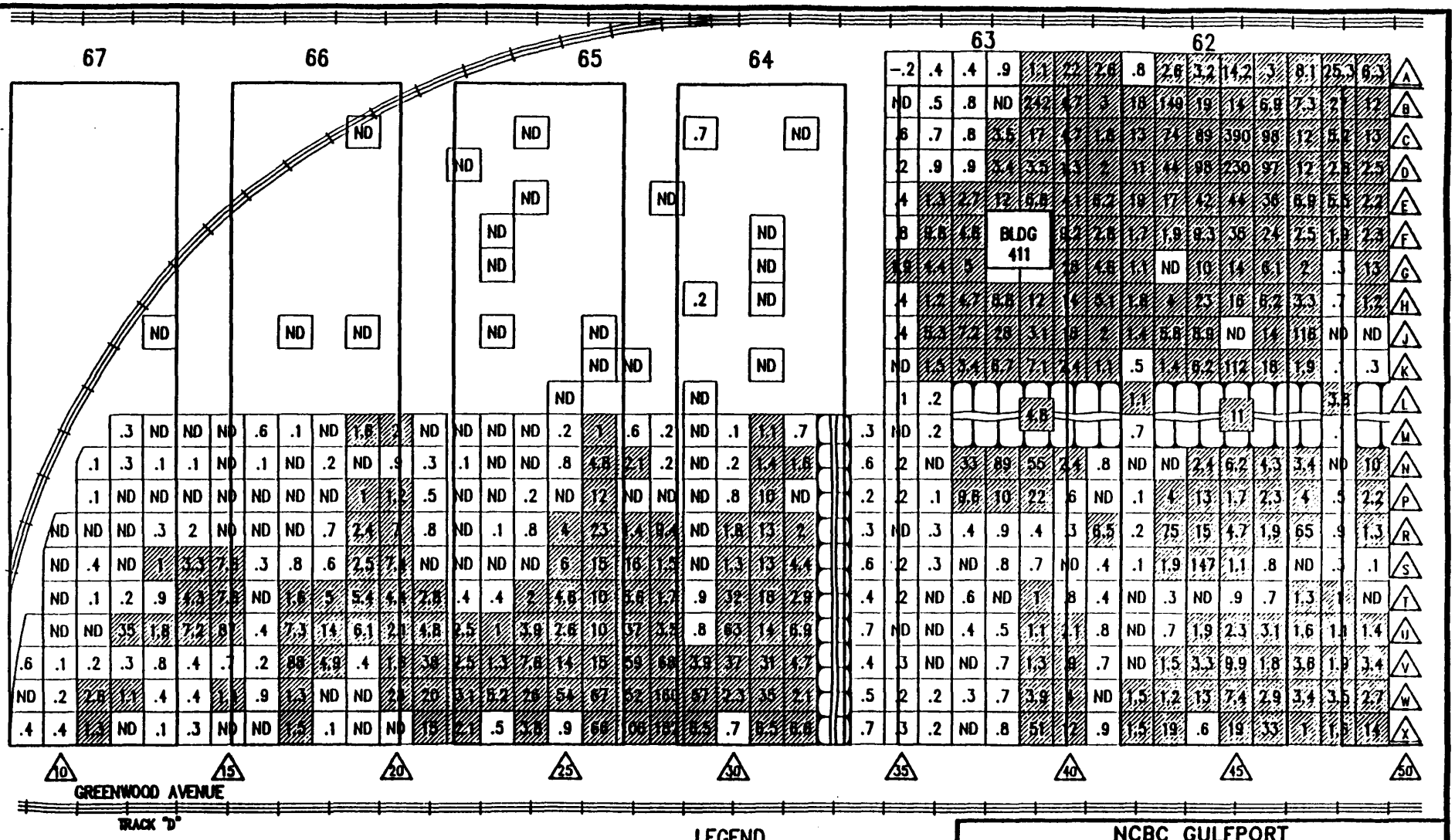
The methods and procedures in this sampling and analysis plan are intended to achieve statistically sound data that characterize constituents and degradation products of HO and metals that may have been inadvertently deposited on storage area soils as a result of leakage or spills from stored vehicles and machinery and past servicing of stored vehicles.

The strategy underlying this plan assumes that no relationship between metals and HO deposition on the soils exists since they were caused by two independent activities. As such, development of methodologies to characterize these two classes of potential contamination were carried out in parallel. This sampling and analysis plan is the result of combining these two methodologies to take advantage of the economy of conducting essentially two investigations simultaneously.

The strategy common to both HO and metals contamination evaluation is based on delineation of individual compliance units. Composite samples collected and analyzed from within these compliance units define a compliance point which will be compared to the target action levels established for the constituents of concern. These compliance units are referred to in this sampling and analysis plan as sample plots and consist of previously established 20 foot by 20 foot grids. Additionally, discrete samples collected from previously established grids which delineate each composite plot sample will be archived and individually analyzed if the composite sample exceeds any of the target action levels. In this manner specific grids which detrimentally contributed to the composite will be identified and targeted for additional remedial action.



Location Reference for Figure 1



All Values of Concentrations of 2,3,7,8-TCDD in $\mu g/kg$.

ND Denotes no 2,3,7,8-TCDD at a Detection Level of 0.1 $\mu g/kg$

LEGEND

X.X	SAMPLED AREA – NOT EXCAVATED
X.X	EXCAVATED AREA
	UNSAMPLED AREA – NOT EXCAVATED
–X	RESULT OF COMPOSITE SAMPLE ANALYSIS COMPRISING SUBJECT GRID

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DESIGNED JUERGENS	DATE 8/10/90	FIGURE 1 SECTION A, PART 1 HERBICIDE STORAGE AREA PAST SAMPLING RESULTS
DRAWN CAROLINO	9/14/90	
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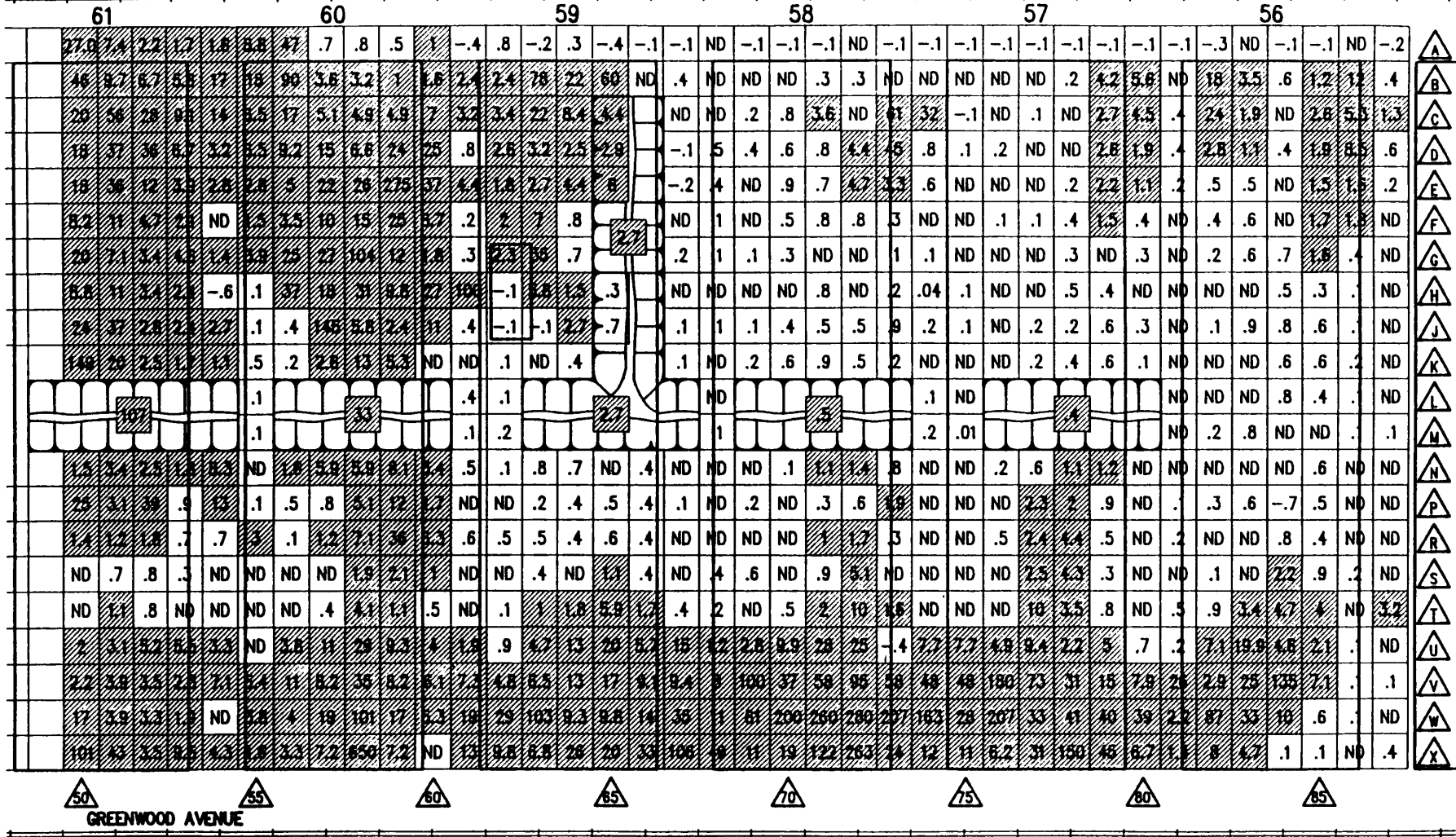

All Values of Concentrations of 2,3,7,8-TCDD in $\mu g/kg$.

ND Denotes no 2,3,7,8-TCDD at a Detection Level of 0.1 $\mu g/kg$

LEGEND

X.X	SAMPLED AREA - NOT EXCAVATED
X.X	EXCAVATED AREA
	UNSAMPLED AREA - NOT EXCAVATED
-X	RESULT OF COMPOSITE SAMPLE ANALYSIS COMPRISING SUBJECT GRID

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TRACK "D"

	5							10							15							20							25							30							35
BA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	17.7	ND	ND	ND	ND	ND	ND	ND										
BB	ND	11.6	ND	1.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.9	0.5	2.5	1.1	ND	ND											
BC	0.3	3.9	ND	5.8	5.3	0.4																				ND	0.4	1.1	3.1	1.7	0.4												
BD	0.3	1.4	28.1	7.1	0.6	-.1																					0.4	0.4	2.2	3	-.7												
BE	-.2	0.3	5.3	1.9	0.5	-.4																						0.1	1.1	1.9	-.2												
BF		0.3	1.8	3.1	1.5	-.1																						-.3	0.4	0.4	-.2												
BG		0.3	2.4	4.1	0.6	-.01																																					
BH		0.7	1.3	8	0.4																																						
BJ		-.2	-.3	1.3	0.5	-.7																																					
BK			-.2	1.5	-.3	-.6																																					
BL											-.5	-.5	-.06																	-.6	-.2	-.2											
BM											0.8	0.7	-.7																		-.2	1.1											
BN										-.3	0.2	7.5	0.3																		-.3	0.6											
BP										-.8	1.8	5.7	0.4																			0.3											
BR										0.5	0.6	5	-.4																		-.1	0.4											
BS									-.3	-.9	1	7.5	0.7										-.7	0.6	0.2	0.2	0				-.3	0.9											
BT									-.2	1.8	11.1	15.6	0.6									-.1	0.7	0.8	1.3	0.9	-.4	-.1			0.2	1.2											
BU									0.5	8.7	38.8	13.7	0.7									0.3	1.5	1.5	0.6	2.7	1.7	ND	0.4	0.8	.03	2.7											
BV	0.1	ND	ND	ND	ND	ND	ND	0.5	80.4	139	4.7	ND	ND	ND	ND	1.8	ND	ND	ND	ND	12.2	0.2	ND	2.1	1.8	ND	0.2	14.5	0.3	1.4													
BW	0.1	ND	0.1	0.1	ND	0.1	ND	ND	118.0	34.0	21.6	2.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.5	ND	0.3											

42

HOLTMAN AVENUE

41 40 39 38 37 36

TRACK "C"

All Values of Concentrations of 2,3,7,8-TCDD in $\mu g/kg$.

