This document was too large to scan as a single document. It has been divided into smaller sections.

Section 2 of 3

Document Information			
Document #	**DOE-RL 90-18**	**Revision**	
Title	Phase 1 Remedial Investigation Report for the Hanford Site 1100-EM-1 Operable Unit		
Date	**08/1990**		
Originator	**DOE-RL**	**Originator Co.**	**DOE-RL**
Recipient		**Recipient Co.**	
References			
Keywords			
Projects			
Other Information	**EDMC # 0010801**		

START

DOE/RL-90-18
UC-600

Phase 1 Remedial Investigation Report for the Hanford Site 1100-EM-1 Operable Unit

Environmental Engineering Group

Date Published
August 1990

Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

United States
Department of Energy
P.O. Box 550
Richland, Washington 99352

Approved for Public Release

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URT SMITCH
Director

DOW LETTER 90-18

RECEIVED
FEB 21 1990
Golder Associates

11.84.13
NRC
File

STATE OF WASHINGTON
DEPARTMENT OF WILDLIFE
600 North Capitol Way, GH-11 • Olympia, Washington 98504-0091 • [illegible] 753-5700

February 12, 1990

Luara Johnson
Golder Associates, Inc.
4104 148th Avenue NE
Redmond, WA 98052

RE: SPECIES OF CONCERN - GOLDER ASSOC.: 893-1407 WHC/0/071

Dear Ms. Johnson:

We have completed a review of our files for information on significant natural features in the study area. The result of this review is presented in the enclosed material, which summarizes the occurrence of special animals reported within or adjacent to the study area. The Washington Natural Heritage program will mail, under separate cover, project area information concerning special plants and plant communities.

We hope this presentation will be useful to you. This response is provided for your information only and is not to be construed as an official Department of Wildlife environmental review of your project. For official Department review and comment, mail environmental impact documents to: Washington Department of Wildlife, Ted Clausing, Regional Habitat Manager, 2802 Fruitvale Boulevard, Mill Creek, WA 98012.

If your office should publish or distribute general information from the enclosed material, please provide the Nongame Wildlife Program with a draft of any document in which information from the Natural Heritage Data System is incorporated or referenced, and cite the System as follows:

Natural Heritage Data System
Washington Department of Natural Resources and
Department of Wildlife - Nongame Program
c/o Mail Stop EX-12
Olympia, Washington 98504

Cyra, T., DOW [Letter to L. Johnson, GAI]
February 12, 1990

The information provided is not to be taken as a complete inventory of the project area and does not eliminate the need or responsibility to conduct more thorough research. If you have further questions or concerns, please feel free to contact us at (206) 586-1449.

Sincerely,

Thomas A. Cyra

Thomas A. Cyra
Nongame Data Systems Biologist

c: Lee Stream
Ted Clausing
John Mankowski

Enclosure

Enclosure 1

ELEMENT OCCURRENCE SUMMARY

Introduction

The Natural Heritage Data System was established by the State of Washington and the Washington Natural Heritage Program of the Nature Conservancy. It is currently maintained by the Heritage Program of the Washington Department of Natural Resources and by the Nongame Wildlife Program of the Washington Department of Wildlife.

The database is comprised of "element occurrences." An "element" is a natural feature of particular interest because it is exemplary, unique, or endangered on a statewide or national basis. An element can be a plant community, special plant, or special animal species. An "element occurrence" is a reported or confirmed locality of a native vegetation community, or of significant habitat for a plant or animal species of concern. Information on element occurrences in the state is collected from herbarium and museum specimens, scientific literature, knowledgeable individuals, and field investigations. This information is compiled in the Natural Heritage Data System for use in land-use planning and evaluating the status of Washington's natural features.

This enclosure summarizes the special animal occurrences reported within or adjacent to the study area and catalogued in the Natural Heritage Data System. The Washington Natural Heritage Program manages similar information concerning special plants and plant communities.

Format

The Element Occurrence Summary table lists those special animals that have been reported to occur in or adjacent to the area specified in your information request.

- The first column lists the U.S. Geological Service (USGS) topographic quadrangle.
- The second column lists the township, range, and section.
- The third column, entitled "conf." (confirmation), lists a code indicating the specificaity of the locations recorded for each element occurrence.

Confirmation Codes

C = The location of the element occurrence is known to within a 1/4-mile radius. In addition, the locality has been confirmed.

U = The location of the element occurrence is known to within a 1/4-mile radius, but at this time has not been confirmed.

- The fifth column, entitled "Crit." (Criteria), lists codes that indicate the specific criterion/criteria used to evaluate whether a habitat location is significant to the species.

Element Occurrence Criteria for Special Animals

IO **Individual occurrence** - Any record of the species constitutes a a special animal occurrence.

HC **Herptile Concentration** - Five or more individuals present in the same location.

CR **Colonial roosts**

B **Evidence of breeding** - nest, young or eggs, adult visiting probable nest site, nest building activity (i.e., carrying nest material), breeding display, agitated behavior and distraction display (i.e., feigning injury).

RI **Regular individual occurrences at the same location** - Observations of less than 10 individuals that have been made during at least three different years, not necessarily consecutive.

RSC **Regular small concentrations** - during migration, breeding or winter season of over 70 individuals observed during at least three different years, not necessarily consecutive.

Comments

The enclosed information represents the reported element occurrences currently catalogued in the Natural Heritage Data System. The Data System is constantly updated as more current and historic information on element occurrences in the state are reported. Consequently, some of the element occurrences reported to occur historically within the study area may no longer be present. Likewise, areas within the study boundary for which element occurrences have not yet been reported, nevertheless, may support special animal species.

Finally, if information is needed on specific plant community or special plant occurrences within the study area, please contact the Washington Natural Heritage Program, (206) 753-2449. For additional information on specific special animal occurrences, please contact the Washington Department of Wildlife Program, (206) 586-1449.

ELEMENT OCCURRENCE SUMMARY - SPECIAL ANIMALS

RE: SPECIES OF CONCERN - GOLDER ASSOC.: 893-1407 WHC/0/071

Quad Name	T	R	S	Conf.	Status Fed.	Status State	Element Name	Crit.	Occ.
RICHLAND 7.5	10N	28E	10	C			Buteo swainsoni Swainson's hawk	B	48 -1
RICHLAND 7.5	10N	28E	15	C		FC2	Numenius americanus Long-billed curlew	B,RSC	36 -1
RICHLAND 7.5	10N	28E	15	C			Buteo swainsoni Swainson's hawk	B	371-1
RICHLAND 7.5	10N	28E	16	C			Buteo swainsoni Swainson's hawk	B	49 -1

July 21, 1989

BENTON-FRANKLIN HEALTH DEPARTMENT
506 McKenzie
Richland, WA 99352

SUBJECT: RICHLAND LANDFILL GROUND WATER WELLS TEST RESULTS

Gentlemen:

Attached are the test results for samples from the four ground water wells at the City's landfill. The samples were collected on 3-13-89 and 5-15-89.

If you have any questions, please call me at 943-9161, extension 236.

Sincerely,

MICHAEL L. GILLUM
Associate Engineer

MLG:mel

Attachments

c: DOE
Stan Arlt
Mark Bauer
Don Dawson

[Department letter to Benton-Franklin Health Department]

Water, Food & Research Lab, Inc.
Problem Solvers
Laboratory: 13035 S.W. Pacific Hwy., Tigard, Oregon 97223
Mailing Address: P.O. Box 19700, Portland, Oregon 97219
Telephone (503) 639-9311

CITY OF RICHLAND
Attn: Mike Gillum
POBOX 190
RICHLAND, WA 99352

REPORT # 7777

CHEMICAL LABORATORY REPORT
******** 06-09-89 ********

Samples: Water from test wells, 1,2,3,4
Collected: 05-15-89 by D.B.D.
Received: 05-16-89 by PBS

ANALYSIS	METHOD	Well #1	Well #2	Well #3	Well #4
Conductivity (umhos/cm)	120.1	550.	275.	350.	310.
pH	150.1	7.6 pH	8.0 pH	7.8 pH	7.9 pH
Chloride	325.3	8.0 ppm	5.0 ppm	11.0 ppm	4.5 ppm
Nitrate	353.3	1.59	0.70	2.30	1.40
Nitrite	352.1	< 0.1	<0.1	< 0.1	< 0.1
Ammonia	350.1	0.03	0.05	0.06	0.05
Sulfate	375.4	27.8	26.4	34.6	28.5
Iron	236.1	< 0.005	<0.005	<0.005	<0.005
Zinc	289.1	< 0.005	<0.005	<0.005	<0.005
Manganese	243.1	0.007	<0.005	<0.005	<0.005
Chemical Oxygen demand	410.1	< 7.0	7.0	< 7.0	< 7.0
Total Organic Carbon	415.1	< 3	< 3	< 3	< 3
Total coliform bacteria	EPA-MPN	<2/100mls	<2/100mls	<2/100mls	<2/100mls
Fecal coliform bacteria	EPA-MPN	<2/100mls	<2/100mls	<2/100mls	<2/100mls

Certified by:

Paul B. Stevens
Microbiologist/Biochemist
LAB DIRECTOR (EPA/OSHD #31)

All test results meet drinking water standards.

< less than or none detected
ppm parts per million or milligrams per liter

Water, Food & Research Lab, Inc.
Laboratory: 13035 S.W. Pacific Hwy., Tigard, Oregon 97223
Mailing Address: P.O. Box 19700, Portland, Oregon 97219
Telephone (503) 639-9311
Problem Solvers

CITY OF RICHLAND
Attn: Mike Gillum
P.O. BOX 190
RICHLAND, WA 99352

REPORT # 7501

CHEMICAL LABORATORY REPORT
******* 03-28-89 *********

Samples: Landfill test well samples (#1,2,3,4)
Collected: 03-13-89 0700 to 0745 hrs
Received: 03-14-89 by PBS

ANALYSIS	METHOD	Well #1	Well #2	Well # 3	Well
Specific Conductivity	120.1	440.0	220.0	330.0	275.0
Chloride	325.3	7.5	7.0	14.0	4.5
Nitrate	353.3	0.53	0.52	0.77	0.6
Nitrite	352.1	< 0.05	< 0.05	< 0.05	< 0.0
Ammonia nitrogen	350.1	0.06	0.08	0.05	0.0
Sulfate	375.4	19.9	14.8	21.1	17.7
Iron	236.1	< 0.005	< 0.005	< 0.005	< 0.0
Zinc	289.1	0.200	0.017	0.014	0.0
Manganese	243.1	0.018	< 0.005	< 0.005	< 0.0
Chemical oxygen demand	410.1	< 4.0	< 4.0	13.0	< 4.0
Total organic carbon	415.1	< 3.0	< 3.0	< 3.0	< 3.0
Total coliform /100mls	MPN	< 2	< 2	< 2	< 2
Fecal coliform / 100mls	MPN	< 2	< 2	< 2	< 2

Certified by:

PAUL B. STEVENS
Microbiologist/Biochemist
LAB DIRECTOR (EPA/CSMD #31)

< less than or none detected

ppm Parts per million or milligrams per l

LANDFILL MONITORING WELLS

Test Results

Test	Test Date	Well #1	Well #2	Well #3	Well #4	Units
TEMPERATURE	7-23-87	16.4	17.0	16.5	16.6	° Cent.
	7-27-87	16.6	17.5	17.5	16.7	
	4-28-88	18.0	18.0	19.0	19.0	
	7-27-88	23.4	21.3	23.6	23.4	
	12-19-88	17.7	17.7	17.0	16.6	
pH	7-23-87	7.13	7.62	7.44	7.58	
	7-27-87	7.31	7.69	7.20	7.62	
	4-28-88	7.30	7.80	7.80	7.60	
	7-27-88	7.40	8.00	8.20	7.90	
	12-19-88	7.30	8.00	8.00	8.00	
	6-09-89	7.60	8.00	7.80	7.90	
CONDUCTIVITY	7-23-87	420	240	340	290	Micro-
	7-27-87	440	240	325	280	mhos
	4-28-88 (Field)	460	260	230	220	
	4-28-88 (Lab)	542	290	396	344	
	7-27-88	490	250	280	280	
	12-19-88 (Field)	440	260	375	320	
	12-19-88 (Lab)	400	210	320	260	
	3-28-89	440	220	330	275	
	6-09-89	550	275	350	310	
CHLORIDE	7-23-87	8.34	6.31	10.33	6.43	PPM
	4-28-88	7.75	6.07	10.92	6.86	
	7-27-88	6.51	5.63	9.79	6.92	
	12-19-88	5.5	8.0	10.5	7.5	
	3-28-89	7.5	7.0	14.0	4.5	
	6-09-89	8.0	5.0	11.0	4.5	
NITRATE	7-23-87	1.47	0.63	1.45	0.98	PPM
	4-28-88	1.32	0.69	1.5	0.95	
	7-27-88	1.31	0.70	1.61	0.996	
	12-19-88	0.70	0.50	0.70	0.63	
	3-28-89	0.53	0.52	0.77	0.6	
	6-09-89	1.59	0.70	2.30	1.40	
NITRITE	7-23-87	<0.3	<0.3	<0.3	<0.3	PPM
	4-28-88	<0.3	<0.3	<0.3	<0.3	
	7-27-88	<0.3	<0.3	<0.3	<0.3	
	12-19-88	<0.1	<0.1	<0.1	<0.1	
	3-28-89	<0.05	<0.05	<0.05	<0.05	
	6-09-89	<0.1	<0.1	<0.1	<0.1	
AMMONIA-N	7-23-87	<0.05	<0.05	<0.05	<0.05	PPM
	4-28-88	<0.05	<0.05	<0.05	<0.05	
	7-27-88	<0.05	<0.05	<0.05	<0.05	
	12-19-88	0.03	0.06	0.05	0.06	
	3-28-89	0.06	0.08	0.05	0.06	
	6-09-89	0.03	0.05	0.06	0.05	
SULFATE	7-23-87	23.0	19.37	24.28	20.23	PPM
	4-28-88	22.96	18.02	24.38	19.31	
	7-27-88	23.80	19.03	25.96	20.23	
	12-19-88	19.4	13.6	19.4	14.1	
	3-28-89	19.9	14.8	21.1	17.7	
	6-09-89	27.8	26.4	34.6	28.5	

Test	Test Date	Well #1	Well #2	Well #3	Well #4	Units
DISSOLVED IRON	7-23-87	0.154	0.710	0.814	<0.050	PPM
	4-28-88	0.275	0.916	0.290	<0.030	
	7-27-88	0.185	0.484	0.115	<0.046	
	12-19-88	0.042	0.244	<0.005	<0.005	
	3-28-89	<0.005	<0.005	<0.005	<0.005	
	6-09-89	<0.005	<0.005	<0.005	<0.005	
MANGANESE (Mn)	7-23-87	0.083	0.034	0.061	<0.005	PPM
	4-28-88	0.075	0.057	0.082	<0.005	
	7-27-88	0.042	0.034	0.033	<0.005	
	12-19-88	<0.005	<0.005	<0.005	<0.005	
	3-28-89	0.018	<0.005	<0.005	<0.005	
	6-09-89	0.007	<0.005	<0.005	<0.005	
ZINC (Zn)	7-23-87	<0.005	0.012	0.006	<0.005	PPM
	4-28-88	<0.005	0.013	0.011	0.008	
	7-27-88	0.007	0.014	0.007	0.009	
	12-19-88	<0.005	<0.005	<0.005	<0.005	
	3-28-89	0.200	0.017	0.014	0.056	
	6-09-89	<0.005	<0.005	<0.005	<0.005	
COD	7-23-87	449	1	345	64	PPM
	4-28-88	<10	<10	<10	<10	
	7-27-88	<10	<10	<10	<10	
	12-19-88	8	16	8	4	
	3-28-89	<4.0	<4.0	13.0	<4.0	
	6-09-89	<7.0	7.0	<7.0	<7.0	
TOC	7-23-87	<1	<1	<1	<1	PPM
	4-28-88	<1	<1	<1	<1	
	7-27-88	<1	<1	1.99	<1	
	12-19-88	<3	<3	<3	<3	
	3-28-89	<3.0	<3.0	<3.0	<3.0	
	6-09-89	<3.0	<3.0	<3.0	<3.0	
TOTAL COLIFORM	7-23-87	9.2	<2.2	<2.2	<2.2	MPN
	4-28-88	<2.2	<2.2	<2.2	<2.2	
	7-27-88	<2.2	<2.2	<2.2	<2.2	
	12-19-88	<2	<2	<2	<2	
	3-28-89	<2	<2	<2	<2	
	6-09-89	<2	<2	<2	<2	
FECAL COLIFORM	7-23-87	<2.2	<2.2	<2.2	2.2	MPN
	4-28-88	<2.2	<2.2	<2.2	<2.2	
	7-27-88	<2.2	<2.2	<2.2	<2.2	
	12-19-88	<2	<2	<2	<2	
	3-28-89	<2	<2	<2	<2	
	6-19-89	<2	<2	<2	<2	
VISUAL	7-23-87	Clear	Turbid	Very Turbid	Clear	
	7-27-87	Clear	Turbid	Turbid	Clear	
	4-28-88	Clear	Clear	Cloudy then cleared	Clear	
	12-19-88	Clear	Clear	Clear	Clear	

HANFORD ENVIRONMENTAL HEALTH FOUNDATION

il 13, 1990 CO 15175

tinghouse Hanford Company
N R3-54

n: P. Bartley

BULK SAMPLE ANALYSIS FOR FIBER CONTENT - HORN RAPIDS LAND FILL

The nine soil samples received February 26, 1990, have been analyzed for fiber content using polarized light microscopy and dispersion staining in accordance with 40 CFR Ch, I (1-1-87 Ed.) Part 763, Subpart F, App. A. None of the samples contained asbestos. The results are attached.