ND Denotes no 2,3,7,8-TCDD at a Detection Level of 0.1 $\mu g/kg$

LEGEND

X.X	SAMPLED AREA – NOT EXCAVATED
X.X	EXCAVATED AREA
	UNSAMPLED AREA – NOT EXCAVATED
-X	RESULT OF COMPOSITE SAMPLE ANALYSIS COMPRISING SUBJECT GRID

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DRAWN CAROLINO	9/14/90	
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TRACK "D"

	30				35				40					45						50					55					60
BA	ND	ND	ND	ND	ND	ND	ND	ND	11.9	3.6	50.4	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BB	ND	ND	ND	ND	ND	0.3	ND	ND	ND	1.1	ND	ND	ND	ND	ND	2.3	5.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BC									ND	0.6	ND				ND	2.7	3.1	ND	-.4											-.1
BD															-.1	0.3	6.7	1.1	-.3											-.2
BE																0.2	3	0.3	-.1											
BF																-.1	0.8	-.3												
BG																														
BH																														
BJ																														
BK																														
BL		3.1	-.3			2.4	1.2				-.3	0.8	0.7																	
BM	0.5	-.5			-.2	0.7	0.7				1	2.1	0.6	-.5																
BN	1.4	-.3			-.8	1.8	0.4				0.5	1.7	1.2	0.4																
BP	1.9	-.1	.06		-.3	1	-.3				-.5	1.4	0.7	0.2											-.5	0.8	0.3			
BR	6	0.8	-.01		-.5	1.5	0.4	0.4	-.1	-.4	0.4	2	1.8	0.5										-.1	0.6	1.2	-.5			
BS	5.8	1.2	-.3	-.3		1	0.3	1.5	-.1	-.4	1.3	4.8	3	0.9									-.1	-.8	5.5	3	0.4	-.1		
BT	8.8	5.3	-.3	0.4	1	ND	5.3	2	-.2	-.7	0.2	8.9	ND	ND	-.5								-.2	1.4	22	8.6	1	-.3		
BU	11.9	3.8	0.9	2	3.4	2.4	5.5	6.7	0.2	0.4	10.4	48.3	9.8	3.1	ND								ND	2.2	6.7	1.1	0.3	-.2		
BV	1.8	2.3	ND	1.0	1.5	83.7	22.8	5.9	ND	0.6	22.9	58.4	13.0	3.5	1.9	ND	ND	ND	ND	ND	ND	ND	ND	5.1	8.3	ND	ND	ND	ND	ND
BW	4.0	0.9	83.1	8.4	ND	ND	ND	ND	ND	ND	ND	57.1	37.5	5.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	87.[illegible]	187.9	ND	ND	ND	ND	ND	ND

HOLTMAN AVENUE 37 36 35 34 33 32

TRACK "C"

All Values of Concentrations of 2,3,7,8-TCDD in $\mu g/kg$.

ND Denotes no 2,3,7,8-TCDD at a Detection Level of 0.1 $\mu g/kg$

LEGEND

X.X	SAMPLED AREA - NOT EXCAVATED
X.X	EXCAVATED AREA
	UNSAMPLED AREA - NOT EXCAVATED
-X	RESULT OF COMPOSITE SAMPLE ANALYSIS COMPRISING SUBJECT GRID

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DRAWN CAROLINO	9/14/90	
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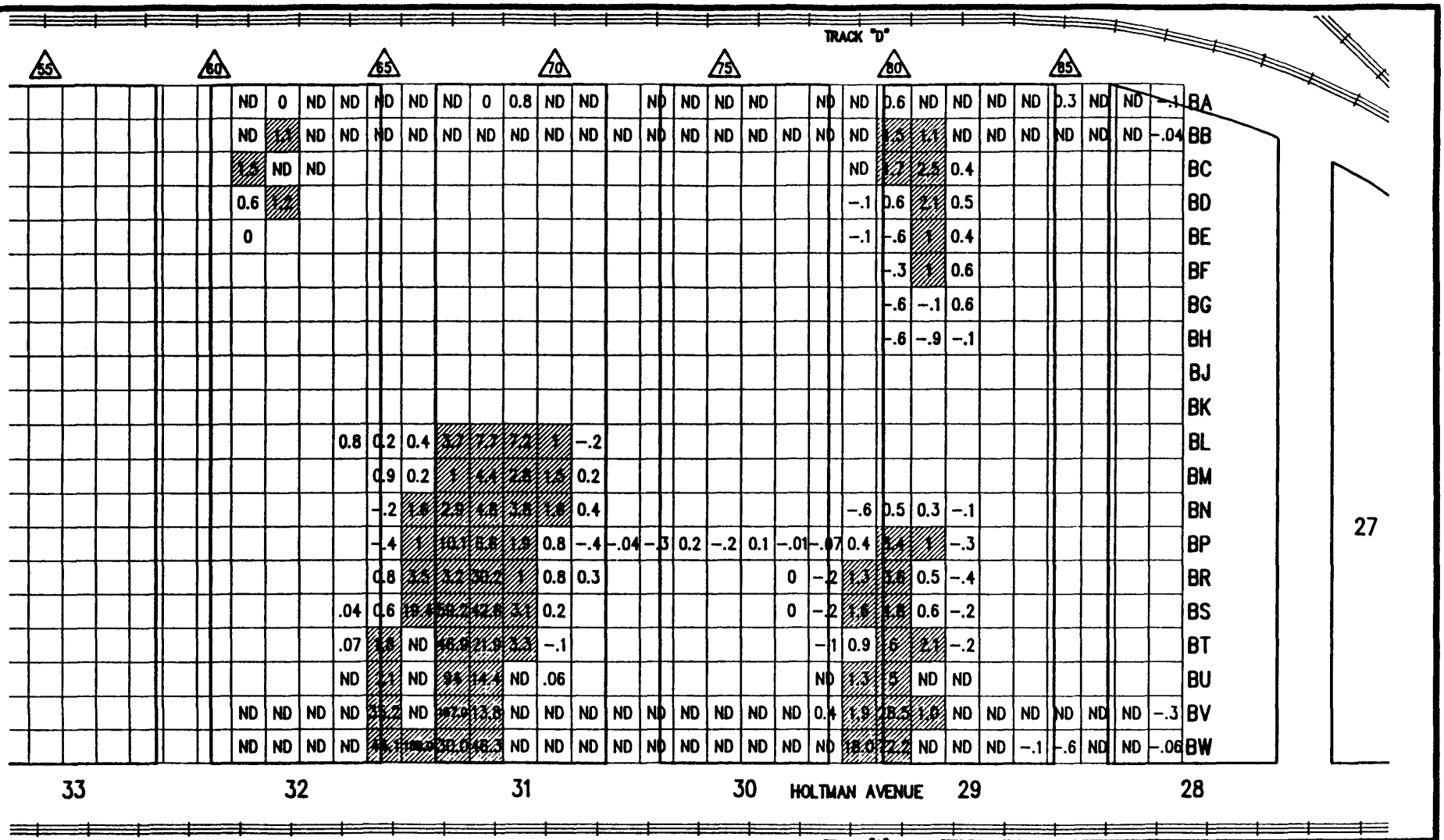

All Values of Concentrations of 2,3,7,8-TCDD in $\mu g/kg$.

ND Denotes no 2,3,7,8-TCDD at a Detection Level of 0.1 $\mu g/kg$

LEGEND

X.X	SAMPLED AREA - NOT EXCAVATED
X.X	EXCAVATED AREA
	UNSAMPLED AREA - NOT EXCAVATED
-X	RESULT OF COMPOSITE SAMPLE ANALYSIS COMPRISING SUBJECT GRID

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TRACK "C"

	5							10						15						20						25						30						35		
CA	0	ND	ND	ND	1.5	1.1	ND	0.9	1.2	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.7	ND	1.4	2.0	1.5	0.5	-.1	0.4	-.08			
CB	0	ND	ND	ND	0	ND	ND	1.7	ND	ND	4.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.7	40.8	95.1	0.7	11.2	0.7	1.4	ND	0.2	76.5	4.5	-.3			
CC							0.3	1.1	0.7	0.4	2.8	3.8	-.4											ND	ND	ND	1.2	0.9	ND	0.3	0.2	ND	1.1	125	2.5	-.4			
CD							0.5	1	1.2	0.7	0.9	1.1	-.3													0.4	ND	1.4	0.6			-.2	0.6	20.8	1.2	-.7			
CE							-.6	0.7	1.5	0.4	0.7	1.3	-.2														-.9	1	-.6				-.3	0.2	-.2	1.1			
CF								-.6	1.8	-.3	0.5	-.7	-.9														-.2	0.3	-.2				0.5	0.3	-.4	-.1			
CG								-.4	0.3	-.3																														
CH																																								
CJ																																								
CK																																								
CL																																								
CM																																								
CN																																								
CP																																								
CR																																								
CS																																								
CT																																								
CU																																								
CV																																								
CW																																								

LEE AVENUE 16 15 14 13 12 11

TRACK "B"

All Values of Concentrations of 2,3,7,8-TCDD in $\mu g/kg$.

ND Denotes no 2,3,7,8-TCDD at a Detection Level of 0.1 $\mu g/kg$

LEGEND

X.X	SAMPLED AREA - NOT EXCAVATED
X.X	EXCAVATED AREA
	UNSAMPLED AREA - NOT EXCAVATED
-X	RESULT OF COMPOSITE SAMPLE ANALYSIS COMPRISING SUBJECT GRID

NCBC GULFPORT

DESIGNED JUERGENS	DATE 8/10/90	FIGURE 1 SECTION C HERBICIDE STORAGE AREA PAST SAMPLING RESULTS
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Finally, there are fundamental differences in past operational and management practices between HSA B and C, and HSA A that have resulted in the development of two distinct sampling approaches. Specifically, HSA A currently contains ash from the incineration of 2,3,7,8-TCDD contaminated soil identified in previous remedial actions which are not the subject of this soil characterization study. Because of the presence of this ash, HSA A sampling is not amenable to configuration into contiguous plots as with HSA B and C. Instead, HSA A will be randomly sampled thus providing data needed to perform statistical confirmation that HSA A is the same population as HSA B and C. Additional sampling of all HSA A grids will be performed to identify areas for further remediation, if it is shown through interpretation of the HSA B and C data that the likelihood exists that HSA A contains areas of unacceptable risk.

3.0 APPLICABLE ACTION LEVELS

Within the context of the objectives of this sampling plan the term "applicable action level" has two distinct meanings. With regard to data collection activities addressed by this sampling and analysis plan, the action levels established relate to evaluating the degree to which the collected samples are representative of the contamination levels and their variabilities. In this instance the action levels will be used to compare plot composite samples to determine if additional analyses of the archived samples are required (i.e. which plot should undergo grid specific analyses). Additionally, the comparison of action levels to the results of plot composite samples will dictate which of the analytes are of concern. In this context the action levels established for soils are of relevant significance.

The action levels that will be used to evaluate the adequacy of the plot composite samples in identifying contamination levels and the criteria by which grid samples will be analyzed are presented on Table 1.

In the second context, action levels apply to remedial actions and the evaluation of the collected data to determine if remediation within certain plots is required in order to reduce health and environmental risks posed by the levels of contaminants as determined by the soil sampling and as evaluated by risk assessment. In this application, the ARARs or target action levels are for all chemicals, media, and exposure pathways found to be present, in order to establish appropriate remediation levels. Additionally, the remediation options can be evaluated to determine likely impacts to human health and the environment.

At this point in the investigation of NCBC soil contamination there are no data to substantiate the presence of any of the chemicals or compounds that are suspected to exist resultant from HO formulation or past storage and management practices on the site. Therefore, remediation has not been determined to be required. For this reason the development of chemical-specific and site-specific ARARs and risk assessment will be

TABLE 1-SOIL SAMPLING ACTION LEVELS
BASED ON APPLICABLE OR RELEVANT AND
APPROPRIATE REQUIREMENTS

CHEMICAL OR COMPOUND	ARAR (mg/kg)	REFERENCE
Arsenic	2.6	A
Barium	200	A
Chromium	50	A
Lead	10	A
Selenium	2.6	A, note 1
Benzo(a)anthracene	0.224	B
Benzo(a)pyrene	0.0609	B
Benzo(a)fluoranthene	0.0609	note 2
Chrysene	0.0609	note 2
Dibenzo(a,h)anthracene	0.0143	B
Fluroanthene	0.069	note 3
2,4-Dichlorophenoxyacetic acid	2	C, note 4
2,4,5-Trichlorophenoxyacetic acid	0.2	C, note 4
Chlorobenzene	2	C, note 4
2,4-Dichlorophenol	0.33	C, note 4
2,5-Dichlorophenol	0.33	C, note 4
Phenol	2	C, note 4
2,4,5-Trichlorophenol	2	C, note 4

References and Rationale

A) Element Concentrations in Soil and Surficial Materials of the Conterminous U.S., Hansford T, Shacklettle and Josephine G. Poernger, 1984.

note 1 Shacklettle and Poernger indicate the 5 mg/kg is typical background for Selenium. The action level was adjusted downward to 2.6 mg/kg assuming Selenium to have similar toxicity as Arsenic.
Since the proposed Selenium MCL is equal to the current MCL for Arsenic, the soil ARAR was assumed to be the same.

TABLE 1-SOIL SAMPLING ACTION LEVELS
References and Rationale-Continued

B) Interim Final, RCRA Facility Investigation (RFI) Guidance, Volume I of IV, Development of an RFI Work Plan and General Considerations For RCRA Facility Investigations, EPA 530/SW-89-031, May 1989 Waste Management Division, Office of Solid Waste, U.S. EPA Health-Based Criteria for Carcinogens-Table 8-6

note 2 Conservative Assumption tht all PAHs of coal tar are equal in potency to Benzo(a)pyrene. Ambient Water Quality Criteria for Polycyclic Aromatic Hydrocarbons, EPA-440/5-86-69, U.S. EPA, 1986

note 3 Conservative Assumption that Fluoranthene is equal in potency to Benzo(a)fluoranthene

C) Interim Final, RCRA Facility Investigation (RFI) Guidance, Volume I of IV, Development of an RFI Work Plan and General Considerations For RCRA Facility Investigations, EPA 530/SW-89-031, May 1989 Waste Management Division, Office of Solid Waste, U.S. EPA

note 4 Table 8-7, Health Based Criteria for Systemic Toxicants provided the following suggested ARARs for soil contamination:

	(mg/kg)
2,4-D	800
2,4,5-T	200
Chlorobenzene	2000
2,4-Dichlorophenol	200
Phenol	3000
2,4,5-Trichlorophenol	3000

These levels were deemed to be inconsistent with PAH levels listed and therefore adjusted to more stringent levels by similar factors as determined by the ratio of published MCLs and soil ARARs for those PAHs having soil ARARs.
In the cases of 2,4- and 2,5-Dichorophenol the action levels are established at method detection limits.

conducted subsequent to the identification of chemicals and compounds as a result of the sampling and analysis being conducted.

The action levels for the metals being investigated are based on published background levels of naturally occurring soils within the United States. The selenium action level was adjusted downward to 2.6 mg/kg to equal that of arsenic since the proposed MCL and toxicity are similar to arsenic.

The action levels for PAHs are generally based on human health-based criteria of systemic toxicants. These criteria are calculated from Reference Doses (RfDs), and are estimates of the daily exposure an individual (including sensitive individuals) can experience without appreciable risk of health effects during a lifetime. The levels presented represent an estimate of soil ingestion assuming an intake rate of 0.2 grams/day and is based on a 5-year exposure period for a 16-kg child. Since the NCBC is generally restricted in access to children, this estimate is considered conservative. In the cases of benzo(a)fluoranthene, fluoranthene, and chrysene where no published information was found, potency was assumed to be equal to that of benzo(a)pyrene.

The action levels for the herbicides and the target degradation compounds are based on analogy to other PAHs where MCLs and soil ARAR ratios were determined. These criteria have been extrapolated from ratios between maximum concentration limits (MCLs) and soil ARARs that have been established for the PAHs. Action levels for 2,4- and 2,5-dichlorophenol have been set at method detection limits.

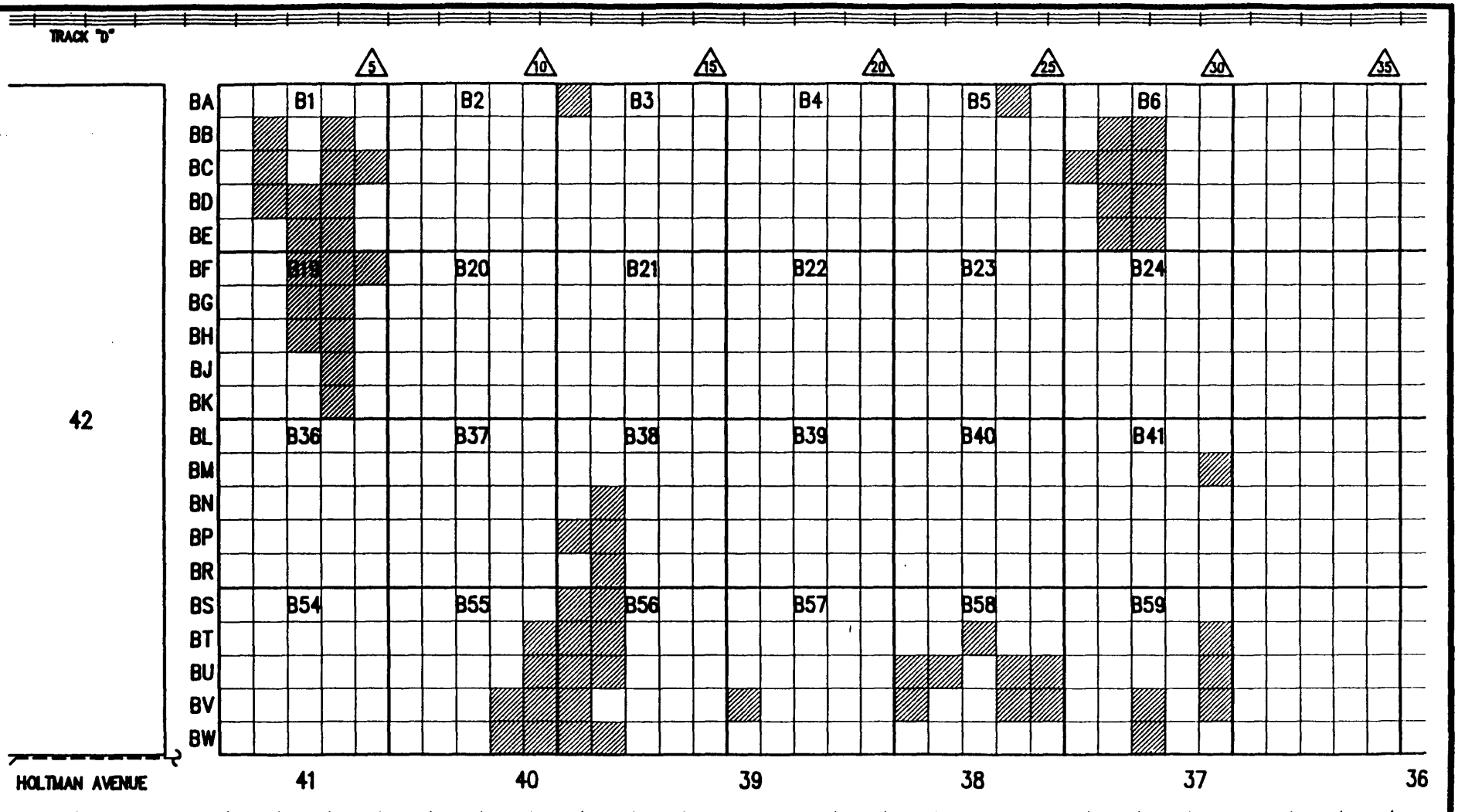
4.0 SAMPLING LOCATIONS

4.1 Area B and C Sampling Location Selection

The specific locations within HSA areas and B and C that will be sampled for characterization of HO constituent and degradation products have been established by designating sample plots generally encompassing 25 previously defined 20 foot by 20 foot grids. (In some instances site geometry necessitated plots of greater or lesser numbers of grids). Sample plots have been delineated and are depicted in Figure 2.

The sampling strategy relies on using the previous demarcation of the HSA's into 20 foot by 20 foot grid areas since (1) the existence of markings for these grids precludes any further extensive surveying efforts, and (2) it has been demonstrated that 20 foot by 20 foot areas can reasonably be excavated as discrete units should further excavation prove necessary.