Reported fiber percentages for samples and sample layers are based on the samples as received by the laboratory. The laboratory cannot verify that these values are representative of the original material sampled.

Hanford Environmental Health Foundation is accredited by the National Institute of Standards and Technology (NIST), National Voluntary Laboratory Accreditation Program (NVLAP), to analyze bulk samples for asbestos content. This accreditation does not constitute approval or endorsement of analytical results by NIST nor does it apply to other analyses performed by this laboratory.

If there are questions concerning this report, please contact the approved signatory listed below.

Hamilton, M. and G. Thomas, HEHF (Letter to P. Bartley, WHC) April 13, 1990

Geg Thomas
G. B. Thomas
Environmental Health Sciences

Maureen K. Hamilton
M. K. Hamilton, CIH
Laboratory Director
Environmental Health Sciences
(Approved Signatory)

ac

cc: R. M. Mitchell
MSIN H4-55

P. O. BOX 100, RICHLAND, WASHINGTON 99352

BULK SAMPLE ANALYSIS FOR FIBER CONTENT - HORN RAPIDS LAND FILL

Sample I.D.	Description	Fiber Content
AH226	Dark brown fibrous dirt with rocks	5-10% cellulose
AH227	Dark brown fibrous dirt with rocks	<1% cellulose
AH228	Brown fibrous dirt with rocks	<1% cellulose
AH229	Brown fibrous dirt	5-10% fiberglass
AH230	Brown fibrous dirt	2-5% synthetic
AH231	Fine brown fibrous gravel	<1% cellulose
AH232	Brown grainy fibrous dirt	<1% cellulose
AH233	Brown grainy fibrous dirt	<1% cellulose
AH234	Brown fibrous dirt with rocks	1-5% cellulose

Note: Negative soil results should not be considered conclusive proof of the absence of asbestos from the sampled site.

NVLAP Accredited by the National Institute of Standards and Technology, National Voluntary Laboratory Accreditation Program, for bulk asbestos analysis using PLM.

ADVANCED NUCLEAR FUELS CORPORATION

2101 HORN RAPIDS ROAD PO BOX 130 RICHLAND WA 99352-0130
(509) 375-8100 TELEX 15-2878

REGULATORY COMPLIANCE

January 12, 1990
SRL:90:003

Lockhaven, S., Advanced Nuclear Fuels Corp.
[Letter to C. Cline, Ecology] January 12, 1990

Washington State Department of Ecology
Attn: Mr. Chuck Cline
Mail Stop PV-11
Olympia, WA 98504

Dear Mr. Cline:

TEST WELL DATA

Please find enclosed the Advanced Nuclear Fuels Corporation (ANF) test well data that you requested. This data was also requested and sent on January 9, 1990 to Maryanne Olascaga of Westinghouse Hanford.

Very truly yours,

Stephen R. Lockhaven, Specialist
Industrial Regulations

jrs

Enclosure
As Stated

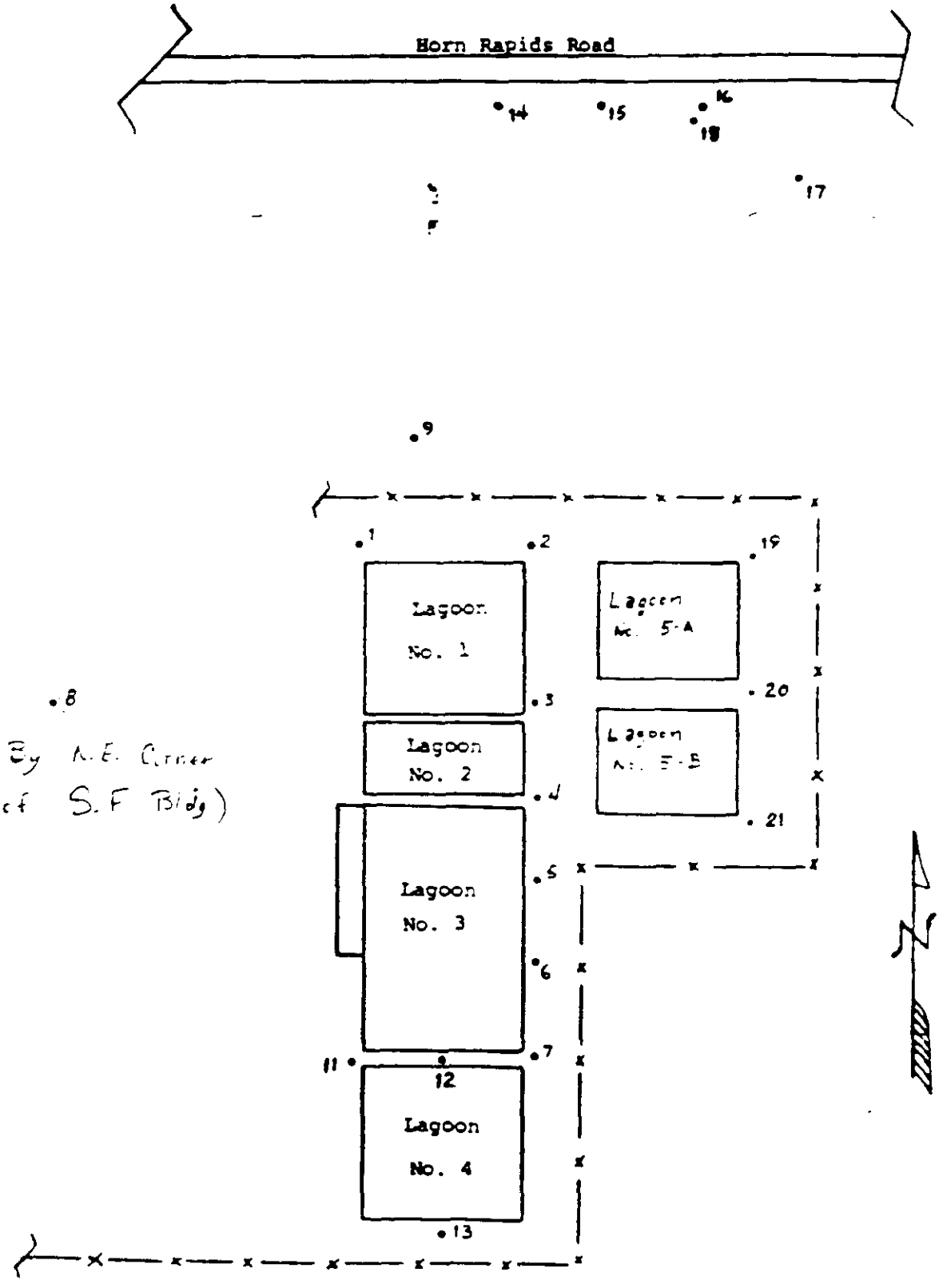


Figure 1-6 Lagoon Test Well Locations

WELL #1

Yr/Qtr	U ppm	Alpha pCi/L	Beta pCi/L	F ppm	NO_3 ppm	[illegible] ppm
81/1	<0.1			5.20	68	72
81/2	<0.1			5.10	79	81
81/3	<0.1			7.60	38	26
81/4	<0.1			11.20	27	30
82/1	<0.1			21.80	72	73
82/2	<0.1			9.70	63	94
82/3	<0.1			6.00	49	107
82/4	<0.1			11.70	81	108
83/1	<0.1			4.00	99	72
83/2	<0.1			6.00	81	69
83/3	<0.1			4.80	60	35
83/4	<0.1			2.90	52	46
84/1	<0.1			3.80	52	49
84/2		24.4	24.4	4.00		
84/3		8.7	46.4	5.00	53	29
84/4		9.9	91.7	4.00		
85/1		11.1	55.6	4.00	71	90
85/2		12.1	29.2	2.00		
85/3		8.0	18.0	2.90	64	-
85/4		42.4	30.4	6.20		
86/1		22.1	17.4	3	46	20
86/2		19.1	24.8	2.6		
86/3		12.8	15.8	3	42	19
86/4		52.6	23.2	5		
87/1		19.6	33.3	2	51.25	52.41
87/2		15.7	14.1	3	23.6	33.5
87/3						
87/4		75.4	42.4	6	34.6	
88/1		[illegible]	34	5	52.6	64.2
88/2		15.4	30	3		
88/3		[illegible]	14.5	1.5	7.4	34.6
88/4		10.5	17.6	4.7		
[illegible]		[illegible]	[illegible]	[illegible]	46.6	62.5
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

WELL #2

Yr/Qtr	U ppm	Alpha pCi/L	Beta pCi/L	F ppm	NO_3 ppm	NH_3 ppm
81/1	<0.1			14.00	34	145
81/2	<0.1			9.70	65	147
81/3	<0.1			7.00	42	85
81/4	<0.1			6.50	18	85
82/1	<0.1			18.90	34	99
82/2	<0.1			11.60	37	114
82/3	<0.1			7.10	33	102
82/4	<0.1			8.00	39	29
83/1	<0.1			8.50	65	163
83/2	<0.1			3.30	57	108
83/3	<0.1			4.50	18	55
83/4	<0.1			4.10	6	46
84/1	<0.1			7.60	44	60
84/2		148	77.6	7.20		
84/3		131	61.1	7.00	43	36
84/4		111	68.1	7.00		
85/1		91.1	70.1	7.50	57	823
85/2		281.0	87.3	4.00		
85/3		98.3	50.3	8.40	69	-
85/4		86.2	30.4	5.20		
86/1		22.1	17.4			
86/2		35.5	27.3	3	38	38
86/3		58.6	33.7	5.8		
86/4		34.8	30.1	8	[redacted]43	[redacted]34
87/1				4		
87/2		—	—	—	—	—
87/3		44.6	45.8	4.4	44.7	35.7
87/4		35.3	34.7	6	37.7	43.5
88/1		24.4	32.6	5	[redacted]	12.4
88/2		31.3	46	7	28.8	[redacted]
88/3		19.6	47.2	5		
88/4		27.1	52.5	4.4	59.5	[redacted]3.5
		45.8	43.4	4.7		
89/1						
89/2		22.2	17.4	12.4	62.6	[redacted]
89/3		11.5	10.1	6.6		
89/4		12.7	10.8	4.0	60.8	3.9
		7.4 [redacted]	8.5 [redacted]	5.2		

WELL #3

Yr/Qtr	U ppm	Alpha pCi/L	Beta pCi/L	F ppm	NO_3	NH_4
81/1	<0.1			0.92		
81/2	<0.1			0.80		
81/3	<0.1			0.54		
81/4	<0.1			0.46		
82/1	<0.1			0.52		
82/2	<0.1			0.81		
82/3	<0.1			0.56		
82/4	<0.1			0.40		
83/1	<0.1			1.30		
83/2	<0.1			0.65		
83/3	<0.1			0.41		
83/4	<0.1			0.45		
84/1	<0.1			0.46		
84/2		5.1	40.6	0.50		
84/3		5.6	19.9	1.00		
84/4		11.6	31.7	6.00		
85/1		19.8	48.5	0.80		
85/2		44.1	24.5	1.50		
85/3		9.2	22.4	0.50		
85/4		6.6	28.2	0.48		
86/1		3.8	17.2			
86/2		9.3	32.3	.4		
86/3		6.1	41.6	.5		
86/4		2.6	14.7	.5		
87/1		—	—	—		
87/2		2.8	27.2	.5	52.0	51.3
87/3		2.3	19.1	.4		
87/4		4.7	26.6	.8		7.8
88/1		1.0	23	2		
88/2		2.9	23.5	.4		
88/3		3.3	24.1	1.0		
88/4		1.7	20	1.6		
89/1		3.8	5.6	.4		
89/2		1.8	10.7	.4		
89/3		2.5	4.9	.4		
89/4		2.3	4.2	.5		

WELL #4

Yr/Qtr	U ppm	Alpha =pCi/L	Beta pCi/L	F ppm	NO3	NH4
81/1	<0.1			0.83		
81/2	<0.1			0.63		
81/3	<0.1			0.68		
81/4	<0.1			0.65		
82/1	<0.1			0.45		
82/2	<0.1			0.67		
82/3	<0.1			0.39		
82/4	<0.1			0.43		
83/1	<0.1			0.91		
83/2	<0.1			0.37		
83/3	<0.1			0.36		
83/4	<0.1			0.42		
84/1	<0.1			0.35		
84/2		46.4	28.6	0.40		
84/3		5.0	26.2	0.70		
84/4		7.1	26.7	0.50		
85/1		6.9	29.1	0.70		
85/2		9.9	33.1	2.00		
85/3		7.6	19.5	0.50		
85/4		3.9	19.8	0.45		
86/1		4.2	18.9	.4		
86/2		7.3	19.4	.4		
86/3		4.8	41.8	1.0		
86/4		8.3	13.8	.5		
87/1						
87/2		—	—	—	—	—
87/3		1.9	19	.6	25.1	
87/4		2.39	22	.3		4.7
		2.2	18.4	.5		
88/1					—	3.1
88/2		2.6	12.9	.4		
88/3		1.7	18.2	.3		
88/4		2.7	13.2	1.7		
		1.8	12.1	.5		
89/1						
89/2						
89/3		2.8	6.0	.4		
89/4		1.2	6.8	.4		
		2.3	10.3	.4		
		2.7	7.9	.4		

WELL #5

yr/qtr	U ppm	= Alpha pCi/L	Beta pCi/L	F ppm	NO_3	NH_4
81/1	<0.1			0.51		
81/2	<0.1			0.28		
81/3				0.29		
81/4				0.31		
82/1				0.27		
82/2				0.60		
82/3				0.27		
82/4				0.41		
83/1				0.85		
83/2				0.40		
83/3				0.28		
83/4				0.28		
84/1				0.35		
84/2		3.2	32.9	0.45		
84/3		3.3	28.8	14.0		
84/4		1.8	5.54	0.30		
85/1		7.8	38.9	0.40		
85/2		1.4	10.7	0.50		
85/3		0.2	10.4	0.30		
85/4		0.03	8.8	0.21		
86/1		1.6	7.4	.2		
86/2		.23	6.5	.2		
86/3		1.69	8.4	.7		
86/4		.05	7.3	.4		
87/1						
87/2		—	—	—		
87/3		.03	5.5	.7		
87/4		.38	6.4	.3		
88/1		.68	7.2	.3		31
88/2		1.1	23.2	.3		
88/3		1.8	8.3	.2		
88/4		.47	6.0	.3		
		1.4	6.6	.5		
89/1						
89/2		2.1	4.5	.4		
89/3		.9	3.2	.3		
89/4		.9	6.1	.3		
		.6	4.2	.3		

WELL #6

Yr/Qtr	U ppm	Alpha = pCi/L	Beta pCi/L	F ppm
81/1	<0.1			0.51
81/2	<0.1			0.54
81/3	<0.1			0.25
81/4	<0.1			0.33
82/1	<0.1			0.53
82/2	<0.1			0.49
82/3	<0.1			0.30
82/4	<0.1			0.34
83/1	<0.1			0.83
83/2	<0.1			4.80
83/3	<0.1			0.30
83/4	<0.1			0.40
84/1	<0.1			0.39
84/2		8.3	19.7	0.60
84/3		3.4	9.0	0.40
84/4		4.4	27.2	0.30
85/1		8.8	23.1	0.80
85/2		6.7	14.6	1.30
85/3		0.1	11.0	0.50
85/4		5.4	14.3	0.30
86/1		2.5	12	.2
86/2		2.5	8.1	.2
86/3		2.4	11.5	.3
86/4		2.2	11.3	.3
87/1		—	—	—
87/2		1.0	9.6	.4
87/3		.6	6.3	.3
87/4		1.98	20.3	.3
88/1		.9		
88/2		1.6	14.3	.3
88/3		2.2	10	.3
88/4		1.2	10.3	.3
89/1			9.6	.5
89/2		1.4	5.7	.3
89/3		2.7	3.7	.3
89/4		1.4	5.7	.3
		1.2	5.7	.4

WELL #7

Yr/Qtr	U ppm	Alpha pCi/L	Beta pCi/L	F ppm
81/1	<0.1			0.39
81/2	<0.1			0.28
81/3	<0.1			0.35
81/4	<0.1			0.38
82/1	<0.1			0.42
82/2	<0.1			0.48
82/3	<0.1			0.31
82/4	<0.1			0.37
83/1	<0.1			1.53
83/2	<0.1			0.50
83/3	<0.1			0.33
83/4	<0.1			0.40
84/1	<0.1			0.39
84/2		2.2	5.1	0.47
84/3		2.6	4.5	0.70
84/4		3.1	5.7	0.40
85/1		3.2	5.0	0.70
85/2		3.9	5.9	0.70
85/3		2.0	7.0	0.30
85/4		2.0	5.3	0.30
86/1		.8	4.7	.3
86/2		.92	5	.2
86/3		.27	5.9	.2
86/4		.79	4.6	.4
87/1		—	—	—
87/2		1.0	2.7	.3
87/3		.7	5.3	.2
87/4		1.0	4.7	.4
88/1		1.3	3.9	.2
88/2		1.0	3.7	.2
88/3		1.0	7.5	.2
88/4		1.3	4.3	.4
89/1		1.3	4.7	.2
89/2		0.7	1.3	[illegible]
89/3		1.4	5.7	.2
89/4		0.95	4.97	.3

WELL #9

	U ppm	Alpha pCi/L	Beta pCi/L	F ppm	NO_3 ppm	NH_3 ppm
					75	193
1					75	129
2					40	112
3					37	90
4						
					47	107
					64	164
	<0.1				53	131
	<0.1				56	130
	<0.1				58	132
2	<0.1				67	120
3	<0.1				48	96
	<0.1				11	95
	<0.1				21	105
	<0.1					
		109.0	47.0		86	178
		17.4	73.8		94	84
2						
3		69.4	36.3		75	14
4						
84		80.2	39.7		59	92
84						
84		49.5	44.7	1.0	86	70
84						
87						
87		—	—	—	—	—
87		—				
87		84.1	56.2	8	77.9	104.8
87		—				
88						
88		192	128		41.5	23
88		—				
88		54.3	44.3		61.5	45.0
		—				
89						
89		97.8	32.6	6.9	20.3	24.0
89		—				
89		45.4	18.4	7.5	83.1	38.8
		—				

WELL #11

[illegible]	U ppm	Alpha = pCi/L	Beta pCi/L	F ppm
1				0.51
2				0.46
3				0.38
[illegible]				0.38
				0.45
				0.62
				0.37
	<0.1			0.43
	<0.1			0.62
	<0.1			0.50
	<0.1			0.42
	<0.1			0.43
	<0.1			0.34
		1.3	7.5	0.38
		2.1	5.0	0.70
		4.3	5.0	0.40
		3.9	9.0	1.00
		4.6	9.1	0.60
		0.1	6.6	0.30
		2.7	3.9	0.30
84/1		.3	5.1	.3
84/2		.2	4.9	.2
84/3		2.5	6.9	.3
84/4		1.4	5.0	.3
87		—	—	—
87/2		3.7	10.5	1.4
87/3		.8	10.1	.4
87/4		1.6	7.4	.5
88/1				
88/2		2.4	6.5	1.6
88/3		0.7	12.1	.3
88/4		.6	5.5	.3
		1.1	11.3	.6
89/1				
89/2		5.1	10.1	.3
89/3		1.0	5.5	.4
89/4		3.1	5.0	.4
		1.7	3.5	.4

WELL #12

Yr/Qtr	U ppm	Alpha pCi/L	Beta pCi/L	F ppm
81/1				0.60
81/2				0.39
81/3				0.39
81/4				0.40
82/1				0.49
82/2				0.65
82/3				0.40
82/4	<0.1			0.33
83/1	<0.1			0.61
83/2	<0.1			0.55
83/3	<0.1			0.35
83/4	<0.1			0.57
84/1	<0.1			0.41
84/2		7.1	7.0	3.00
84/3		0.8	8.3	0.60
84/4		1.8	5.0	0.40
85/1		0.2	7.3	1.00
85/2		2.6	6.7	1.00
85/3		3.7	4.0	0.30
85/4		1.0	6.7	0.23
86/1		2.6	4.8	0.2
86/2		4.5	6.7	0.3
86/3		3.25	4.16	0.4
86/4		.15	6.7	0.3
87/1		—	—	—
87/2		2.2	8.7	0.2
87/3		1.3	5.8	0.6
87/4		1.2	6.3	0.4
88/1		.4	8.1	0.4
88/2		.3	6.4	0.3
88/3		1.0	1.4	0.3
88/4		1.3	4.9	0.7
89/1		2.1	7.6	0.5
89/2		0.2	3.9	0.3
89/3		2.5	3.4	0.3
89/4		2.5	7.8	0.3

WELL #13

r/Qu	U ppm	Alpha =pCi/L	Beta pCi/L	F ppm	NO_3 ppm	NH_3 ppm
31/1				0.35	2.6	0.19
31/2				0.27	3.2	0.02
31/3				0.55	2.1	0.19
31/4				0.38	1.4	0.53
2/1				0.29	2.5	0.33
2/2				0.46	3.1	0.12
2/3				0.38	1.4	0.16
2/4	<0.1			0.25	0.8	0.22
3/1	<0.1			0.41	3.5	0.10
3/2	<0.1			0.45	4.4	0.90
3/3	<0.1			0.39	1.6	0.35
[illegible]	<0.1			0.60	1.3	0.67
[illegible]	<0.1			0.34	2.8	0.11
[illegible]		2.1	0.5	0.47		
[illegible]		2.6	0.7	0.70	2.7	0.16
[illegible]		3.1	1.9			
[illegible]		4.3	6.9	~~8.00~~ 1.0	10.2	0.74
5/2		3.0	5.6	.3		
5/3		1.6	3.5	~~8.00~~ .3	5.6	-
5/4		1.8	6.6			
86/1		1.1	4.0	0.3	5.6	1.4
86/2		2.4	4.2	0.3		
86/3		1.4	4.92	0.4	2.4	1.9
86/4						
87/1		—	—	—	—	—
87/2						
87/3		[redacted].6	3.8	0.5		
87/4		1.2	5.1	0.2		
88/1		1.7	6.4	0.5		
88/2		0.44	6.8	0.3		
88/3		.0	3.2	0.3		
88/4		1.5	4.9	0.2		
89/1		2.3	3.8	0.5		
89/2		1.6	6.6	0.4		
89/3		2.7	6.4	0.4		
89/4		1.5	3.9	0.3		
		2.8	5.4	0.3		

WELL #14

Yr/Qtr	U ppm	Alpha pCi/L	Beta pCi/L	F ppm	NO_3 ppm	NH_3 ppm
81/1					53	71
81/2					77	43
81/3					34	58
81/4					21	84
82/1					40	86
82/2					37	111
82/3					51	170
82/4	<0.1				65	72
83/1	<0.1				68	84
83/2	<0.1				68	85
83/3	<0.1				52	148
83/4	<0.1				41	71
84/1	<0.1				75	120
84/2						
84/3		25.0	18.0		64	77
84/4						
85/1		68.0	25.0		46	38
85/2						
85/3		55.0	23.0		49	-
85/4						
86/1		59	29.8		52	9
86/2						
86/3		65	87.9	6	49	8.5
86/4						
87/1		—	—	—	—	—
87/2		—				
87/3						
87/4		2.4	35.7		64.2	43.5
88/1		—				
88/2		72.8	53.2		42.0	25.6
88/3		—				
88/4		33.0	27.4	2.7	46.4	17.1
		23.2	28.5	4.5		
89/1		19.8	14.6	3.1	56.5	1.9
89/2		—				
89/3						
89/4		17.8	1.8	3.7	63.4	9.3
		—				

WELL #15

Yr/Qtr	U ppm	Alpha pCi/L	Beta pCi/L	F ppm	NO_3 ppm	NH_3 ppm
81/1					80	225
81/2					65	123
81/3					39	134
81/4					22	129
82/1					46	101
82/2					61	123
82/3					41	135
82/4	<0.1				31	160
83/1	<0.1				54	94
83/2	<0.1				51	90
83/3	<0.1				11	69
83/4	<0.1				39	87
84/1	<0.1				64	73
84/2						
84/3		88.0	52.0		53	122
84/4						
85/1		82.0	80.0		85	100
85/2		-				
85/3		29.0	34.0		49	-
85/4						
86/1						
86/2		71.0	46.2		56.0	73.0
86/3						
86/4		46.3	49.1	13.0	33.9	101.0
87/1						
87/2		—	—	—	—	—
87/3		—			—	—
87/4		—			59.4	97.1
88/1					—	—
88/2		94.7	123		58.4	93.2
88/3		—				
88/4		59.9	63.2	8.0	38.4	27.9
89/1		64.1	55.9	7.8		
89/2		64.7	26.1	7.6	64.2	65.2
89/3		—				
89/4		71.4	17.7	8.3	63.9	93.2
		—				

WELL #16

Yr/Qtr	U ppm	Alpha pCi/L	Beta pCi/L	F ppm	NO_3 ppm	NH_3 ppm
81/1						
81/2						
81/3						
81/4						
82/1						
82/2						
82/3	<0.1				24	43
82/4	<0.1				13	72
83/1	<0.1				41	36
83/2	<0.1				0.90	32
83/3	<0.1				1.2	43
83/4	<0.1				1.5	38
84/1	<0.1				1.4	33
84/2						
84/3		2.3	10.0		1.4	54
84/4						
85/1		4.9	20.0		1.8	44
85/2						
85/3		0.9	11.5		1.1	-
85/4						
86/1						
86/2		.86	12.7		1.4	22
86/3						
86/4		.8	10.4	9.0	1.4	34
87/1		—				
87/2		—				
87/3						
87/4		0.86	8.48		2.3	166.9
88/1		—				
88/2		0.26	7.1		1.1	24.1
88/3		—				
88/4		0.14	10.6	2.3	1.8	15.5
89/1		0.77	4.0	5.0		
89/2		0.53	9.1	4.4	5.7	20.2
89/3		—				
89/4		0.55	5.0	4.0	2.5	7.8

WELL #19

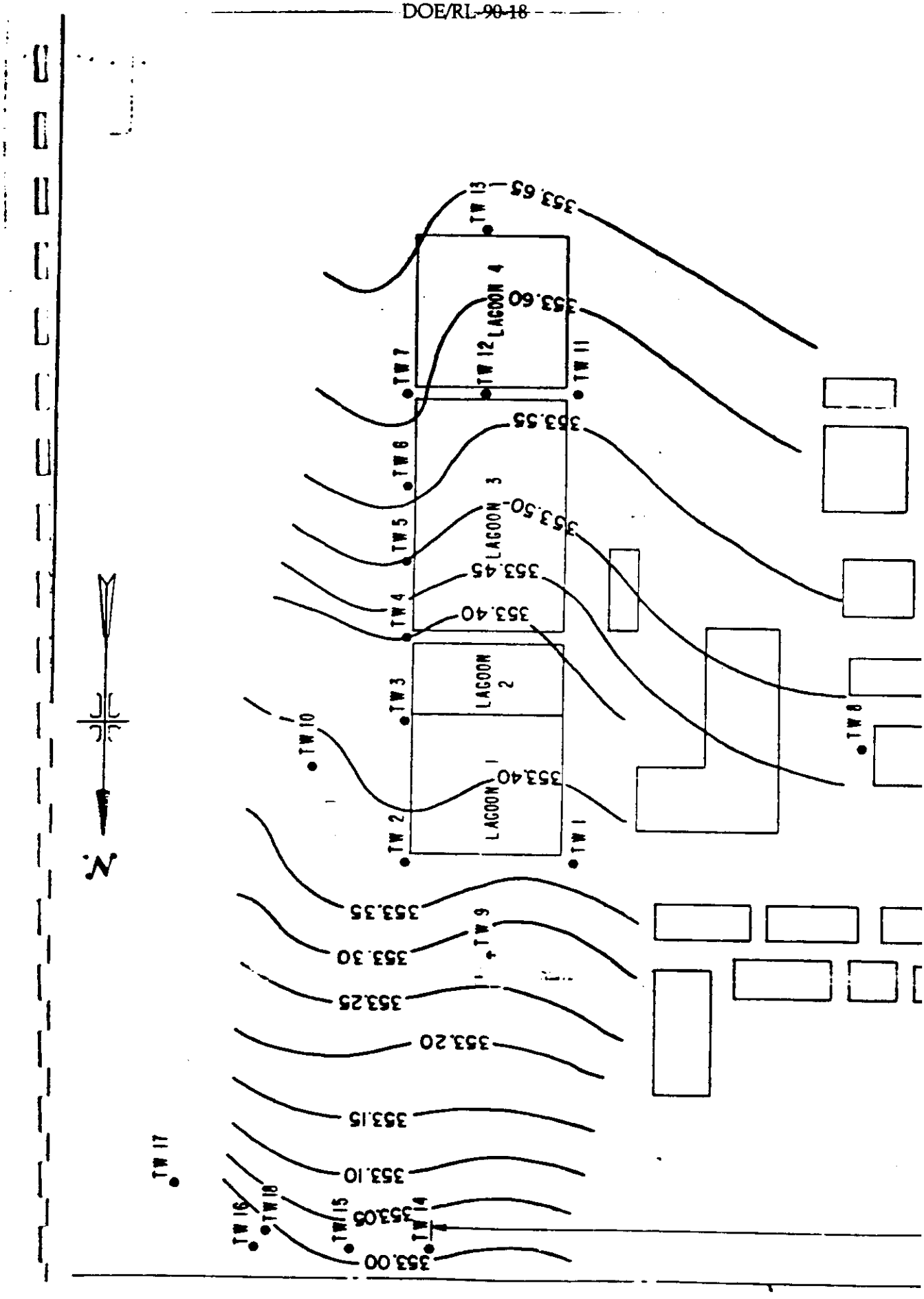
Year	U ppm	Alpha pCi/L	Beta pCi/L	F ppm
81/1				
81/2				
81/3				
81/4				
82/1				
82/2				
82/3				
82/4	<0.1			0.46
83/1	<0.1			1.70
83/2	<0.1			0.55
83/3	<0.1			0.40
83/4	<0.1			0.55
84/1	<0.1			0.43
84/2		4.2	5.5	3.00
84/3		2.8	5.0	2.00
84/4		1.0	4.4	0.30
85/1		4.9	9.3	1.50
85/2		4.1	19.1	2.00
85/3		4.5	19.0	0.20
85/4		4.0	11.5	0.20
86/1		1.2	5.3	0.3
86/2		2.2	8.2	0.3
86/3		2.2	13.6	0.4
86/4		1.5	7.2	0.4
87/1		—		
87/2		3.6	5.8	0.4
87/3		1.2	10.7	0.3
87/4		1.7	9.2	0.3
88/1		1.8	11.6	0.3
88/2		3.1	6.1	0.2
88/3		2.5	9.7	0.3
88/4		1.4	12.4	0.4
89/1		2.4	5.5	0.2
89/2		5.4	10.5	0.3
89/3		1.4	6.3	0.3
89/4		3.4	5.4	0.8