For the purposes of sampling it is assumed that previous excavation conducted has reduced HO constituent levels, therefore excavated and non-excavated areas are assumed to be separate populations. As such, samples from each grid type (i.e. excavated and



LEGEND

GRIDS TO BE INCLUDED IN COMPOSITE SAMPLE TO CHARACTERIZE NON-EXCAVATED AREAS

GRIDS TO BE INCLUDED IN COMPOSITE SAMPLE TO CHARACTERIZE EXCAVATED AREAS

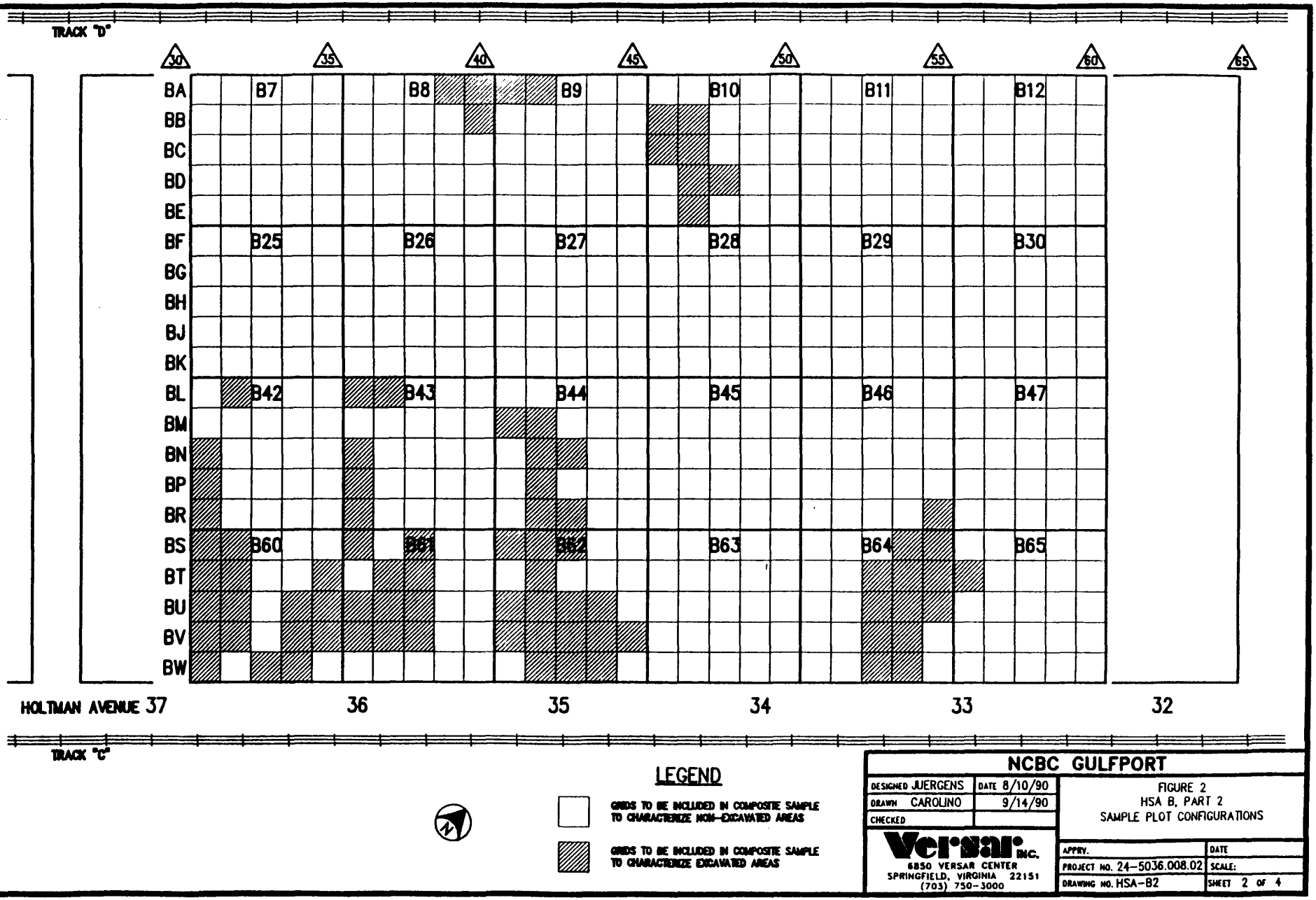
NCBC GULFPORT

DESIGNED JUERGENS	DATE 8/10/90	FIGURE 2 HSA 8, PART 1 SAMPLE PLOT CONFIGURATIONS
DRAWN CAROLINO	9/14/90	
CHECKED		

Versar INC.
6850 VERSAR CENTER
SPRINGFIELD, VIRGINIA 22151
(703) 750-3000

APPRV.	DATE
PROJECT NO. 24-5036.008.02	SCALE:
DRAWING NO. HSA-81	SHEET 1 OF 4

DRAWING: D:\241\5036\008.02\HSA-81.DWG PROJECT#: 24-5036.008.02


TRACK "D"
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BJ
BK
BL
BM
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B45
B46
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B61
B62
B63
B64
B65
HOLTMAN AVENUE 37
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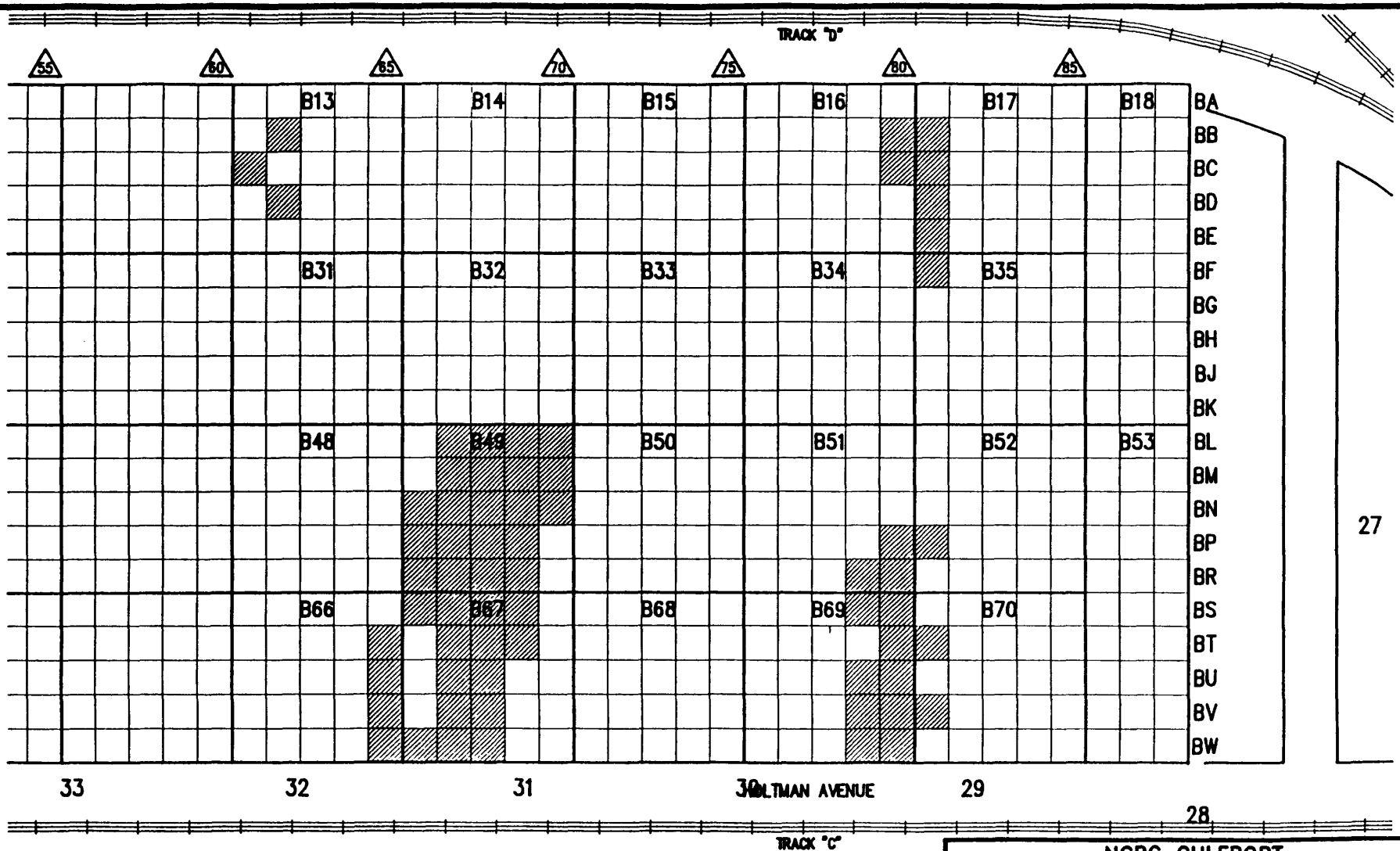
32
TRACK "C"
LEGEND
GRIDS TO BE INCLUDED IN COMPOSITE SAMPLE TO CHARACTERIZE NON-EXCAVATED AREAS
GRIDS TO BE INCLUDED IN COMPOSITE SAMPLE TO CHARACTERIZE EXCAVATED AREAS
NCBC GULFPORT
DESIGNED JUERGENS
DATE 8/10/90
DRAWN CAROLINO
9/14/90
CHECKED
Versar INC.
6850 VERSAR CENTER
SPRINGFIELD, VIRGINIA 22151
(703) 750-3000
FIGURE 2
HSA B, PART 2
SAMPLE PLOT CONFIGURATIONS
APPRV.
DATE
PROJECT NO. 24-5036.008.02
SCALE:
DRAWING NO. HSA-B2
SHEET 2 OF 4



LEGEND

GRIDS TO BE INCLUDED IN COMPOSITE SAMPLE TO CHARACTERIZE NON-EXCAVATED AREAS

GRIDS TO BE INCLUDED IN COMPOSITE SAMPLE TO CHARACTERIZE EXCAVATED AREAS

NCBC GULFPORT

DESIGNED JUERGENS	DATE 8/10/90	FIGURE 2 HSA B, PART3 SAMPLE PLOT CONFIGURATIONS
DRAWN CAROLINO	9/14/90	
CHECKED		

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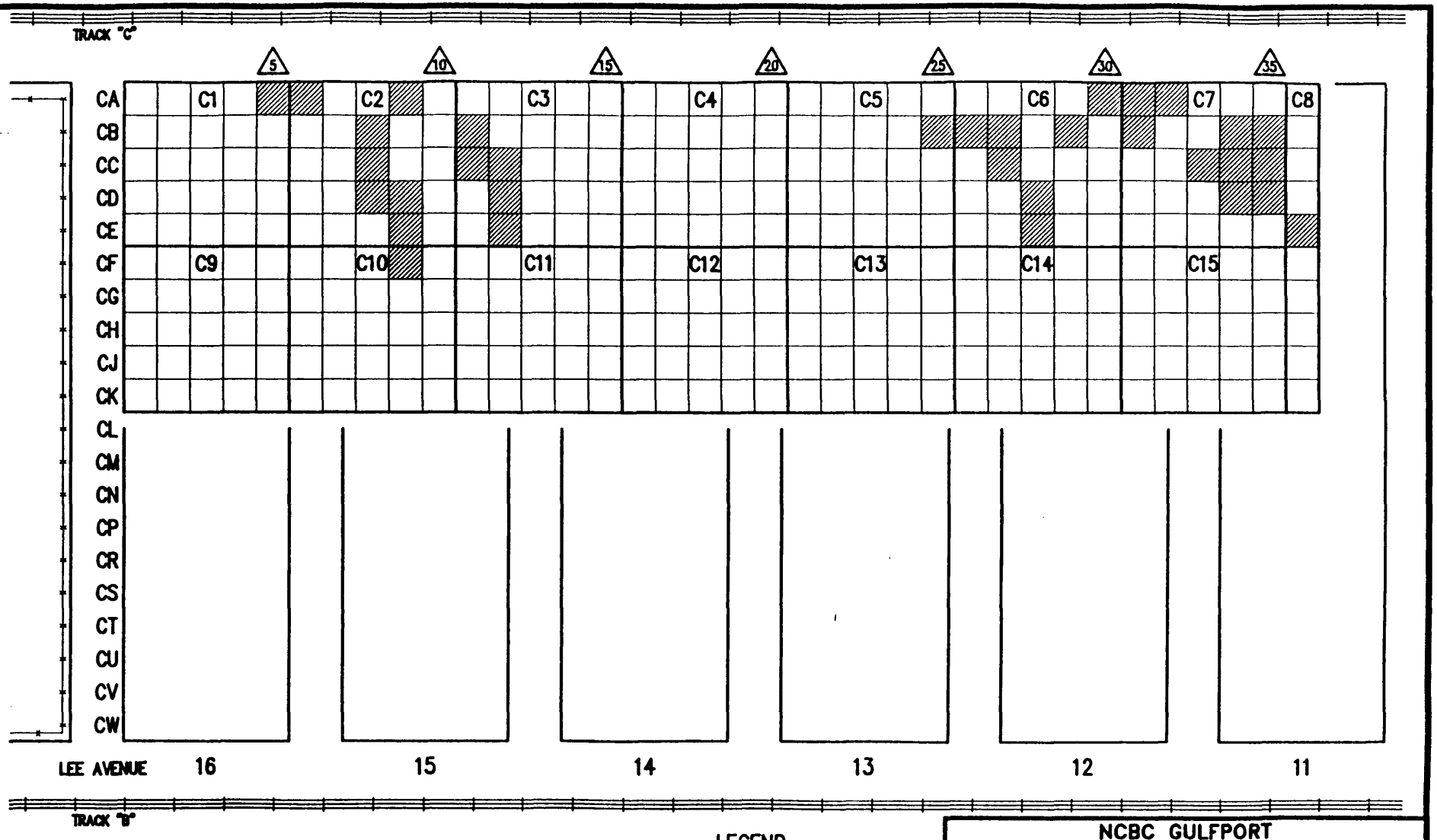
APPRV.	DATE
PROJECT NO. 24-5036.008.02	SCALE:
DRAWING NO. HSA-B3	SHEET 3 OF 4

DRAWING: D:\24\5036\008.02\HSA-B3.DWG PROJECT#: 24-5036.008.02



LEGEND

GRIDS TO BE INCLUDED IN COMPOSITE SAMPLE TO CHARACTERIZE NON-EXCAVATED AREAS

GRIDS TO BE INCLUDED IN COMPOSITE SAMPLE TO CHARACTERIZE EXCAVATED AREAS

NCBC GULFPORT

DESIGNED JUERGENS	DATE 8/10/90	FIGURE 2 HSA C SAMPLE PLOT CONFIGURATIONS
DRAWN CAROLINO	9/14/90	
CHECKED		

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(703) 750-3000

APPRV.	DATE
PROJECT NO. 24-5036.008.02	SCALE:
DRAWING NO. HSA-C	SHEET 4 OF 4

DRAWING: D:\24\5036\008.02\HSA-C.DWG PROJECT #: 24-5036.008.02

non-excavated) will be kept separate so that where both types of grids exist within a sample plot two composite samples will be obtained. Previously unsampled areas will be included within the non-excavated composite samples. Areas which can be documented as having been backfilled with offsite soils will be excluded from sampling. The specific grids within each of the delineated plots and the total number of each sample type (excavated, non-excavated) that will be obtained from each of the plots are listed in Table 2. Subsequent statistical analyses will be performed to determine if there is any significant difference between excavated and non-excavated areas.

4.2 Area A Sampling Location Selection

Area A sampling location selection deviates from the strategy developed for Areas B and C since treated soil (i.e. incinerator ash), which has been fully characterized as part of the delisting effort and therefore is not being characterized in this investigation, was deposited on excavated grids within the HSA. Instead non-excavated grids within Area A will be characterized by a random sampling strategy that specifies the appropriate number of samples as determined by comparison of the variance of the analytes with action levels of Area B and C data using the equation:

$$n = (t^2) \frac{0.20s^2}{R.T.-X}$$

Where:

n = The number of samples
t = Students t value for the appropriate degrees of freedom
s = The variance of the sample
R.T. = Regulatory threshold, or in this application the clean up criteria as determined by ARAR's or risk modeling
X = The mean of the measurements generated by sample

These samples will be analyzed as separate discrete samples to establish the mean concentration and variances of each of the constituents of concern.

TABLE 2-SAMPLE PLOT COMPOSITE SAMPLE SUMMARY

PLOT IDENTIFIER	TOTAL GRIDS IN COMPOSITE SAMPLE				TOTAL NUMBER OF GRIDS IN PLOT
	NON-EXCAVATED	NOT PREV. SAMPLED	TOTAL	EXCAVATED	
B1	15	0	15	10	25
B2	13	12	25	0	25
B3	9	15	24	1	25
B4	10	15	25	0	25
B5	12	12	24	1	25
B6	13	3	16	9	25
B7	10	15	25	0	25
B8	9	13	22	3	25
B9	11	12	23	2	25
B10	15	3	18	7	25
B11	10	15	25	0	25
B12	12	13	25	0	25
B13	13	9	22	3	25
B14	10	15	25	0	25
B15	9	16	25	0	25
B16	13	10	23	2	25
B17	12	9	21	4	25
B18	6	24	30	0	30
B19	10	6	16	9	25
B20	4	21	25	0	25
B21	0	25	25	0	25
B22	0	25	25	0	25
B23	0	25	25	0	25
B24	4	21	25	0	25
B25	0	25	25	0	25
B26	0	25	25	0	25
B27	0	25	25	0	25
B28	3	22	25	0	25
B29	0	25	25	0	25
B30	0	25	25	0	25
B31	0	25	25	0	25
B32	0	25	25	0	25
B33	0	25	25	0	25
B34	3	22	25	0	25
B35	5	19	24	1	25
B36	0	25	25	0	25
B37	3	22	25	0	25
B38	11	10	21	4	25
B39	0	25	25	0	25
B40	0	25	25	0	25
B41	9	15	24	1	25
B42	12	9	21	4	25
B43	8	12	20	5	25
B44	12	6	18	7	25
B45	0	25	25	0	25
B46	4	20	24	1	25
B47	2	23	25	0	25

TABLE 2-SAMPLE PLOT COMPOSITE SAMPLE SUMMARY

PLOT IDENTIFIER	TOTAL GRIDS IN COMPOSITE SAMPLE				TOTAL NUMBER OF GRIDS IN PLOT
	NON-EXCAVATED	NOT PREV. SAMPLED	TOTAL	EXCAVATED	
B48	6	19	25	0	25
B49	4	0	4	21	25
B50	9	16	25	0	25
B51	8	14	22	3	25
B52	5	19	24	1	25
B53	6	24	30	0	30
B54	10	15	25	0	25
B55	10	9	19	6	25
B56	10	6	16	9	25
B57	10	13	23	1	24
B58	17	0	17	8	25
B59	15	5	20	5	25
B60	9	0	9	16	25
B61	15	0	15	10	25
B62	9	0	9	16	25
B63	10	15	25	0	25
B64	10	3	13	12	25
B65	15	9	24	1	25
B66	12	9	21	4	25
B67	11	0	11	14	25
B68	10	15	25	0	25
B69	11	5	16	9	25
B70	14	9	23	2	25
C1	9	15	24	1	25
C2	15	3	18	7	25
C3	14	6	20	5	25
C4	10	15	25	0	25
C5	11	13	24	1	25
C6	15	3	18	7	25
C7	12	3	15	10	25
C8	5	4	9	1	10
C9	0	25	25	0	25
C10	5	19	24	1	25
C11	3	22	25	0	25
C12	0	25	25	0	25
C13	0	25	25	0	25
C14	3	22	25	0	25
C15	3	22	25	0	25
NO. OF GRID SAMPLES			1874	245	
NO. OF PLOT SAMPLES			85	43	

5.0 SAMPLING PROCEDURES

5.1 Sampling Devices

To loosen and partially crush the cement stabilized surface soils, an impact drill head will be used to power a carbon steel drill bit. This device will be used to loosen an area of approximately 10 inches in diameter and 6 inches in depth from each of the designated sampling locations. The impact drill will be powered by portable generator that will remain outside the sampling areas and generally kept downwind of the sampling activity. In areas previously excavated, or in cases where the soil is sufficiently loose, the use of the drill will not be required.

5.2 Compositing Procedure

Once the soil has been sufficiently processed by the drill, or otherwise loosened, disposable plastic scoops will be used to remove the soil from the hole. The material willbe placed into a stainless steel bowl or foil lined aluminum tray. The material contained in the bowl or tray will be homogenized by mixing with a teflon scoop. A portion of the sample will be placed into a 250 milliliter glass beaker to a predetermined mark so that all composite aliquots will be of equal volume. The remaining sample from each grid (composite aliquot) will be placed into an 8 ounce wide mouth glass container for archiving. A second beaker volume will be placed into a sixteen ounce wide mouth glass container as part of the composite sample. Figure 3 illustrates the sample collection and processing strategy to be employed during this investigation. Sample containers will be commercially pre-cleaned in accordance with recognized EPA cleaning procedures. (Containers will be obtained from ICHEM or similar commercial supplier having a cleaning and QA/QC program). Sample containers will either be amber glass or will be immediately protected from direct sunlight upon filling to prevent the effects of photodegradation.

5.3 Sample Identification

Composite samples will be identified by composite plot identification number HSA letter designation, and the word "YES" to indicate that the sample came from previously excavated grids, or the word "NO" to indicate that the sample came from non-excavated grids. Discrete samples will be identified by the grid number, plot number, HSA letter designation, and the same "YES" or "NO" identification to indicate excavated or non-excavated status. Additionally all sample labels will list the sampling date, sampling time, and initials of the sampling personnel. Sample label configurations are shown in Figure 4.