WELL #20

Yr/Qtr	U ppm	Alpha pCi/L	Beta pCi/L	F ppm
81/1				
81/2				
81/3				
81/4				
82/1				
82/2				
82/3				
82/4	<0.1			0.35
83/1	<0.1			0.50
83/2	<0.1			0.50
83/3	<0.1			0.35
83/4	<0.1			0.41
84/1	<0.1			0.37
84/2		2.2	4.8	1.00
84/3		0.8	3.2	1.00
84/4		1.5	5.9	0.40
85/1		3.8	11.0	1.00
85/2		2.4	19.0	0.70
85/3		2.8	8.9	0.30
85/4		3.1	4.1	0.30
86/1		1.7	6.2	0.3
86/2		3.8	9.9	0.2
86/3		1.7	8.4	0.5
86/4		2.8	5.3	0.3
87/1		—		
87/2		1.1	7.9	0.4
87/3		2.1	7.9	0.4
87/4		1.9	8.1	0.3
88/1				
88/2		2.7	6.6	0.3
88/3		2.0	5.2	0.3
88/4		.7	7.2	0.2
89/1		.9	6.8	0.6
89/2		1.4	5.3	0.5
89/3		1.0	2.1	0.7
89/4		1.5	7.0	0.3
		1.6	4.8	0.4

WELL #21

Yr/Qtr	U ppm	= Alpha µCi/L	Beta pCi/L	F ppm
81/1				
81/2				
81/3				
81/4				
82/1				
82/2				
82/3				
82/4				
83/1	<0.1			
83/2	<0.1			0.80
83/3	<0.1			0.35
83/4	<0.1			0.51
84/1	<0.1			0.41
84/2		3.2	8.2	
84/3		2.4	5.9	1.00
84/4		1.6	7.1	0.40
85/1		4.1	17.1	0.50
85/2		2.5	24.0	0.80
85/3		2.6	4.0	0.30
85/4		3.5	4.0	0.30
86/1				
86/2		2.1	3.7	0.2
86/3		2.4	7.6	0.3
86/4		1.3	6.6	0.6
87/1		1.4	5.6	0.3
87/2		2.2	5.5	0.3
87/3		2.4	6.3	0.4
87/4		1.9	4.9	0.3
88/1				
88/2		1.5	6.5	0.3
88/3		2.7	7.5	0.2
88/4		.6	2.2	0.3
		1.7	5.3	0.4
89/1				
89/2		0.6	12.4	0.5
89/3		2.7	2.7	0.4
89/4		3.7	6.4	0.3
		3.1	5.2	0.4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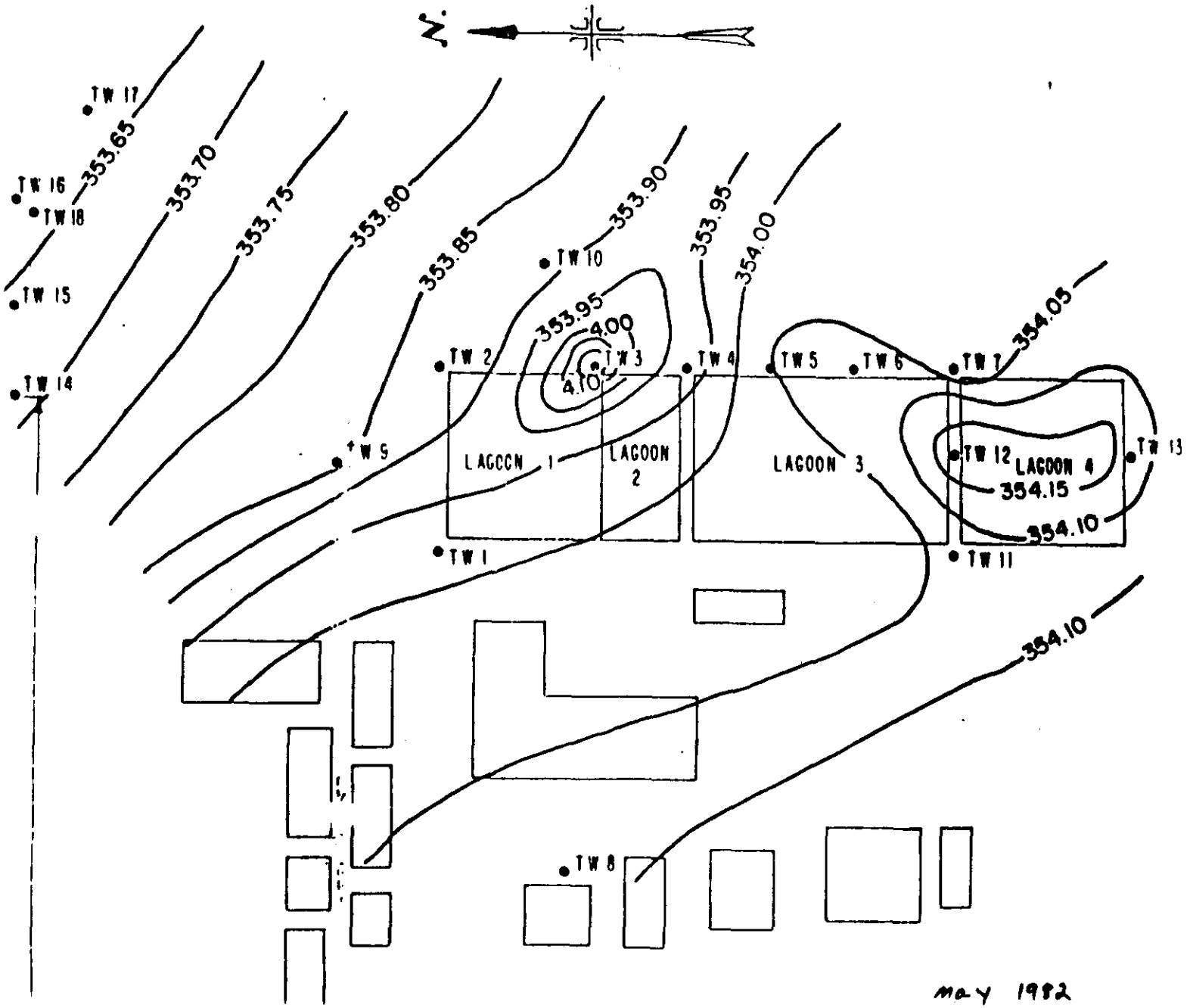
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May 1982

DOE/RL-90-18

WASHINGTON STATE DEPARTMENT OF
Natural Resources

BRIAN BOYLE
Commissioner of Public Lands

OLYMPIA, WA 98504

February 6, 1990

RECEIVED
MAR 22 1990
Golder Associates

Laura Johnson
Golder Associates, Inc.
4104 - 148th Ave NE
Redmond, WA 98052

Subject: **Proposed Project in Benton County,**
Township 10 North, Range 28 East
Section 15 and the Eastern Half of Sections 22 and 27

We've searched the Natural Heritage Data System for information on significant natural features in your study area. Currently, we have no records for rare plants, high quality native plant communities or native wetlands in the vicinity of your project.

The Natural Heritage Data System is a cooperative effort between the Department of Natural Resources' Washington Natural Heritage Program and the Department of Wildlife's Nongame Program. The Washington Natural Heritage Program is responsible for information on the state's endangered, threatened, and sensitive plants as well as high quality native plant communities and wetlands. The Nongame Program manages and interprets data on wildlife species of concern in the state. For information on animals of concern in the state, please contact the Nongame Program, Washington Department of Wildlife, Mail Stop: EX-12, Olympia, WA 98504.

The Natural Heritage Data System is not a complete inventory of Washington's natural features. Many areas of the state have never been thoroughly surveyed. There may be significant natural features in your study area that we don't yet know about. This response should not be regarded as a final statement on the natural features of the areas being considered and doesn't eliminate the need or responsibility for detailed on-site surveys.

I hope you'll find this information helpful.

Sincerely,

Nancy Sprague

Nancy Sprague, Assistant Data Manager
Washington Natural Heritage Program
Division of Land & Water Conservation
Mail Stop: EX-13
Olympia, WA 98504
(206) 753-2449

NS:fg

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HANFORD ENVIRONMENTAL HEALTH FOUNDATION

August 20, 1986

CO 10823

Pacific Northwest Laboratory
Sigma 5
3000 Area

Attn: C. Bishop

WATER SAMPLES ANALYSES

The results of the analysis of water samples received during the month of July, 1986, are on the following table. Analyses were done in accordance with Standard Methods for the Analysis of Water and Wastewater, 16th Ed.

If you have any questions concerning this report, please contact Environmental Health Sciences.

P. A. Thurman
Environmental Health Sciences

lmk

Attachment

P. O. BOX 100, RICHLAND, WASHINGTON 99352

SUMMARY

July 18 thru July 25, 1986 Eleven wells on and near the 1100 and 3000 Areas on the Hanford site were sampled for petrochemicals, herbicides, pesticides and various cations and ions. This was to determine if the ground water beneath the areas was contaminated by past and/or present activities on or near the Hanford site. This was a pilot project and sampling was very limited. Although some chemicals were found in the samples at generally low levels, many others were either not present or present at levels below the detection limits. Further sampling is needed to determine concentration levels and sources.

INTRODUCTION

The following ground-water quality study was undertaken by Pacific Northwest Laboratory (PNL) for the U.S. Department of Energy (DOE). The "1100 and 3000 Area Study" was identified as Task 8 under the Hazardous Materials Monitoring Project. The objective of this pilot study were primarily to determine which, if any hazardous chemicals are present in the ground water beneath the study area and secondarily to better define the local hydrology. Figure one is a map of the study area indicating sites of potential contamination and potential sampling wells.

Since this was a pilot project, only one sampling for chemicals was done in each well. While this is enough to

detect the presents of chemicals in measurable quantities, it is not enough to make conclusive determinations concerning the concentrations of those chemicals. Those determinations will be left to follow-up studies.

BACKGROUND

Since the 1940's various locations within the 1100 and 3000 Areas of the Hanford Site have been used as sites for collection, storage and disposal of potentially hazardous chemicals. Equipment maintenance shops and gasoline stations presently operated by J. A. Jones Construction Company (JAJ) and Rockwell Hanford Operations (RHO) (Figure One) have generated waste oils, battery acid and cleaning solvents. Gasoline and other fuels have been stored in underground tanks.

From 1954 to 1984, disposal practices have included collecting waste oils and either dumping them on the ground or spraying small quantities in the air (letter #R85-0795 to Dr. Don Elle of SQA from HA Haerer of RHO, dated 2-26-85). Other chemicals, such as those used in the radiography-photography lab in the 3000 Area, have been disposed of through the city sewer system (Krupin 1985).

Agricultural activities within the 3000 Area may have allowed pesticides and herbicides to escape into the ground water. The agricultural sites, primarily used for alfalfa hay production, have been cultivated for a number of years.

The old Army Corps of Engineers dump and Exxon-Nuclear facilities also have the potential to chemically contaminate the ground water under the study area.

While past land usage in the study area proper may have provided sources of potential ground-water contamination, other sources peripheral to the 1100 and 3000 Areas may also have introduced hazardous chemicals to the area's ground water. These include a site which adjoins JAJ and the North Richland Well Field where the City of Richland currently stores herbicides and pesticides. The Richland sanitary landfill, located to the west of the study area, is a potential source of a variety of chemical contaminants. The Lamb-Weston potato processing plant, southwest of the study area, is another potential source of chemical contamination, as are abandoned landfills which are also located to the southwest. Figure one shows locations of all the above except the abandoned landfills whose exact locations were not identified.

HYDROLOGY SETTING

The geologic formations which underlie the study area are, in ascending order, the Columbia River Basalt Group, the Ringold Formation, the Hanford formation and eolian sediments. The Columbia River Basalt Group, which is at least several thousand feet thick, is bedrock. Overlying the basalts is the Ringold Formation, that consists of semi-consolidated sediments including bedded silts, quartz-rich

sands and quartzite gravels. Thickness of the Ringold Formation under the 1100 and 3000 Areas is approximately 150 feet (Lindberg and Bond 1979). The Hanford formation, consisting of unconsolidated glaciofluvial sands and gravels, overlies the Ringold Formation. Its thickness in the study area varies considerably but is not greater than 150 feet. Surface sediments, generally less than ten feet thick, are composed of eolian sands that have been stabilized by vegetation and recent alluvium.

Ground water in the North Richland and 1100 and 3000 study area is naturally recharged by the Yakima River and generally flows eastward to discharge into the Columbia River (Lindberg and Bond 1979). Water levels in both rivers affect the elevation of the water table. This elevation is also greatly influenced by artificial recharge.

In the study area the two most significant sources of artificial recharge are irrigation water and the City of Richland's infiltration system. The water level in well 699-S36-E13A (Figure 1) was monitored for most of June and August and all of July with a continuous water-stage recorder. During this time the water-table elevation increased 3.31 ft. This increase seems to be of a regional nature as indicated by increases in other nearby wells. It is attributable, at least in part, to irrigation.

The City of Richland's infiltration system operates by pumping water from the Columbia River into infiltration

ponds and allowing it to percolate into the aquifer. Pumping from the river is regulated to limit mounding of the ground water beneath the ponds. Subsequently, the water is pumped from the aquifer and added to the Richland water supply.

Lawn irrigation in North Richland significantly influences the regional water table by adding in excess of 360 million gallons per 1000 acre area during irrigation season (Myers and Thorne 1982). Waste water from industrial sources such as the Lamb-Weston potato plant also increases the ground-water level (Myers and Thorne 1982). In parts of North Richland, the water table surfaces and drains into a river-channel scar (Newcomb et al. 1972).

METHODS

The objectives of this study were achieved by organizing the task into six major phases: 1) preliminary survey of existing wells, 2) establishment of a sampling network, 3) collection of ground-water samples, 4) biweekly water-table measurements, 5) analysis of results, and 6) preparation of a reviewed letter report.

Survey of Existing Wells

Many of the 1100 and 3000 Area wells, drilled in the 1940's and 1950's at Hanford, were either covered and unused or destroyed. Since many Hanford wells no longer exist, city and private wells were sampled and/or measured to supplement

the data set. Private wells became especially useful for measuring the water table.

Establishment of Sampling Network

To establish a sampling network, several factors were considered: 1) well location, 2) completion depth, 3) accessibility, and 4) suitability for sampling. Figure 2 shows the locations of the eleven wells in the sampling network.

Care was taken to include wells adjacent to and upgradient from the study area so that chemicals present in the ground water prior to its reaching the 1100 and 3000 Areas could be identified. The Off Road Vehicle Park (ORV) well was included in the sampling network even though it did not meet all of the above parameters. Although only marginally acceptable for sampling purposes, it was used in the absence of other accessible wells in that area. This well taps ground water from several zones in the confined aquifer within the basalts. Therefore, data from this well are of limited value since comparison with data obtained from the unconfined aquifer is inappropriate.

Sample Collection

Specific chemicals sought in ground-water analysis were selected by considering primary drinking water standards (40 CFR 141), ground-water quality parameters (40 CFR 141), by evaluation of historical and current chemical use, and by

advice from chemists and scientists who have studied ground water in the Hanford area. In general, samples were analyzed for anions, organics, metals, herbicides, pesticides, and petrochemicals.

The eleven wells sampled varied from those with no pumps to those with large turbine pumps (Table 1). Wells without pumps were purged using a 1/2 horse-power Peabody Barnes submersible pump with a garden hose for discharge. The pump, washed prior to installation, was lowered by hand into each of the five wells without pumps (wells 699-S31-E13, 699-S32-E13A, 3000-G, 699-S36-E13B and 3000D-1). A 20 minute standard purge time was selected. As each well was purged, pH, temperature and conductivity readings were taken every five minutes to ensure ground-water stabilization in each well before sampling began. For most city wells with turbine pumps pumping at rates in excess of 1,000 gpm, several minutes running time was considered sufficient for stabilization. Stabilization was achieved in all wells with the exception of 699-S36-E13B.

Ground-water sampling commenced July 18, 1986 and continued through July 25, 1986. Except for the stabilization method described above, sampling was done in accordance with the Procedures for the Hazardous Materials Monitoring Project as documented in PNL-MA-580 (Earth Science Dept. 1986). In accordance with these procedures, a

depth-to-water measurement was taken with a graduated steel tape prior to purging.

After purging was completed and the pump removed from the five wells (Table 1), a clean teflon bailer was lowered into each well and rinsed twice with well water before samples were drawn. Samples were collected from the top of the water column where many contaminants have been found at the Hanford site (Eddy, Myers and Raymond 1978). Sample bottles were filled from the bailer according to the previously mentioned procedures. Well 699-S31-1 was purged with its permanently installed submersible pump and sampled using the bailer following the procedures outlined above.

After obtaining permission, samples were gathered from the five city wells (3000-D, 3000-N, Athletic Park Complex well, 1100-B and DRV) using the sampling port provided because no direct access to the water down the borehole exists.

Samples were analyzed by U.S. Testing Laboratory (UST) and Hanford Environmental Health Foundation (HEHF). Table 2 is a listing of chemicals analyzed by each laboratory along with the detection limits. Samples were delivered to the labs on the day of collection. Because sampling for this project was done at the same time as the Resource Conservation Recovery Act (RCRA) compliance sampling and analysis was done at the RCRA program labs, quality control samples done specifically for the RCRA compliance sampling

were considered sufficient to ensure analysis integrity. Analysis results on blanks, spikes, and interlab comparisons indicated a high level of quality control.

Water-table Measurement

Depth-to-water measurements were taken twice, about two weeks apart. This data was used to construct water-table maps (figures 3 and 4). Effort was made to take water-table elevations in all wells on the same day. However, many of the private wells were accessible only during evening hours and, therefore, were measured up to several days following measurement of Hanford and city wells.

Measurements were taken using a graduated steel tape except in city wells and some private wells. Getting an accurate depth-to-water measurement in city wells was difficult since the measurement is calculated from pressure in an air line that extends down the casing. The length of these lines were unknown and some were thought to be leaking pressure. Some of the data collected by pressure measurement were not used in water-table map preparation. To improve water-table measurement accuracy in the southern part of the study area, measurements were made in private wells. Most of the private wells were measured with an electric tape because its small probe avoided problems associated with the larger steel tape. Surface elevations for private well locations were extrapolated from a topographic map with a 10 foot interval.

DISCUSSION OF RESULTS

Table 3 shows wells grouped by similar location and lists their chemical concentrations. Well 699-S31-1 was assumed to supply background information characterizing the water coming into the study area. Five other wells made up two more groupings from which rough estimates of variation within the ground water were obtained. These were 699-S31-E13 and 699-S32-E13A in one group and 3000-G, 3000-D and 3000-N (3000 group)in the other.

The sample concentrations indicate that the 3000 group, which included two wells from the North Richland well field (3000-D and 3000-N) respond differently for some chemical constituents than the other wells in the study. Analysis results for most chemical components in this group were either below detection limits or present in very small amounts. This probably reflects the introduction of Columbia River water into ground water that has its origin in the Yakima River.

The one sampling from well 699-S36-E13B appeared to be atypical resulting from high sediment concentrations. As per EPA guidance, samples were not filtered in order to obtain total "recoverable" results. When compared with the rest of the data, metal values in this well were generally in the high range. It is probable that these values resulted from the high sediment concentration in the ground-water sample. This sample was not considered valid and its

results will not be discussed further. To ensure this problem does not reoccur, sampling procedures are being changed so that two samples are collected for metal analysis--one filtered and preserved, the other nonfiltered and preserved.

All wells were sampled for nitrate, sulfate, fluoride, chloride and phosphate. Of the remaining ten wells, fluoride (in 6 of 10 samples), chloride (10 of 10), nitrate (8 0f 10), and sulfate (8 of 10) were found in the ground water samples (Figure 5). Concentrations were generally low reflecting Hanford background levels (reference needed). Chloride was found in higher ( ).0005 ppm) concentrations in the southern part of the study area (1100-B and the Athletic Complex well) ranging from 26 to 50 ppm, with a median value of 38 ppm. For the northern part of the study area (ORV, 699-S31-E13, 699-S32-E13A wells), the range was 2.3 to 5.5 ppm with a median of 4.65 ppm. Concentrations in the 3000 group ranged from 0.8 to 1.1 ppm with a median of 0.85 ppm.

Higher nitrate concentrations formed a band (wells 699-S31-1, 3000D-1, Athletic Complex, and 1100-B) tending from the northwest to southeast through the study area. Outside of the band (wells 699-S31-E13, 699-S32-E13A, the 3000 group, and ORV) concentrations ranged from not detectable ((.02) to 2.4 ppm. Within the band nitrates ranged from 12.5 to 165 ppm. The median was 27 ppm. Further sampling and analysis is necessary to refine the estimate of the

distribution of the concentration levels and to establish the source or sources.

Fluoride concentrations in all wells except ORV ranged from undetectable ((0.1) to .34 ppm. Among the samples, the ORV sample was high with 1.3 ppm.

Sulfate concentrations vary throughout the study area. Concentrations range from undetectable ((.1) low to a high of 40 ppm. No spatial pattern was evident.

All wells were sampled for volatile organics (VOC), acid/base/neutral (semi-volatile) organics (ABN) and/or herbicides and pesticides. The VOA and ABN are indicators of the presence of petrochemicals. Methylene chloride (20 ppb) was found in the ground-water sample from 3000D-1, and bis(2-ethylhexyl) phthalate (22 ppb) was present in the sample from S31-1. Otherwise no petrochemicals, herbicides or pesticides were detected in any of the samples. Total Organic Halogen (TOX) and Total Organic Carbon (TOC) generally fell within acceptable ranges ((ppm) (reference needed).

Samples were tested for the following metals: barium, cadmium, chromium, silver, copper, mercury, sodium, nickel, manganese, vanadium, aluminum, iron, lead and potassium. Of these, barium (in 9 of 10 samples), cadmium (5 of 10), manganese (4 of 10), sodium (10 of 10), potassium (10 of 10), and iron (5 of 10) were found to be present in the

ground-water samples (figure 6). Concentrations for all other metals were below detection limits.

The higher barium concentrations were located in the same band that the higher nitrate values were found. Within the band, barium values ranged from 0.47 ppm to 0.83 ppm with a median of .53 ppm. Outside the band, barium values ranged from undetectable (<0.1 ppm) to 0.23 ppm with a median of .15 ppm.

Samples from three wells (S32-E13A, 3000D-1 and 3000-G) had the highest cadmium levels. These wells are located in the northern half of the study area. Values range from undetectable (<.005 ppm) to a high of 0.035 ppm with a median of .0137 ppm.

Lead traces were found on the northern perimeter of the study area. Concentrations ranged from undetectable (<.0005 ppm) to 0.047 ppm with a median of 0.017 ppm. Throughout most of the study area, lead concentrations were at levels too low to detect.

Although potassium is present throughout the study area, concentrations are thought to be Hanford background levels. The "Hanford average" is about 5 ppm (Price, K.R. 1985). Potassium ranged from 5.1 to 13.2 ppm with a median of 8.5 ppm. Within the 3000 group the range was .95 to 1.82 ppm with a median of 1.10 ppm.

Concentrations of sodium were found to be significantly lower in the 3000 group also, ranging from 3.5 to 4.1 ppm. Sodium concentrations in other parts of the area ranged from 17 to 72 ppm with a median value of 31.0 ppm. which reflects the higher sodium concentrations found in the Yakima River and therefore the ground water (Newcomb and others 1972).

Along the northern perimeter of the study area, manganese was detected ranging from .055 to 1.0 ppm in the samples. It was not detectable in samples from most of the other wells.

Samples for coliform bacteria were drawn from six wells. Well 3000-D tested positive at 2.2 total coliform/100 mL which is the detection limit; all others were negative.

Two water-table maps (Figures 2 and 3) of the 1100 and 3000 Study Areas and part of North Richland were prepared from the water-level measurements taken during this study. Both maps support the eastward flow of the ground water. Both maps have cones of depression centered under the North Richland well field indicating that water is being withdrawn from some of the wells. The first map was constructed from data collected during the two week period of July 21 thru August 1, 1986 (figure 2). The second map (figure 3) was drawn from data collected during the August 4 to August 15, 1986 period.

RECOMMENDATIONS

Even though the chemicals found in the ground-water samples from the 1100 and 300 study area were in what generally appeared to be low concentrations, a follow-up study is recommended. The objective of the follow-up study should be to estimate concentration levels for chemical constituents found in this study. If sources can be established, that should also be an objective.

The following recommendations should considered if the proposed study is conducted. 1) Well 536-13B should be purged only until it has stabilized or allowed to recover after being evacuated to avoid sediment collection with the sample; 2) to obtain better control effort should be made to sample and measure the monitoring wells around the Exxon-Nuclear facilities; 3) if city wells are included in future studies, another means should be found to measure depth-to-water. Perhaps a canyon tape could be used for calibration facilitating more accurate measurements; 4) more background wells especially to the south and west of the 1100 and 3000 should be found or drilled; 5) if private wells are used, a more accurate method of obtaining surface elevations needs to be employed and well completion schedules need to be obtained.

REFERENCES

Eddy, P.A., Myers, D.A., and Raaymond, J.R. 1978. Vertical contamination in the unconfined groundwater at the Hanford Site, Washington: PNL-2724, Pacific Northwest Laboratory,

Haerer, H.A. letter #r85-0795 to Dr. Don Elle of SQA 12-26-85

Krupin, P.J. memo thru Dr. D.R. Elle of SQA 12-14-85

Lindberg, J.W., and Bond, F.W. 1979. Geohydrology and ground-water quality beneath the 300 area, Hanford Site, Washington: PNL-EY-76-c-06-1830, Pacific Northwest Laboratory

Myers, D.A. and Thorne, P.D. letter to Stan Arlt, City of Richland 8-11-1982

Newcomb, R.C., Strnad, R.C., and Frank, 1972, Geology and ground water characteristics of the Hanford Reservation of the U.S. Atomic Energy Commission, Washington: U.S. Geol. Survey Prof. Paper 716

PNL-MA-580 Earth Science Department 1986

Price, K.R. 1986. Environmental Monitoring at Hanford for 1985: PNL-5817, Pacific Northwest Laboratory

40 CFR 141

UST	DETECTION LIMIT	HEHF	DETECTION LIMIT
TOX		Coliform	
TOC		Ions	
Petrochemicals			
VOC		Fluoride	
ABN		Chloride	
Pesticides		Nitrate	
Herbicides		Phosphate	
		Sulfate	
		Metals	
		Barium	
		Cadmium	
		Chromium	
		Silver	
		Copper	
		Mercury	
		Sodium	
		Nickel	
		Manganese	
		Vanadium	
		Aluminum	
		Iron	
		Lead	
		Potassium	

WELL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LMAB	4903	4904	4907	4902	4906	4898	4606	4899	4901	4900	4905
TOX	0.0004	0.0006	0.0002	0.0065	0.0008	0.0006	0.0094	0.0144	0.0124	0	19.6
TOC	4.206	5.762	3.748	1.38	1.001	-0.0855	1.608	2.499	1.278	2.786	9736
F	(0.1	(0.1	(0.1	(0.1	0.28	1.3	0.94	0.34	0.1	0.16	0.27
Cl	0.85	0.8	1.1	5.5	4.5	2.3	4.8	50	26	6	4.2
NO3	0.45	0.35	1.5	2.4	21	(0.2	(0.2	165	33	12.5	(0.2
SO4	20.5	9.1	10	4.4	20.5	(1	(1	5.9	40	16	13.8
Ba	0.11	0.1	0.15	0.2	0.47	(0.10	0.21	0.83	0.53	0.23	1.2
Cd	0.01	(0.0005	(0.0005	0.0072	0.0046	(0.0005	0.035	(0.0005	(0.0005	0.012	(0.0005
Mn	(0.1	(0.01	(0.01	1	0.16	(0.01	0.055	(0.01	(0.01	0.19	1.63
Na	3.5	3.7	4.1	20	20	42.8	43.7	72	31	17	25.4
K	1.1	0.95	1.82	7	9.8	9.6	7.8	13	8.5	5.1	13.2
Fe	(0.03	(0.03	(0.03	32.8	6.7	(0.03	1.67	(0.03	0.068	1.69	16.8
Pb	(0.005	(0.005	(0.005	0.017	0.008	(0.005	0.047	(0.005	(0.005	(0.005	(0.005
Al	(0.5	(0.5	(0.5	(0.5	(0.5	(0.5	(0.5	(0.5	(0.5	(0.5	4.9
Cr	(0.005	(0.005	(0.005	(0.005	(0.005	(0.005	(0.005	(0.005	(0.005	(0.005	(0.005
Ag	(0.005	(0.005	(0.005	(0.005	(0.005	(0.005	(0.005	(0.005	(0.005	(0.005	(0.005
Cu	(0.05	(0.05	(0.05	(0.05	(0.05	(0.05	(0.05	(0.05	(0.06	(0.05	(0.05
Ni	(0.1	(0.1	(0.1	(0.1	(0.1	(0.1	(0.1	(0.1	(0.1	(0.1	(0.1
V	(0.04	(0.04	(0.04	(0.04	(0.04	(0.04	(0.04	(0.04	(0.04	(0.04	(0.04
Hg	(0.0005	(0.0005	(0.0005	(0.001*	(0.0005	(0.0005	(0.001*	(0.0005	(0.0005	(0.0005	(0.0005
ABN				ND	ND**		NT	NT			
VOA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND***	ND
HERB	NT	NT	NT	(0.001	(0.001	(0.0016**	(0.001	(0.001	(0.001	(0.001	(0.001
PEST	NT	NT	NT	(0.001	(0.001		(0.001			(0.001	(0.001
PO4	(0.5	(0.5	(0.5	(0.5	(0.5	(0.5	(0.05	(0.5	(0.5	(0.5	(0.5
COLIFORM	NEG	POS	NEG	NT	NT	NEG	NEG	NEG	NT	NT	NEG

* Inadequate sample volume

** B40 22ppb

*** Methylene Chloride A93 20ppb

**** Inadequate sample

Units in parts per million

NT= Not taken

ND= None detected

WELL	30000	30000	3000N	S31-E13	S32-E13A	ORV	S31-1	ATH C	1100-D	300001	S36-13B
EMAB	4903	4904	4907	4902	4906	4838	4606	4899	4901	4900	4905
TOX	0.4	0.6	0.2	6.5	0.8	0.6	9.4	14.4	12.4	0	19.6
TOC	4206	5762	3748	1380	1001	-85.5	1608	2499	1278	2786	9736
F	(100	(100	(100	(100	280	1300	940	340	100	160	270
Cl	850	800	1100	5500	4500	2300	4800	50000	26000	6000	4200
NO3	450	350	1500	2400	12000	(200	(200	165000	33000	12500	(200
SO4	20500	9100	10000	4400	20500	(1000	(1000	5900	40000	16000	13000
Ba	110	100	150	200	470	(100	210	830	530	230	1200
Cd	10	(0.5	(0.5	7.2	4.6	(0.5	35	(0.5	(0.5	12	(0.5
Mn	(100	(10	(10	1000	160	(10	55	(10	(10	190	1630
Na	3500	3700	4100	20000	20000	42000	43700	72000	31000	17000	25400
K	1100	950	1820	7000	9000	9600	7000	13000	8500	5100	13200
Fe	(30	(30	(30	32000	6700	(30	1670	(30	68	1690	16000
Pb	(5	(5	(5	17	8	(5	47	(5	(5	(5	(5
Al	(500	(500	(500	(500	(500	(500	(500	(500	(500	(500	4900
Cr	(5	(5	(5	(5	(5	(5	(5	(5	(5	(5	(5
Ag	(5	(5	(5	(5	(5	(5	(5	(5	(5	(5	(5
Cu	(50	(50	(50	(50	(50	(50	(50	(50	(60	(50	(50
Ni	(100	(100	(100	(100	(100	(100	(100	(100	(100	(100	(100
V	(40	(40	(40	(40	(40	(40	(40	(40	(40	(40	(40
Hg	(0.5	(0.5	(0.5	(1*	(0.5	(0.5	(1*	(0.5	(0.5	(0.5	(0.5
ABN				ND	ND**		NT	NT			
VOA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND***	ND
HERB	NT	NT	NT	(1	(1	(1.6****	(1	(1	(1	(1	(1
PEST	NT	NT	NT	(1	(1		(1			(1	(1
PO4	(500	(500	(500	(500	(500	(500	(50	(500	(500	(500	(500
COLIFORM	NEG	POS	NEG	NT	NT	NEG	NEG	NEG	NT	NT	NEG

* Inadequate sample volume
** B40 22ppb
*** Methylene Chloride A93 20ppb
**** Inadequate sample