FIGURE 3-SAMPLE COLLECTION AND PROCESSING

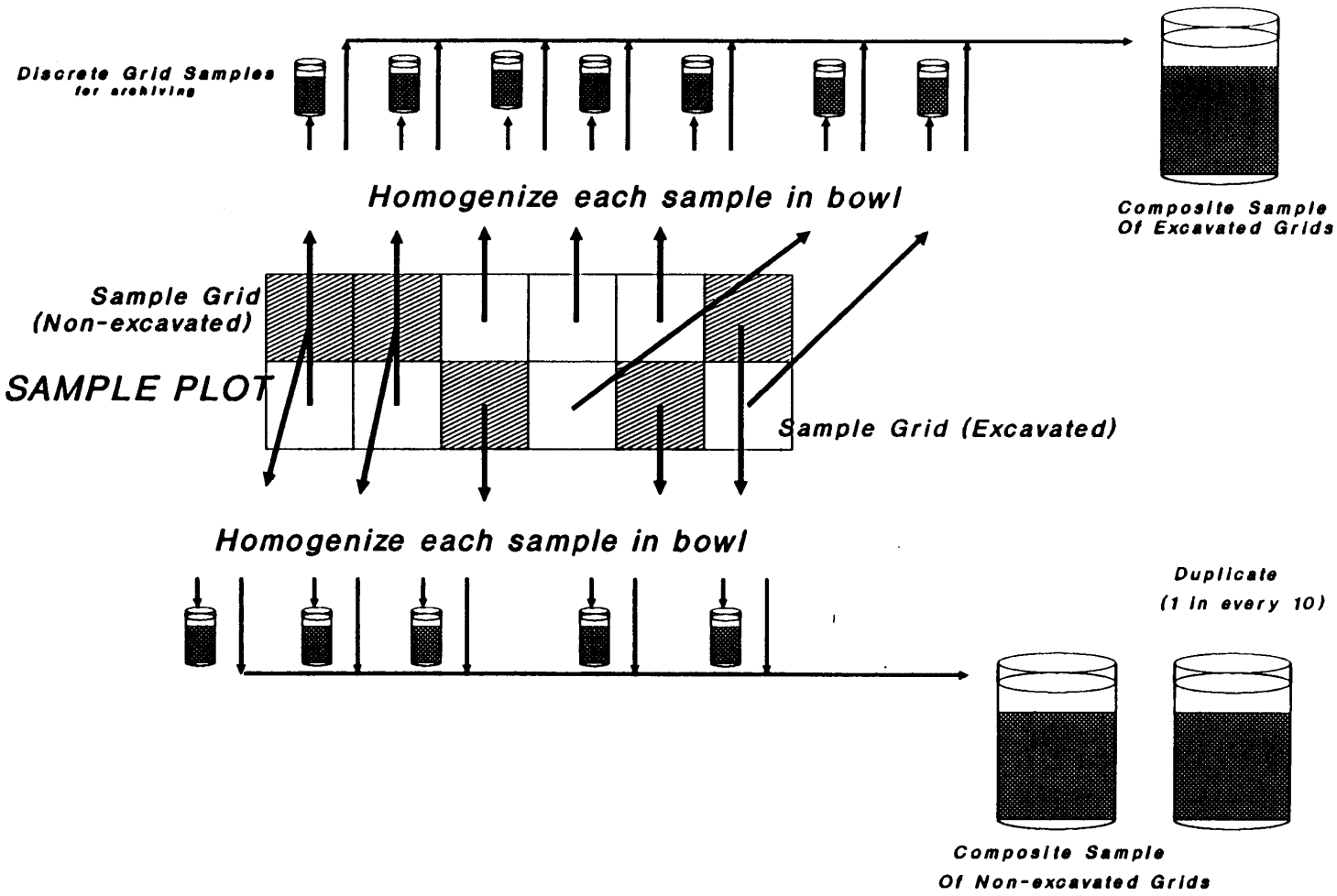


FIGURE 4-SOIL SAMPLE LABEL FORMAT

NCBC SOIL SAMPLE

PLOT LOCATION B1

HSA HSA B

EXCAVATED AREA YES (NO)

SAMPLE TIME 1320

SAMPLE DATE 08-29-90

SAMPLER EDJ

COMMENTS Composite of BB2,4

BC2,4,5,BD2,3,4,,BE3,4,

COMPOSITE SAMPLE LABEL (PLOT)

NCBC SOIL SAMPLE

GRID LOCATION BB2

HSA HSA B

EXCAVATED AREA YES (NO)

SAMPLE TIME 1320

SAMPLE DATE 08-29-90

SAMPLER EDJ

COMMENTS

DISCRETE SAMPLE LABEL (GRID)

5.4 Sample Preservation

No specific measures are required to preserve the soil except protection from direct sunlight immediately upon collection. Archived samples will be boxed and stored in a cool, dry location until final disposition.

5.5 Sample Shipment

All samples will be considered to be hazardous materials for purposes of packaging and labeling for transport to the selected analytical laboratories. Each glass sample container closure will be secured with tape and placed in an appropriately sized paint can with cushioning material to ensure against breakage. Each paint can will be placed in a DOT approved corrugated box (12D type). The box will be labeled to indicate the sender and receiving laboratory. Additionally the box will display the DOT identification "NA1988-Hazardous Solid, N.O.S." on two adjacent sides of the box.

5.6 Chain-of-Custody Procedures

An accurate chain-of-custody will be maintained to trace the possession of each sample from the moment of collection through its introduction into the laboratory, where internal chain-of-custody procedures will be followed. A sample will be considered in custody if any one of the following requirements is met:

- It is in the actual physical possession of the sampling personnel of laboratory analyst.
- It is in view of the sampling personnel or analyst.
- It was in the physical possession of the sampling personnel or analyst, and he/she locked it up so as to prevent tampering.
- The sample is kept in a secured area which is restricted to authorized personnel only.
- The sample is placed in a container and then sealed with a "custody" seal that must be broken when the container is opened.

Sample custody will be initiated at the time of sample collection by fixing a numbered custody seal to each sample taken, or by placing the sample in a locked container or in a container that is then sealed with a custody seal. The field chain-of-custody form will be filled out and signed by the person collecting the sample or by a single individual assigned to document and log each sample. It will be the responsibility of the individual who collected the

sample to ensure that the sample and sample description forms are in custody (locked or properly sealed to prevent tampering) and that all descriptive information is accurate and complete. Each individual who subsequently signs the field custody form has a similar responsibility until the samples are received at the laboratory.

5.7 Field Quality Assurance/Quality Control Procedures

5.7.1 Field QA/QC Samples

Field duplicate samples of both excavated and non-excavated grids will be generated at a frequency of one in every ten plot composite samples. To prepare these duplicates approximately twice the sample volume from each grid within the plot composite sample will be collected. The resulting grid samples will then be measured using a graduated beaker and equal amounts from each grid will be placed into two separate composite sample containers. If archived discrete sample analyses are warranted, duplicate samples will be prepared by repackaging one in every ten samples into additional sample containers.

Blanks will also be generated to determine if any devices used in sampling contribute to contamination. On a daily basis, a disposable scoop will be randomly selected and rinsed in double distilled water. The rinse water will be collected and submitted for analysis.
If a drill is required to loosen soil, the drill bit will be similarly rinsed at a frequency of one in ten uses. This rinsate will also be submitted for analysis.

5.7.2 Field Contamination Reduction Procedures

To prevent cross contamination of samples the following procedures will be followed:

a. Within each plot area collect samples from grids in sequence, first sampling all excavated areas, followed by all non-excavated areas. If disposable sampling devices are used, a new device will be used for each sample.

b. Between the collection of each grid sample the drill bit, trowel, and other non-disposable devices contacting the soil will be decontaminated or replaced by previously decontaminated devices.
Decontamination will consist of sequentially removing surface soil by dry wiping, water wash, water rinse and hexane rinse. Devices will be allowed to thoroughly air dry prior to re-use. Aluminum foil on the trays will be replaced after each sample.

5.7.3 Management of Field Generated Waste

Solid wastes such as tyvek suits, respirator cartridges, and sampling scoops will be contained in fiber drums and will be appropriately disposed on completion of field activities. Review of soil data will be used as the basis for designating appropriate disposal.

5.7.4 Field Documentation

Each grid within a plot area will be confirmed by entering into a log book, every individual grid sample identification number that forms each individual composite plot sample.

Archived samples will be placed in boxes in a manner corresponding to the plot areas from which they were collected. The outside of each box will be identified by plot number and will list each individual sample that it contains.

6.0 HEALTH AND SAFETY CONSIDERATIONS

During the conduct of the sampling in all HSA's sampling personnel can potentially be exposed to any residual contamination. As all contaminants of concern pose certain health risks the sampling personnel will be required to adhere to health and safety procedures specified in the Health and Safety Plan (Appendix A) to minimize personal exposure and to reduce the potential for migration of any contaminants to clean areas on the site. The levels of protection for soil sampling activities (as well as groundwater well installation and sampling activities) are specified in the Health and Safety Plan (Appendix A). As well as adhering to the specified procedures, all personnel involved in sampling will be required to have met the training requirements for hazardous site workers and emergency responders as required by 40 CFR 1910.120.

The site has been divided into three zones of hazard classifications for personnel protection management control purposes:

6.1 Exclusion Zones

Those areas that have been shown to contain measurable levels, where past practices would indicated potential contamination, or areas where contamination was likely to migrate, will be managed as exclusion zones. These areas are defined as follows:

- The area bounded by Greenwood Avenue on the east, Goodier Avenue on the west, the North Main track on the north, and the South Main track onthe south. This area is referred to in the sampling plan as HSA A.

- The area bounded by Holtman Avenue on the east, Greenwood Avenue on the west, the North Main track on the north, and the plat numbered 43 on the south. This area is referred to in the sampling plan as HSA B.

- The area abounded by Lee Avenue on the east, Holtman Avenue on the west, the North Main track on the north, and the South Main track on the south.

6.2 Transition Zones

Those areas that have been demonstrated to be minimally contaminated and those areas where past practices would indicated only minimal contaminant migration may have occurred will be managed as transition zones.

These areas will include:

- All paved roadways onsite;

- All areas in any contamination reduction areas;

- All other areas that may be designated transition by the site Health and Safety Officer.

6.3 Clean Zones

Those areas onsite that have been demonstrated to be free of contamination, those areas onsite whose distance and direction from known or suspected contaminated areas that would indicate no contamination, and all offsite areas will be managed as clean zones.

These areas include:

- Onsite office trailers;

- All onsite areas not otherwise characterized as either exclusion or transition zones.