Units in parts per billion

NT= Not taken
ND= None detected

50 ppb

Bishop

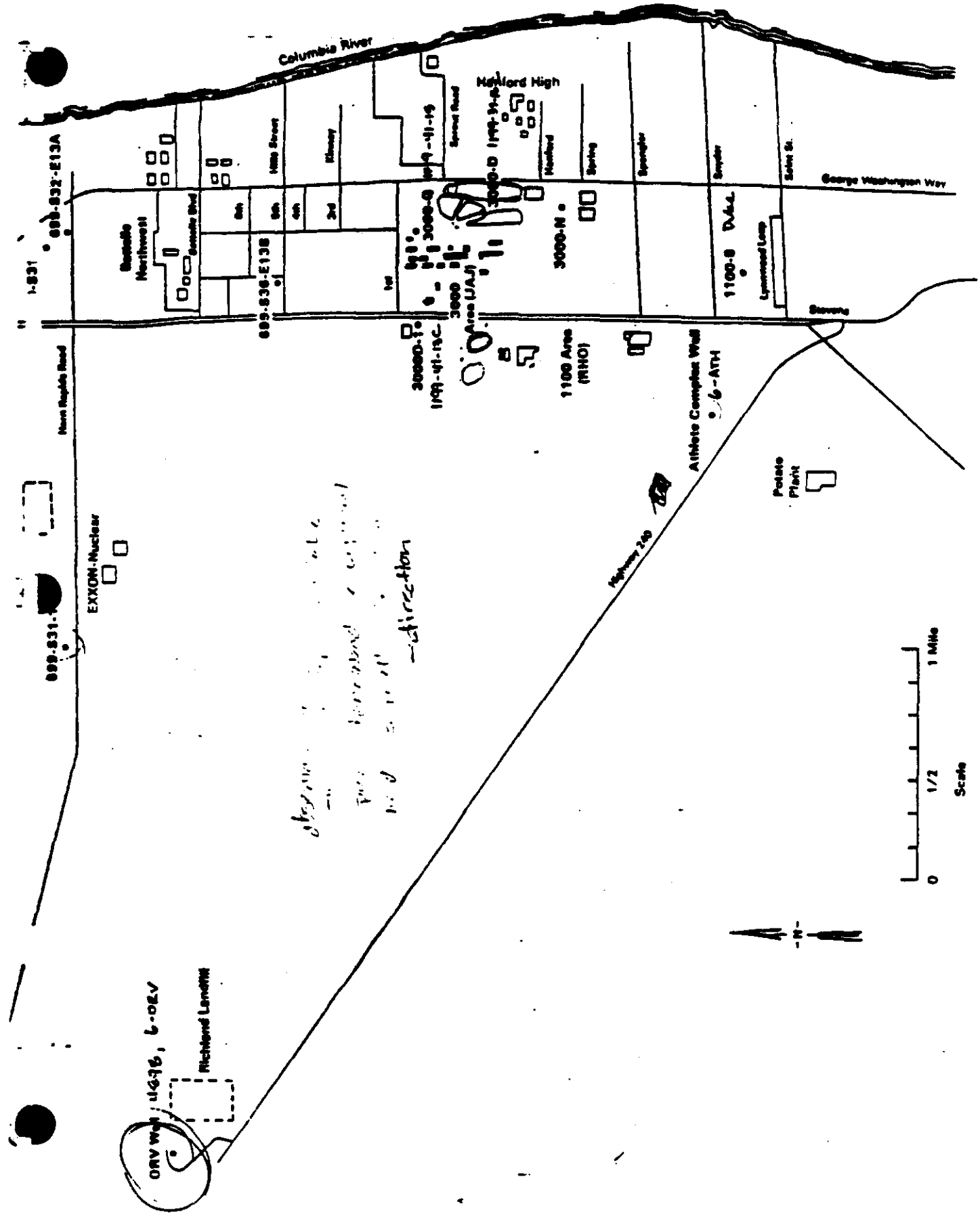
CO 1

Parameters (mg/L)	3000D-1 Samples				3000-4	
	699-S-31-1 (4606)	699-S-31-E13 (4902)	1191-41-13C (49000)	699-S36-13B (4905)	1199-41-15 (4903)	699-S32-E13A (4906)
Fluoride 2 ppm	0.94	<0.1	0.16	0.27	<0.1	0.28
Chloride 250 ppm	4.8	5.5	6.0	4.2	0.85	4.5
Nitrate (NO_3) 10 ppm = N	<0.2	2.4	12.5	<0.2	0.45	21.0
Phosphate —	<.05	<0.5	<0.5	<0.5	<0.5	<0.5
Sulfate 250 mg/L	<1	4.4	16	13.8	20.5	20.5
Barium 1 ppm	0.21	0.20	0.23	1.2	0.11	0.47
Cadmium 10 ppb	0.035	0.0072	0.012	<0.0005	0.010	0.0046
Chromium 50 ppb	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver 50 ppb	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper 1 ppm	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Mercury 2 ppb	<0.001*	<0.001*	<0.0005	<0.0005	<0.0005	<0.0005
Sodium —	43.7	20	17	25.4	3.5	20
Nickel —	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese 50 ppb	0.055	1.0	0.19	1.63	<0.01	0.16
Vanadium —	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Aluminum —	<0.5	<0.5	<0.5	4.9	<0.5	<0.5
Iron —	1.67	32.8	1.69	16.8	<0.03	6.7
Lead 50 ppb	0.047	0.017	<0.005	<0.005	<0.005	0.008
Potassium —	7.8	7.0	5.1	13.2	1.1	9.8

C. Bishop

CO 10823

Parameters (mg/L)	Samples				
	3000N (4907)	3000-D 1199-39-16C (4904-D)	6-OQV 4898	6-ATH Horn Rapids Athletic Complex (4899)	1100-B Duke Well (4901)
Fluoride	<0.1	<0.1	1.3	0.34	0.1
Chloride	1.1	0.8	2.3	50	26
Nitrate	1.5	0.35	<0.2	165	33
Phosphate	<0.5	<0.5	<0.5	<0.5	<0.5
Sulfate	10.0	9.1	<1	5.9	40
Barium	0.15	0.10	<0.10	0.83	0.53
Cadmium	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	<0.005	<0.005	<0.005	<0.005	<0.005
Silver	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	<0.05	<0.05	<0.05	<0.05	0.06
Mercury	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Sodium	4.1	3.7	42.8	72	31
Nickel	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	<0.04	<0.04	<0.04	<0.04	<0.04
Aluminum	<0.5	<0.5	<0.5	<0.5	<0.5
Iron	<0.03	<0.03	<0.03	<0.03	0.068
Lead	<0.005	<0.005	<0.005	<0.005	<0.005
Potassium	1.82	0.95	9.6	13	8.5


Columbia River
Hanford High
George Washington Way
Stevens
Sanford Road
Hanford
Stirling
Spengler
Snyder
Sanford St.
Hills Street
Kinsey
Sanford Blvd
Sanford Northwest
8th
6th
4th
2nd
1st
I-931
699-832-E13A
699-836-E13B
3000-N
3000-D
1100-B
Lynnwood Loop
1100 Area (RHO)
Athlete Complex Well
Potato Plant
Highway 240
EXXON-Nuclear
North Rapids Road
Richland Landfill
0
1/2
1 Mile
Scale
N

CITY OF RICHLAND

WATER SYSTEM DATA

A. PRODUCTION

The City of Richland's water supply comes from two major sources:

1. Water Treatment Plant: The Water Treatment Plant uses the "Micro-Floc" process for water treatment (see attached flow diagram). Its present design production capacity is 30 million gallons per day. The plant can be expanded to a maximum production capacity of 45 MGD.
2. Wells: The 18 wells are located in five well fields. The total production capacity of all the wells is 18.2 MGD. The North Richland well field groundwater is recharged artificially through the use of recharge basins (see attachment). The wells are recharged through the months of April to November.

The production capacities can be summarized as follows:

Source	# Wells	Capacity
Columbia Well Field	1	0.8 MGD
Duke Well Field	2	2.0 MGD
North Richland Well Field & D-5	11	11.0 MGD
Wellsian Way Well Field	3	3.0 MGD
Willowbrook Well	1	1.4 MGD
Water Treatment Plant		30.0 MGD
TOTAL	18	48.2 MGD

B. STORAGE

The City of Richland's water system has a water storage capacity of 23.67 million gallons. The major elevated storage, a five and ten million gallon reservoir, is located west of the Yakima River. The other elevated storage consists of five additional reservoirs, with a capacity of 4.47 million gallons and are also located west of the Yakima River, serving the Badger Mountain Area. Water from the remaining reservoirs is pumped into the system by booster pumps.

Storage can be summarized as follows:

Storage		Capacity
Two (2) one-million gallon reservoirs (1182)		2.0 MG
Five million gallon reservoir		5.0 MG
Ten million gallon reservoir		10.0 MG
Water Treatment Plant Clearwell reservoir		2.2 MG
Tapteal I reservoir (reservoir #1)		0.75 MG
Tapteal I reservoir (reservoir #2)		2.6 MG
Tapteal II reservoir (reservoir #1)	Upper Pressure Zone	0.18 MG
Tapteal II reservoir (reservoir #2)	Upper Pressure Zone	0.7 MG
Country Ridge reservoir	Upper Pressure Zone	0.24 MG
TOTAL		23.67 MG

C. TRANSMISSION

All water transmission lines, 10" or larger, are shown on the utility map of the City of Richland. The major transmission lines are shown on the attached facilities location map.

D. PRESSURE ZONES

The City of Richland has three pressure zones:

1. Richland City core area.
2. Badger Mountain/Meadow Springs area (area west of Yakima River) - Tapteal I pressure zone.
3. Badger Mountain/Meadow Springs area (higher elevations west of Keene Road and portion of Hills West area) - Tapteal II pressure zone.

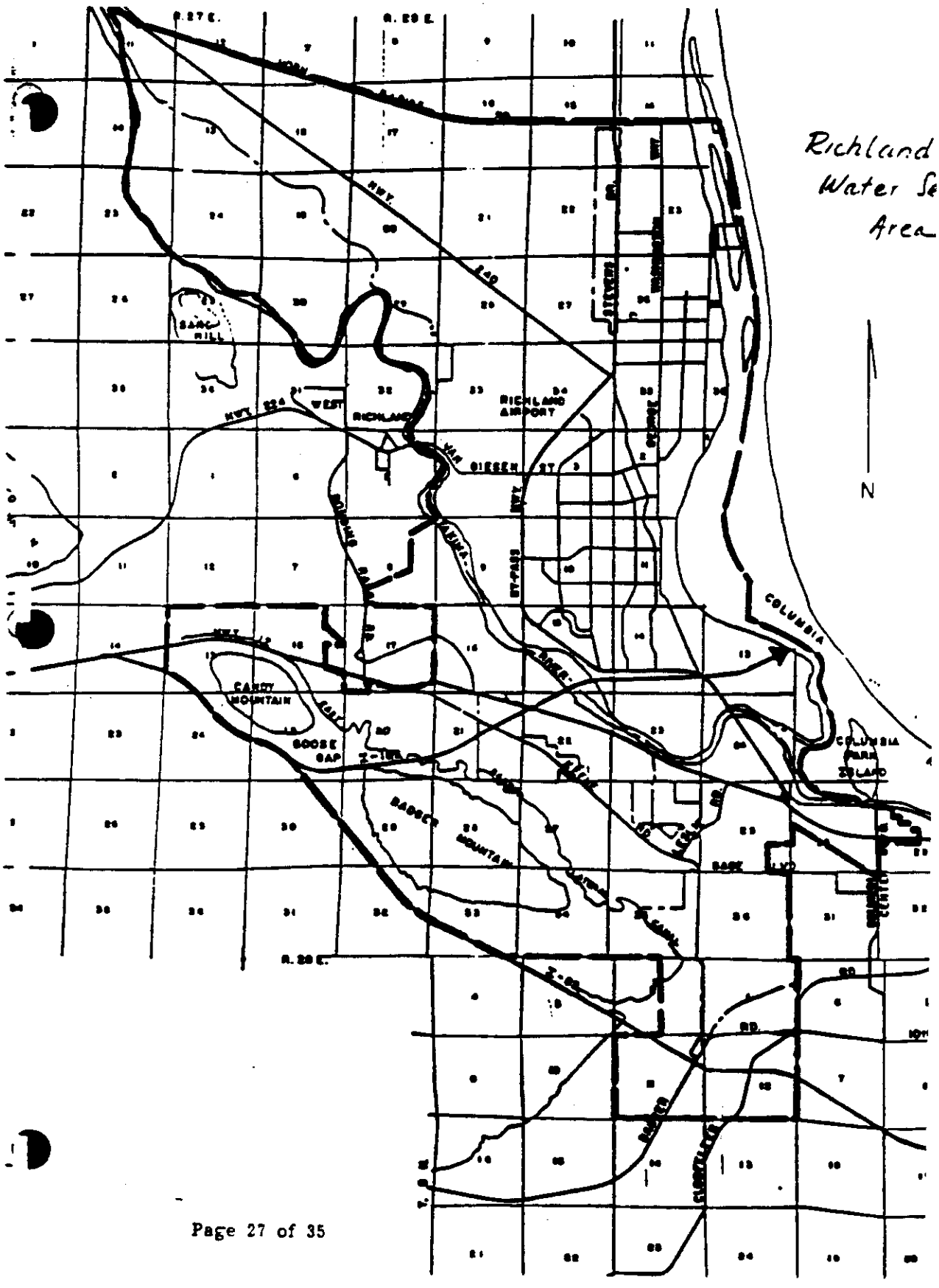
The Badger Mountain/Meadow Springs area water is pumped from the Richland City core pressure zone to the higher Badger Mountain pressure zone. The booster pump station for this zone is located at the five and ten million gallon reservoirs.

The third pressure zone is supplied by (1) a pumping station off High Meadows Street and currently serves the majority of homes on High Meadows Street, Hillview Drive and all homes west of Orchard Court on Orchard Way and Greenview Drive, and (2) a pumping station on Keene Road at Country Ridge and serves the Country Ridge Keene Village area.

7-9-84

CITY OF RICHLAND
GROUND WATER WELLS
PUMP AND MOTOR INFORMATION (NAME PLATE DATA)

Pump Name	Year of Installation	Motor Data: Make	Type	Size (HP)	Serial No.	Voltage	Phase	60 hz FL AMP	S.F.	Pump Data: Make	Type	Size (GPM)	Serial No.	RPM
3000 Area (North Richland)														
A	1940	General Electric	12P56245	75	MD36700755	220/440	3	102/91 @ 1765 RPM	1.15	Fairbanks Morse	Vert.	700	RJ3054	1760
B	1940	General Electric	31E2625	75	YD6711649	220/440	3	102/91 @ 1765 RPM	1.15	Fairbanks Morse	Vert.	700	RJ3052	1760
C	1940	Westinghouse	ABCD	100	6278531G30	220/440	3	230/119 @ 1775 RPM	1.15	Fairbanks Morse	Vert.	800	RJ3051	1760
D	1940	Fairbanks Morse	QBHV	125	F170949	220/440	3	292/146 @ 1765 RPM	1.15	Fairbanks Morse	Vert.	850	PR1048	1760
E	1940	Fairbanks Morse	QBHV	250	597055	440	3	290 @ 1775 RPM	1.15	Fairbanks Morse	Vert.	2,200	PR7108	1760
H	1940	Fairbanks Morse	QBHV	200	590593	440	3	232 @ 1770 RPM	1.15	Fairbanks Morse	Vert.	1,800	PR1049	1760
J	1954	Fairbanks Morse	QBHV	125	F187044	220/440	3	292/146 @ 1765 RPM	1.15	Fairbanks Morse	Vert.	850	PR1047	1760
K														
L	1954	Fairbanks Morse	QBHV	125	F170948	220/440	3	292/146 @ 1765 RPM	1.15	Fairbanks Morse	Vert.	850	PR2111	1760
M	1961	General Electric	5K6276 KC6A	100	GMJ223115	220/440	3	242/121 @ 1770 RPM	1.15	Western Pump	Vert.	800	14936	1760
D5	1944	General Electric	31E2620	75	YEJ6711635	220/440	3	101/90.5 @ 1765 RPM	1.15	Fairbanks Morse	Vert.	700	RJ3056	1760
1100 Area (Duhe Field)														
A	1940	General Electric	31E2625	75	YD6711630	220/440	3	102/91 @ 1765 RPM	1.15	Fairbanks Morse	Vert.	600	RJ3059	1760
B	1940	Westinghouse	ABCD	100	6278531G30	220/440	3	230/119 @ 1775 RPM	1.15	Fairbanks Morse	Vert.	800	RJ3053	1760
(Columbia Field) B	1940	General Electric	31E2625	75	YD6711611	220/440	3	102/91 @ 1765 RPM	1.15	Fairbanks Morse	Vert.	600	RJ3055	1760
Hallsian Way 4		General Electric	31E2620	75	YD6711637	220/440	3	102/91 @ 1765 RPM	1.15	Worthington	Vert.	800	96168	1760
5	1943	U. S. Elec. Motor	CPU	60	338265	220/440	3	147/73.5 @ 1000 RPM	1.15	Worthington	Vert.	800	96169	1500
14		U. S. Elec. Motor	CPU	50	359795	220/440	3	122/61 @ 1000 RPM	1.15	Worthington	Vert.	525	96647	1000
Willowbrook Well Well		U. S. Elec. Motor	RU	150	R-6375 R2138174 T-1000091-934	460	3	173 @ 1770 RPM	1.15	Layne	Vert.	1,000 @ 400'	P00113	1760
Booster		U. S. Elec. Motor	RU	75	R-6327-04-070 R-21435111M	460	3	91.5 @ 1765 RPM	1.15	Layne	Vert.	1,000 @ 215'	P00114	1760

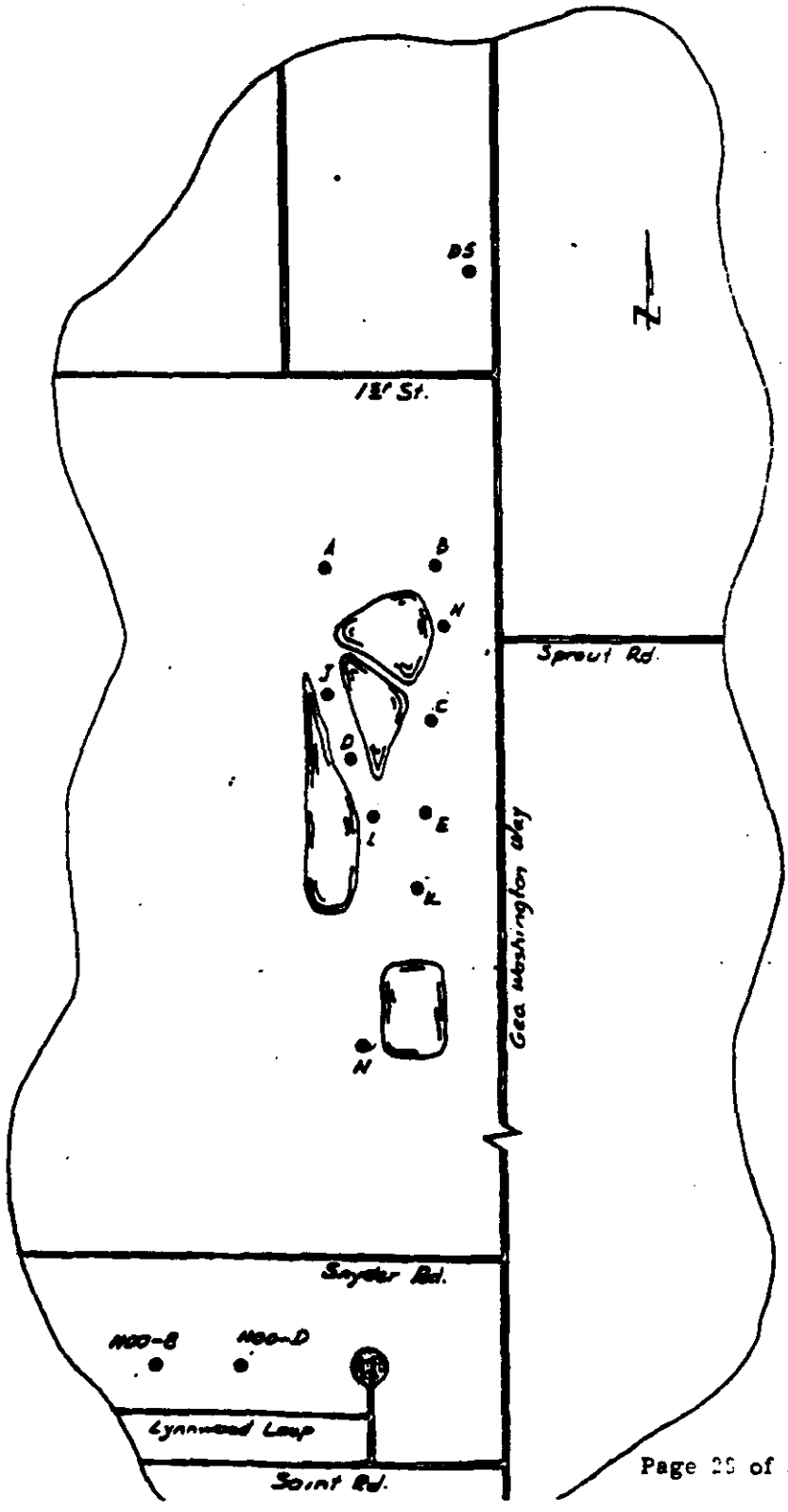

Richland
Water Se
Area
N
R. 27 E.
R. 28 E.
R. 29 E.
HWY.
SAND HILL
WEST RICHLAND
RICHLAND AIRPORT
GIBBEN
BYPASS
COLUMBIA
CANTY MOUNTAIN
GOOSE GAP
RABBIT MOUNTAIN
COLUMBIA PARK
BASIN

Attachment

NORTH RICHLAND WELLS

North Richland Well Field

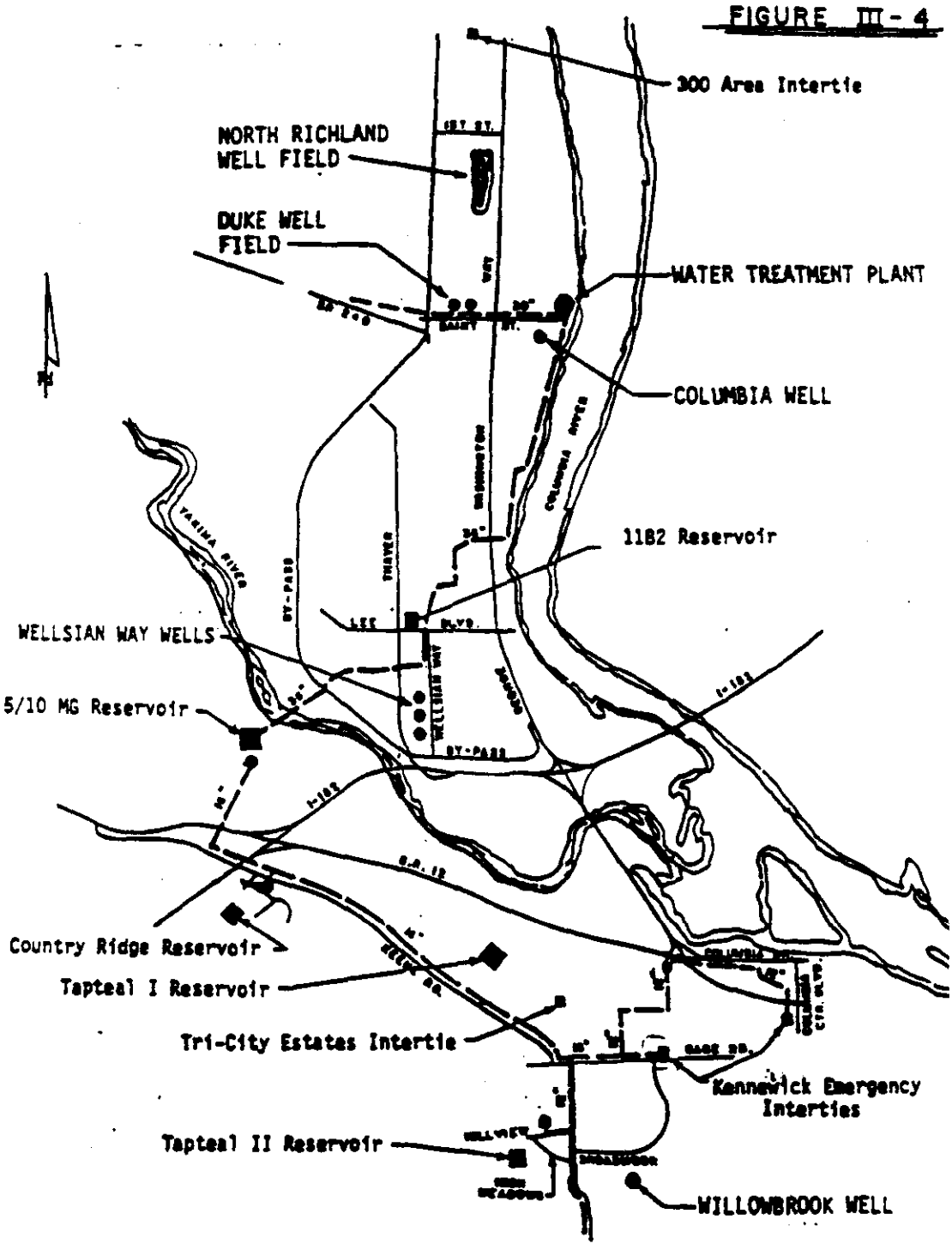
Well #	Depth
3000-A	88'
3000-B	87'
3000-C	64'
3000-D	75.3'
3000-E	61.8'
3000-H	56'
3000-J	71'
3000-K	59'
3000-L	83'
3000-N	40'
3000-D5	134'



Duke Well Field

Well #	Depth
1100-B	120'
1100-D	86'

FIGURE III-4



CITY OF RICHLAND

WATER SYSTEM SOURCE and STORAGE FACILITIE LOCATION MAP

LOG & AS-B ILT DIAGRAM

FIGURE 1

DRILLER: ONWEGO DRILLING CO., INC.
COMPLETION DATE: 11-4-82
ALTITUDE: 475 ± 5 FT. FROM SITE TOPO. MAP

HYDROLOGIC UNIT | LOG DEPTH IN FEET | WATER LEVEL | AS BUILT

— GROUND SURFACE —

Slightly silty SAND: grades from very fine to medium sand, grey

Silty, medium SAND: grades from very fine to coarse sand, grey

Slightly fine, gravelly, coarse SAND: 10% gravel, 90% sand, grades from fine sand to fine gravel, grey

Silty, medium SAND: grades from very fine to coarse sand, grey

Slightly silty, coarse SAND: grades from very fine to very coarse sand, grey

Silty, medium SAND: grades from very fine to coarse sand, grey

— RINGOLD FORMATION? —

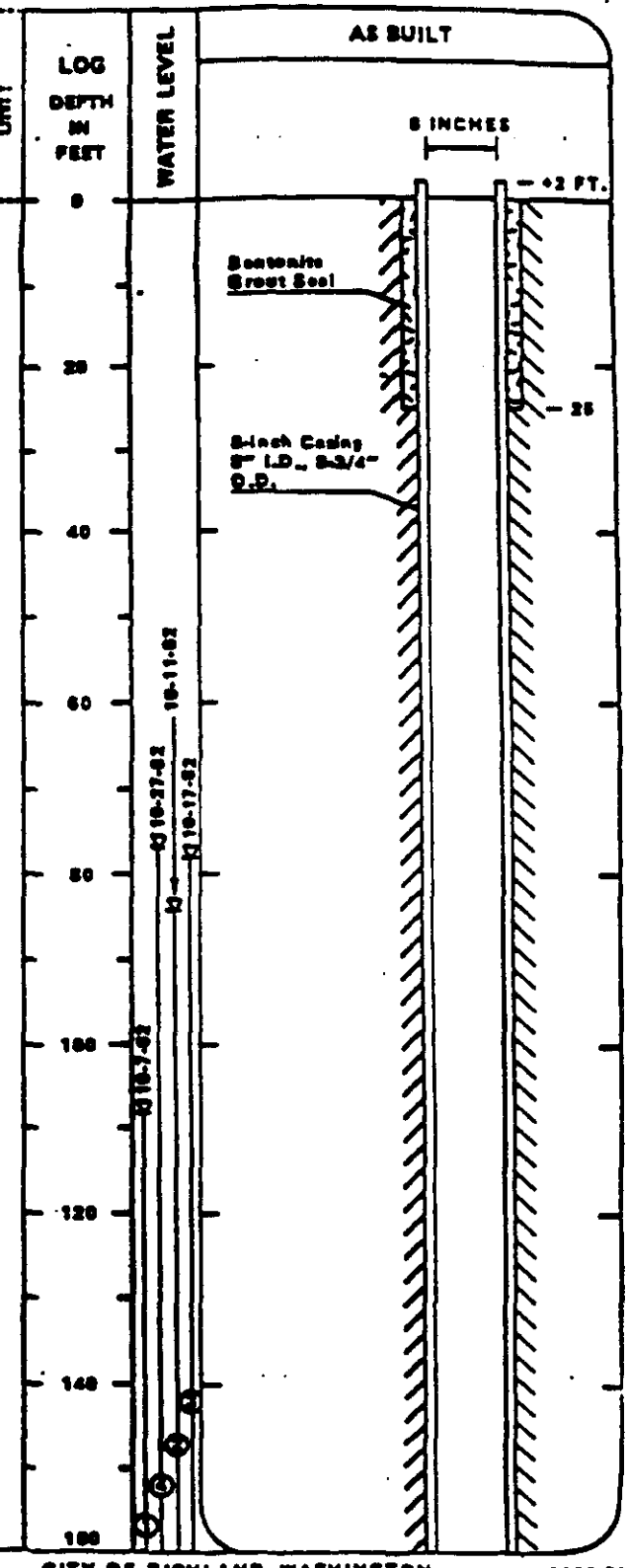
Silty, gravelly SAND: fine to medium gravelly, silty, fine sand; 30% gravel, 50% sand, 10% silt; grades from very fine sand to medium gravel, gravel became more compact with depth

WATER-BEARING AT 198 FT.

Silty, gravelly SAND: fine to medium gravelly, silty, fine sand; 10% gravel, 70% sand, 20% silt, sand grades from very fine to coarse, grey, formation compact throughout

Silty, gravelly SAND: fine, gravelly, silty, fine sand; 5% gravel, 75% sand, 20% silt; grades from very fine to coarse sand, dark grey

Slightly sandy CLAY: blue-black with occasional basalt fragments



SHANNON & WILSON, INC.
GROUNDWATER SECTION
SEATTLE, WASHINGTON
(206) 632-8020

CITY OF RICHLAND, WASHINGTON
HORN RAPIDS TRIANGLE O.R.V. PARK

O.R.V. PARK WELL #1

W-3552-02
NOV. 1982

PAGE 1 OF

LOG & AS-BUILT DIAGRAM

FIGURE 1

DRILLER:
COMPLETION DATE:
ALTITUDE:

	HYDROLOGIC UNIT	LOG DEPTH IN FEET	WATER LEVEL	AS BUILT
Slightly sandy CLAY: blue-black with occasional basalt fragment		160		
Slightly sandy CLAY: dark brown, with occasional basalt fragments (basalt gravels)				8-inch Casing 8" I.D., 8-3/4" O.D.
Slightly sandy CLAY: blue to black, with basalt fragment content increasing with depth		180		
TOP OF BASALT		200		
WATER-BEARING, rubbly BASALT: broken basalt, and black CLAY				Drive Shoe
BASALT: gray, hard		220		
				8-inch Open Bore Hole From 217 - 286 Ft.
		240		
		260		
		280		6-inch Liner Casing, 5" I.D., 6-1/2" O.D.
WATER-BEARING BASALT: gray, fractured				Torch Slot Perforations 286 - 294 Ft.
Gray, broken BASALT: basalt gravel and blue-green clay		300		
Blue CLAY with some broken BASALT: contains some water				Unperforated 294 - 322 Ft.
		320		

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CITY OF RICHLAND, WASHINGTON
HORN RAPIDS TRIANGLE O.R.V. PARK

O.R.V. PARK WELL #1
Page 31 of 35

LOG & AS-B' 'LT DIAGRAM

FIGURE 1 CONT.

DRILLER:
COMPLETION DATE:
ALTITUDE:

HYDROLOGIC UNIT | LOG DEPTH IN FEET | WATER LEVEL | AS BUILT

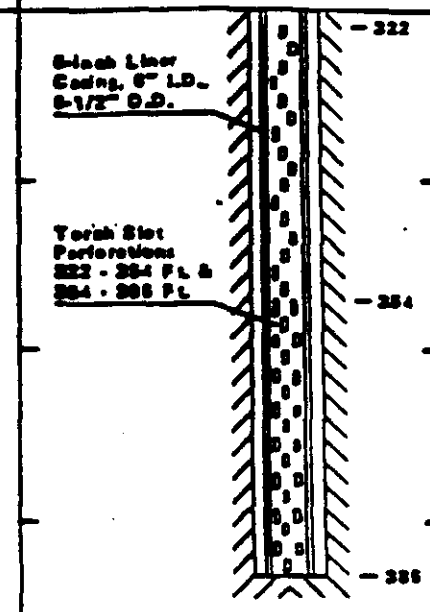
WATER-BEARING, broken BASALT with some blue CLAY

BASALT, grey, hard

WATER-BEARING BASALT: vesicular, brownish-black with bluish-green claystone vein fillings

WATER-BEARING BASALT: very porous, reddish-brown

TOTAL DEPTH 385 FEET



NOTES

1. 6-INCH LINER—PERFORATION SUMMARY. TORCH-SLOT PERFORATION (1/2 INCH WIDE BY 6 INCHES LONG)
   32 PERFORATIONS FROM 285 - 294 FT.
   64 PERFORATIONS FROM 322 - 354 FT.
   128 PERFORATIONS FROM 354 - 385 FT.
2. WELL WAS PUMPED AT 325 GALLONS PER MINUTE FOR 16 HOURS. STATIC-WATER LEVEL WAS 77 FEET BELOW GROUND SURFACE. DRAWDOWN WAS 14-1/2 FEET WITH PUMPING WATER LEVEL AT 91-1/2 FEET.