7.0 SAMPLE ANALYSIS

All analytical procedures that will be conducted will adhere to specific methodologies, including method specific QA/QC procedures as outlined in the methods referenced on Table 3. Table 3 also lists target detection limits which have been established to reflect the detection limits that were routinely achievable on ash samples during sampling and analyses

TABLE 3-ANALYTICAL METHODS AND TARGET DETECTION LIMITS
SOIL CHARACTERIZATION SAMPLING AND ANALYSIS-NCBC GULFPORT

CLASS	ANALYTE	ANALYTICAL METHOD	REFERENCE	DETECTION LIMIT ug/kg (ppb)
METALS				
	Arsenic	CLP	1	200
	Barium	CLP	1	400
	Chromium	CLP	1	2000
	Lead	CLP	1	200
	Selenium	CLP	1	200
POLYNUCLEAR AROMATIC HYDROCARBONS				
	Benzo(a)anthracene	8310	3	2.0
	Benzo(a)pyrene	8310	3	2.0
	Benzo(a)fluoranthene	8310	3	2.0
	Chrysene	8310	3	1.0
	Dibenzo(a,h)anthracene	8310	3	1.0
	Fluoranthene	8310	3	2.0
HERBICIDES				
	2,4-Dichlorophenoxyacetic Acid (2,4-D), salts and esters	8150	3	1.0
	2,4,5-Trichlorophenoxyacetic Acid (2,4,5-T), salts and esters	8150	3	2.0
POTENTIAL DEGRADATION PRODUCTS				
	Chlorobenzene	8240/CLP	4	330
	2,4-Dichlorophenol	8270/CLP	2	330
	2,5-Dichlorophenol	8270/CLP	4	330
	Phenol	8270/CLP	2	330
	2,4,5-Trichlorophenol	8270/CLP	4	330
MISCELLANEOUS				
	Total Organic Carbon	9060	3	

TABLE 3-ANALYTICAL METHODS AND TARGET DETECTION LIMITS
SOIL CHARACTERIZATION SAMPLING AND ANALYSIS-NCBC GULFPORT

REFERENCES

(1) U.S. Environmental Protection Agency (EPA), 1987, "Chemical Analytical Services for Multi-Media Multi-Concentration Metals and Inorganics", Statement of Work 7/88, WA-87-K026, U.S. EPA Washington, D.C.

(2) U.S. Environmental Protection Agency (EPA), 1987, "Chemical Analytical Services for Multi-Media Multi-Concentration Organics, GC/MS Techniques", Statement of Work 7/88, WA-87-K236, U.S. EPA Washington, D.C.

(3) U.S. Environmental Protection Agency (EPA) November 1986, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", SW-846, Revised Third Edition

(4) These compounds are not a part of the CLP list. The method will include Reference 2 protocol with modifications from Reference 3.

(5) U.S. Environmental Protection Agency (EPA), 1986, "Dioxin Analysis, Soil Sediment and Water Matrices Multi-Concentration, Selected Ion Monitoring (SIM) GC/MS Analysis", Statement of Work 9/86, WA-86-K357, U.S. EPA, Washington, D.C.

for the delisting effort. It is anticipated that these detection limits can be achieved in soil matrix samples during this investigation.

The methods specified include Contract Laboratory Program procedures that are inclusive of RCRA SW-846 analytical procedures and instrument operating conditions and include contract specified data quality objectives and specific corrective action procedures. If a non-CLP laboratory is contracted to conduct the specified analysis, that laboratory must demonstrate that a comparable internal QA/QC system exists and will be followed. This demonstration will include the existence of a formal QA/QC program document, demonstration of the successful participation in a recent EPA audit, and current and active participation in an EPA sponsored performance sample analysis program.

7.1 Data Precision and Accuracy

Precision is defined as the measure of mutual agreement among individual measurements of the same property, usually secured under the same conditions. Field and laboratory precision will be expressed as relative percent difference (RPD).

$$RPD = \frac{X1-X2}{(X1+X2)/2} \times 100$$

Where:

RPD = Relative percent difference between duplicate analyses
X1 and X2 = Results of duplicate analyses
X1-X2 = Absolute difference between duplicates X1 and X2

Accuracy is defined as the degree to which the analytical measurement reflects the true level present. Accuracy will be expressed as percent recovery for matrix and surrogate spikes.

$$\frac{X-B}{T} \times 100$$

Where:

X = Measured concentration in sample after spiking
B = Background concentration in the sample
T = concentration of spike added

The quality assurance objectives for this investigation are defined by precision and accuracy as presented for each method as included in Appendix B. It should be noted that all methods caveat matrix interference as a bases for not achieving data objectives.

7.2 Data Comparability

Comparability is a measure of the confidence with which one data set can be compared to another. The following measures will be taken to ensure the comparability of the data.

- Standardized written sampling and analysis procedures will be followed for all tasks.
- Standardized written field measurement and instrument calibration procedures will be followed for all tasks.
- Standard handling and shipping procedures will be used for all samples collected.
- A uniform supply of sample containers will be used.
- Results will be reported in consistent units.

7.3 Data Representativeness

Representativeness is considered an objective to be achieved, rather than a characteristic which can be described in quantitative terms. Representativeness is the degree to which the data accurately and precisely represent the characteristics of the site that is being investigated. First, the field measurements and analytical results must adequately characterize the sample that was analyzed, and second, the collected samples must adequately characterize the site that was being investigated. The sample collection and analysis procedures will ensure that the data collected is representative of the site.

7.4 Data Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount of data that was collected. The validity of the data is assessed using the quality control quality criteria as specified by the referenced methods. Data meeting these criteria are considered to be valid. The goal for completeness for this particular project is highly dependent upon meeting the statistical analysis objectives and therefore cannot be quantitatively be established. In general however, the goal for completeness is greater than 95 per cent. The goal for completeness will be assessed for each parameter in the following manner.

$$C = \frac{V}{D} \times 100$$

Where:

C = The percentage of valid data for each parameter
V = The number of valid results for each parameter
D = The number of samples collected for each parameter

8.0 DATA ANALYSIS

Data analysis procedures are designated to achieve several objectives. First, ANOVA analysis will be performed on the two populations of data generated from the analyses of excavated area and non-excavated plot composite samples to determine if there is a significant difference in populations. Secondly, the analysis of the variances observed in either the combined data sets (i.e. excavated and non-excavated) or the separate data sets (if a significant difference exists) as compared to the action levels will establish the number of samples that will be required to be collected from Area A to accurately characterize any soil contamination which may be present. Thirdly, data from the analysis of random samples collected from HSA A will be compared to HSA B and C composite samples to determine if they can be considered the same population. Fourthly, the data will be compared to the soil ARAR's or target action levels to a defined level of confidence. As described in chapter nine of Test Methods for Evaluating Solid Waste, SW-846, EPA, 1986, a confidence interval of 80% has been selected for purposes of evaluation solid waste. Finally, if discrete sample analyses are required because sample plot analyses indicate exceedance of the action level, regression analysis will be performed to determine if a relationship exists between previously obtained surface sample 2,3,7,8-TCDD concentrations and HO constituent concentrations. Figure 5 delineates the steps and decisions that will be incorporated into the data analysis process.

8.1 Excavated Versus Non-Excavated Comparison

The soil characterization data will be statistically evaluated using analysis of variance (ANOVA) to determine if the excavated and non-excavated areas are statistically similar (i.e. are the same population). If the evaluation indicates that the populations are the same then all subsequent risk analyses will be performed on the combined data sets. If the evaluation indicates a statistical difference between excavated and non-excavated areas, separate risk analyses will be performed. In this manner the effectiveness of prior remedial actions (i.e. excavation in increments of three inches) can be evaluated against risk reduction criteria, and the non-excavated area contaminant levels can be assessed on the basis of the risks that they pose. This evaluation will also be used to determine if additional excavation will be effective in reducing the risk associated with the areas that have contaminant levels above the

FIGURE 5 - LOGIC FLOW DIAGRAM FOR SOIL DATA ANALYSIS

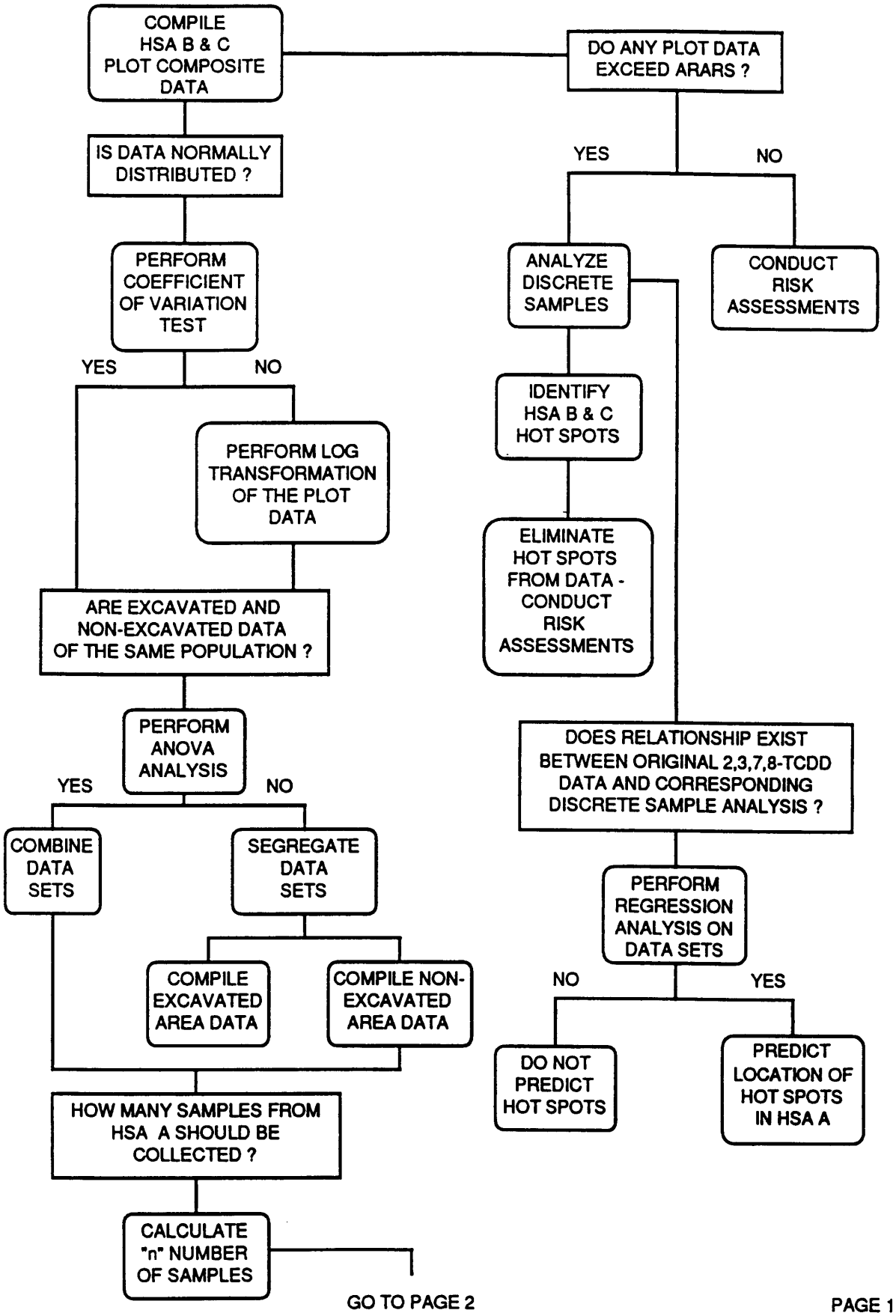
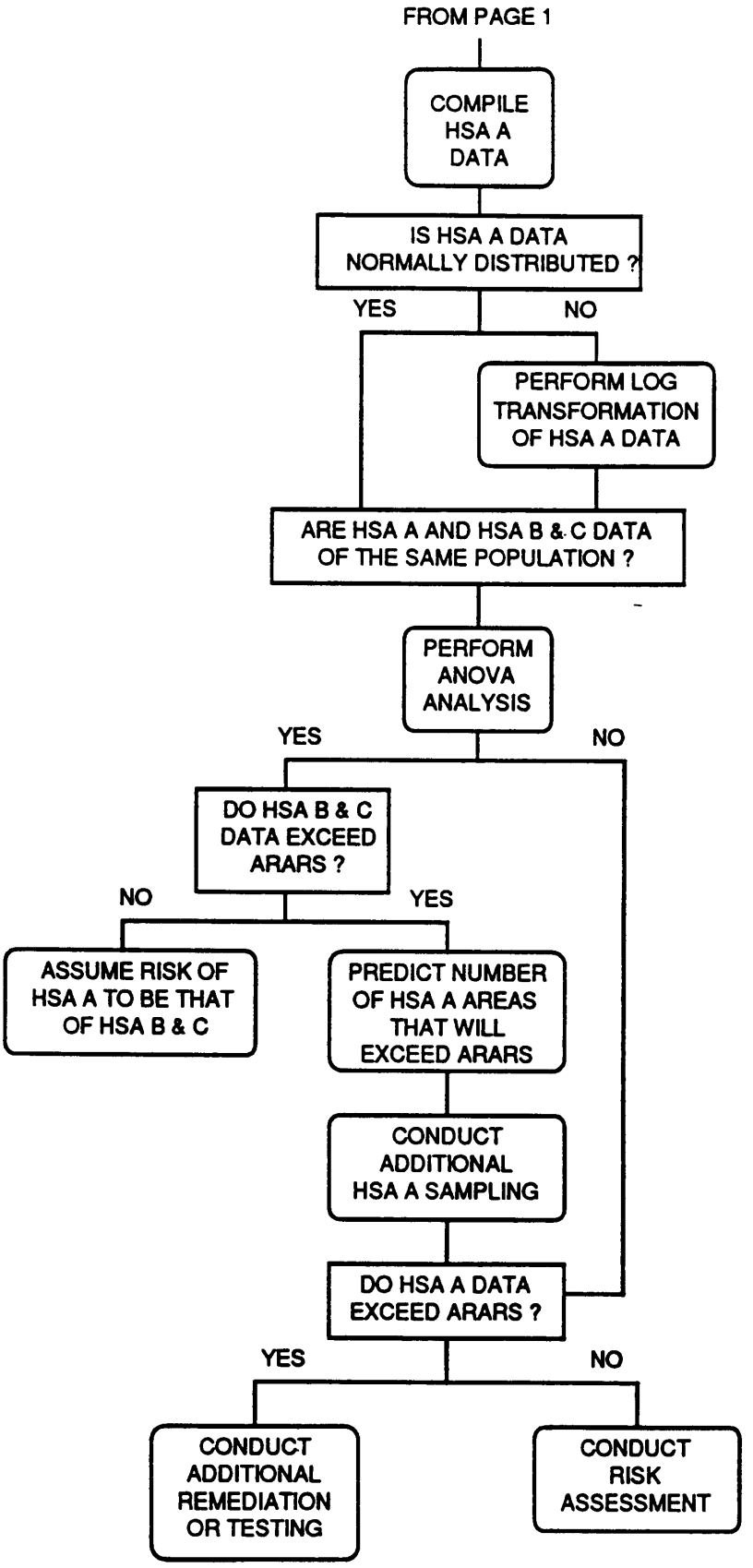


FIGURE 5 - LOGIC FLOW DIAGRAM FOR SOIL DATA ANALYSIS (CONTINUED)



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ARAR's or target action levels. The premise of this evaluation is that despite natural variations in HO constituent concentrations as a result of production, prior to excavation all contaminated areas were a single statistical population. Accepting this, any observed significant statistical differences in contaminant levels between excavated areas and non-excavated areas are a result of the excavation itself. Therefore, if excavated areas demonstrate an acceptable level of reduced risk, then it is likely that additional excavation will likewise reduce risks to acceptable levels within areas that have elevated contaminant concentrations. Conversely, if no statistical difference is seen between excavated and non-excavated areas and the currentlevels pose unacceptable risk, then it can be concluded that prior excavation was not effective in reducing contaminant levels to acceptable levels.

Prior to performing ANOVA analysis, the distributional assumptions of the ANOVA test using the coefficient-of-variation test or other appropriate test of normality will be tested. If this test indicates that the assumption of a normally distributed population is not adequately met, then a log transformation of the data will be performed.

8.2 Confirmation of Population Size-HSA B and C

To confirm that the number of composite samples collected and analyzed from HSA B and C characterizes the soil to a defined level of confidence an estimate of the number of samples will be determined. If the ANOVA analysis indicates that there are no differences in the excavated and non-excavated the variance of the combined data sets will be used along with the ARAR's to predict "n". If the ANOVA analysis indicates that the excavated and non-excavated areas are statistically different populations then the individual variance of each population will be used to predict "n".

8.3 Determination of the Appropriate Number of Samples-HSA A

The resulting calculation of "n" will also be used to determine the number of samples that will be collected from HSA A. If the ANOVA analysis indicates that excavated and non-excavated areas are similar then "n" numbers of samples as determined by combining the two data sets will be randomly collected from HSA A. If it is determined that the excavated and non-excavated areas are statistically dissimilar, then "n" number of samples (as determined by the analysis of samples from excavated areas alone) will be collected from HSA A.

8.4 Comparison of HSA A Data to HSA B and C Data

Once the random samples are collected and analyzed from HSA A an ANOVA analysis will be performed to determine if the contaminants in HSA A are of the same population as those detected in HSA B and C. Prior to ANOVA analysis the data will be evaluated for normality and log transformed and if such transformation was performed on the HSA B and

C data. If the HSA A data is found to be of the same population as HSA B and C then the comparison to the soil action levels and the subsequent risk assessment performed on HSA B and C data will be applied to HSA A. If the data from HSA A is found to be different form HSA B and C then a comparison to the soil action levels and risk assessment on HSA A data will be performed.

8.5 Comparison to Soil Action Levels

HSA B and C plot data will be compared to the action levels levels presented in Section 3 of this plan. If any of the plot data exceeds the soil action level for any particular compound each discrete grid sample that made up the plot composite sample will be separately analyzed for that compound. Comparison to soil action levels will also be performed on HSA A data should it be determined that HSA A data is statistically different from HSA B and C data and if additional HSA A sampling is performed.

9.0 RISK ASSESSMENT

Data gathered during the soil characterization effort will be used to establish presence and extent of contamination in the potentially affected media of each plot. Initially, chemical and site specific ARARs or TBCs will be compiled for those chemicals and compounds that were determined to be present within the HSAs. This information along with data concerning potential contaminant migration routes (i.e. direction of ground-water flow) will aid in determining the potential for human and environmental exposure to the chemicals and compounds found to be present at the site. Information gathered concerning chemical-specific properties of the contaminants will be used along with site data to determine the environmental fate of those contaminants. All of these determinations will be used to determine the potentially significant exposure pathways. An exposure pathway will to considered complete if all of the following conditions are met:

1. A source of contamination with a release mechanism exists,

2. A migratory pathway exists for contaminant to move from source to an exposure point,

3. An exposure mechanism exists for receptors to contact contaminants at the exposure point, and

4. Receptors are identified who may contact contaminants at the exposure point.

An evaluation will be performed to identify all potentially complete exposure pathways.

An exposure analysis will be performed to determine the possible human intakes of contaminants. Depending on the predicted environmental fate and transport of contaminants either sample data or computer modeled data will be used to determine intakes.

An evaluation of toxicity of site contaminants will be performed to determine possible human health effects of exposure to site contaminants.
Where possible, this evaluation will include determination of acceptable levels of exposure based on U.S. EPA recommendations.

Potential risks to humans exposed to chemicals from each plot will be calculated based on the exposure assessments and toxicity evaluations. Both carcinogenic and noncarcinogenic risk will be quantified for each plot.

9.1 Toxicity Profiles

Toxicity profiles will be developed for each compound and element on the constituent list that was detected in the soil plot samples to provide the following information: acute toxicity, chronic toxicity, including systemic toxic effects, carinogenicity, mutagenicity, teratogenicity, and reproductive and other effects. Acute and chronic effects of these contaminants on non-human terrestrial populations, aquatic life, and vegetation shall also be addressed.

9.2 Dose-Response Assessment

EPA regulatory standards and guidelines will be determined for each contaminant of concern according to its appropriate chemical-specific ARARs. Dose-response assessments shall be made for both human and non-human animal populations.

9.3 Exposure Assessment

An exposure assessment will be conducted to identify exposure pathways, including non-human exposure pathways such as food web, aquatic contact, bioconcentration, etc.; characterize the human and non-human receptors (or potential receptors); and whenever possible, quantify the exposure of affected populations. The environmental fate and transport of all compounds will be evaluated to determine the pathways that are significant to the site. This evaluation will be based on sample data and on mathematical modeling of relevant fate and transport processes. Potentially exposed populations will then be characterized, including: characterization estimates of the numbers and ages of people potentially exposed at each exposure point; identification of sensitive groups; and identification of human activity patterns which may influence exposure. Exposure scenarios will be constructed to quantify the known or potential human exposure levels based on exposure pathways analyses and population characterization. Once the exposure scenarios are developed, the "dose" to the affected

populations will be calculated using sample data and modeling techniques. Exposure scenarios will be developed for the average and plausible maximum conditions of exposure.

All exposure assessment models will be conservative in order to prevent underestimates of exposure. Any use of non-referenced or non-conservative models will be accompanied by a statement of scientific justification. Literature values will be referenced and all assumptions will be clearly stated and justified.

9.4 Risk Characterization

Based on results of hazard identification, the dose-response assessment, and the exposure assessment, an estimate of the risk to public health and the environment at the site will be made. Exposure point concentrations for each exposure pathway at the site will be compared to the chemical-specific ARAR identified. The risk from exposure to individual contaminants and/or concurrent exposure to a chemical mixture will be described and evaluated. Both carcinogenic and non-carcinogenic effects will be evaluated. Whenever possible, risk to humans will be quantified. The risks posed to non-human receptors will be qualitatively evaluated.