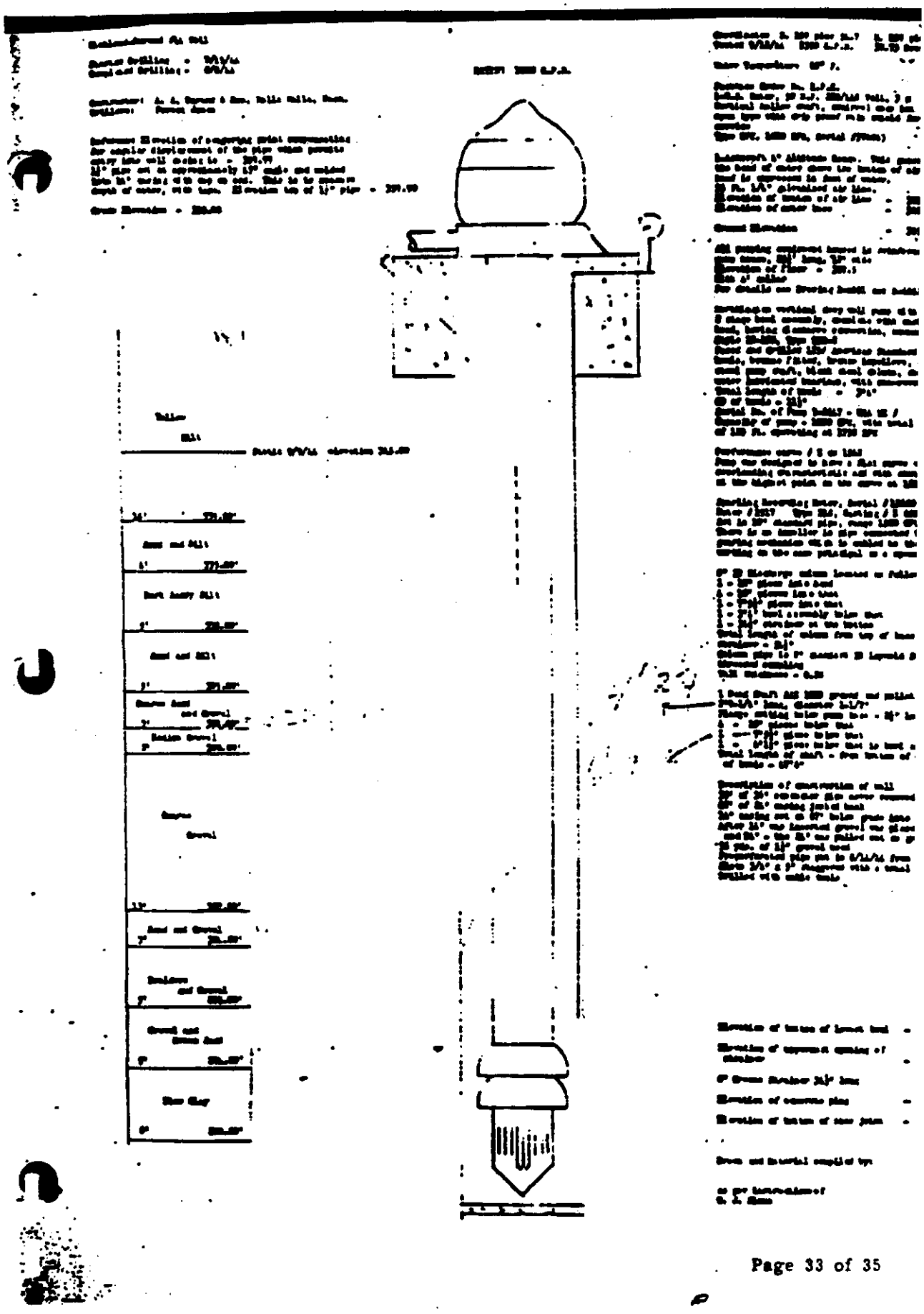
SHANNON & WILSON, INC.
GROUNDWATER SECTION
SEATTLE, WASHINGTON
(206) 632-8020

CITY OF RICHLAND, WASHINGTON
HORN RAPIDS TRIANGLE O.R.V. PARK

O.R.V. PARK WELL #1

W-3982-02
NOV. 1982

PAGE 3 OF



Page 33 of 35

SIMPLIFIED GEOLOGIC CROSS SECTION

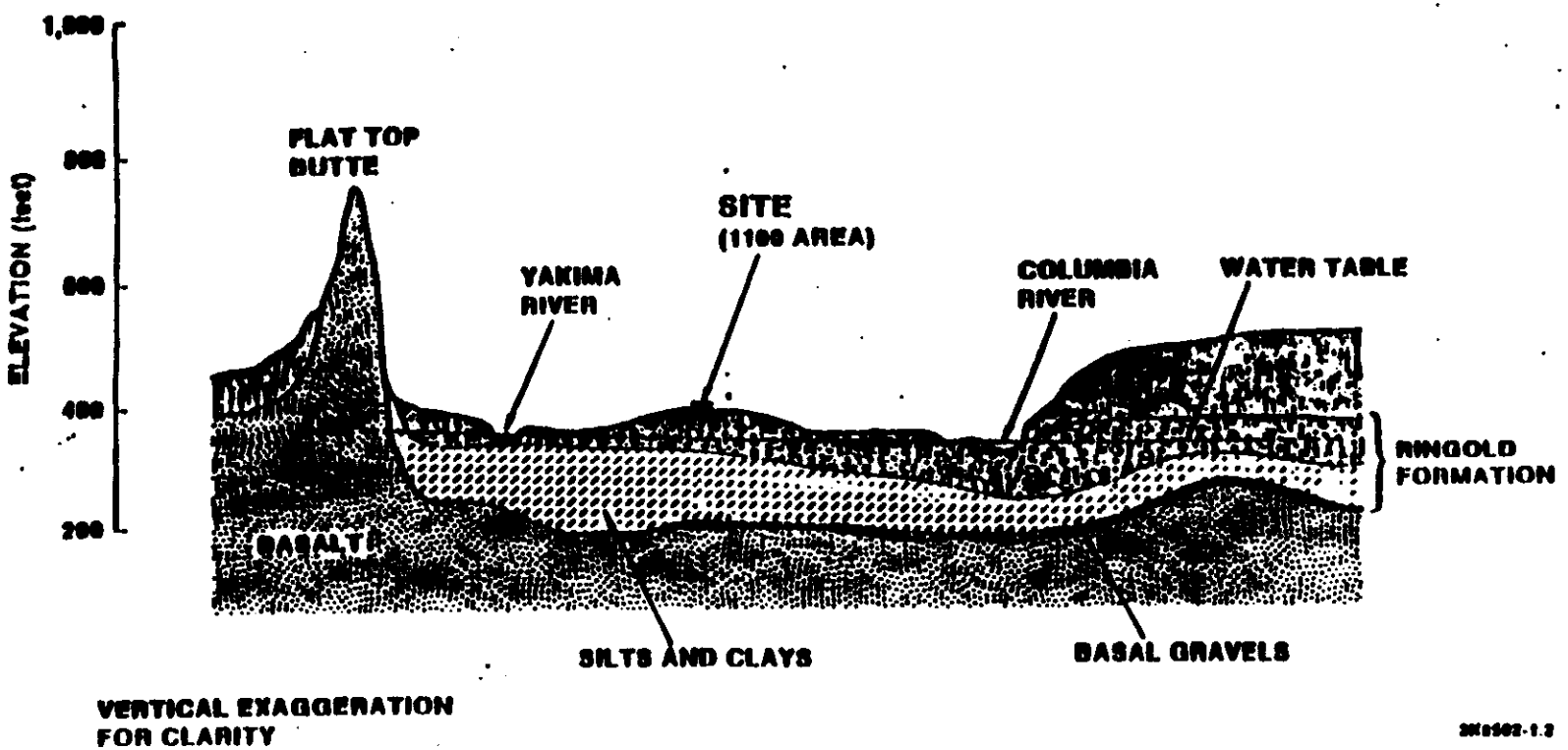
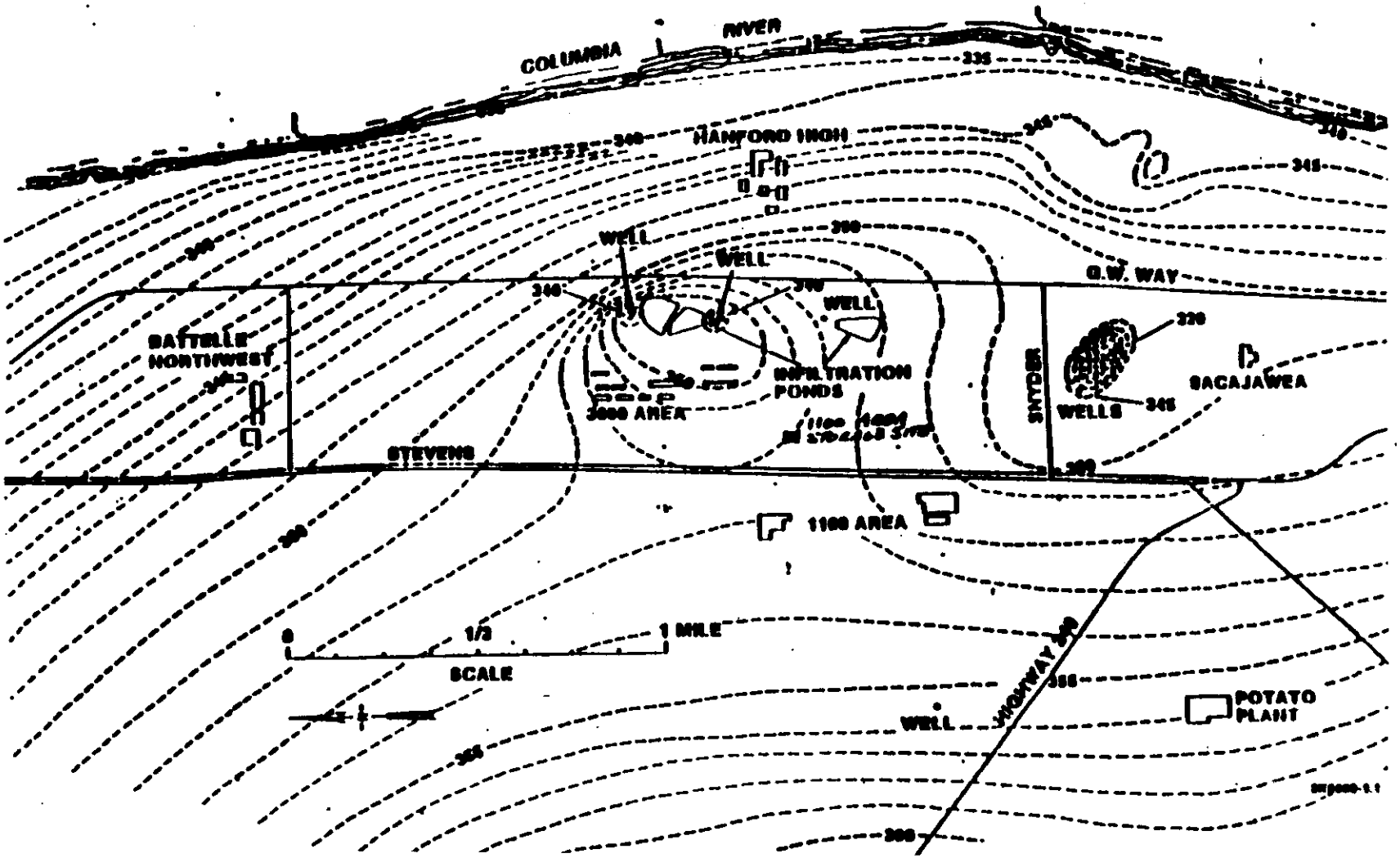


FIGURE 3. Hydrologeologic Characteristics of the 1100 Area

Rob Peterson, 1997


COLUMBIA
RIVER
HANFORD HIGH
WELL
WELL
WELL
G.W. WAY
BATTELLE NORTHWEST
INFILTRATION PONDS
3000 AREA
SNYDER
WELLS
SACAJAWEA
STEVENS
1100 AREA
0
1/2
1 MILE
SCALE
WELL
HIGHWAY 240
POTATO PLANT

SUBAPPENDIX A-2
MEMORANDUMS

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DON'T SAY IT -- WRITE IT!

TO: Bill Wright - GAI DATE: February, 22, 1990

FROM: Steven Clark - WHC S.W. Clark

SUBJECT: TRANSMITTAL OF RICK MCCAIN'S RECONNAISSANCE PLAN FOR THE HORN RAPIDS LANDFILL

Per your request, find attached a copy of R. G. McCain's Reconnaissance Plan for the Horn Rapids Landfill, dated October 29, 1989.

Clark, S., WHC [Memo to B. Wright, GAI] February 22, 1990

R.G. McCain October 29, 1989

Reconnaissance Plan
Horn Rapids Landfill

1. INTRODUCTION

The Horn Rapids Landfill is located on the southern boundary of the Hanford site, immediately north of Horn Rapids Road, and approximately 1/2 mile west of Stevens Drive. It was operated as a solid-waste landfill from approximately 1950 to 1970, primarily for office and construction waste. The site is reported to have received indeterminate quantities of hazardous chemicals (possibly in drums), tires, asbestos materials, construction debris, and scrap lumber. Evidence also exists of liquid disposal; probably sewage sludge and/or fly ash. It was apparently used by a variety of contractors, and unauthorized dumping by both onsite and offsite parties was reportedly a continuing problem. However, no records of waste disposal are available.

The Horn Rapids Landfill is included in the 1100-EM-1 Operable Unit, for which a Remedial Investigation / Feasibility Study (RI/FS) Work Plan has been developed by Westinghouse Hanford and approved by EPA in August 1989. Part of the RI effort will be oriented toward determining the nature and extent of contamination at the Horn Rapids Landfill. Work elements include a surface radiation survey, geophysical surveys (electromagnetic induction, magnetometer, metal detector, and ground penetrating radar (GPR)), soil gas surveys, surface reconnaissance mapping, surface soil sampling, vadose zone sampling, and groundwater monitoring wells. The purpose of this document is to summarize available data and to present a plan for surface reconnaissance mapping. The results of the surface mapping effort will be used to locate vadose zone borings and groundwater monitoring wells.

2. BACKGROUND

A surface radiation survey was completed in December of 1988. No evidence of surface radioactivity was found. Geophysical surveys and soil gas surveys were conducted along a 100-ft grid during March - April 1989. Aerial photographs were taken in May of 1989, and a topographic map was prepared. Figure 1 is a topographic map of the Horn Rapids Landfill. Figure 2 shows indications of possible waste burial trenches as determined from geophysical data, and indications of elevated levels of chlorinated solvents in soil gas, both overlain on the topography. Evaluation of stereo air photos also indicates several probable waste burial areas. Figure 3 indicates suspect areas detected from analysis of air photos in conjunction with geophysical and soil gas data. Table 1 provides a brief summary description of each suspect area.

3. PLAN OF OPERATION

The surface reconnaissance will consist of visual inspection of the ground surface followed by collection and analysis of surface soil samples. The work will be carried out by personnel from the Environmental Engineering Group and Geosciences Group, with health and safety monitoring from the Environmental Field Services Group. All work will be carried out in accordance with an approved Pre-Job Health and Safety Plan.

Areas for surface soil sampling will be identified during the visual inspection. It is also possible that the surface reconnaissance will identify the need for additional geophysical surveys and/or soil gas measurements. If such additional work is required, a separate plan will be prepared.

Specific items to be evaluated during the surface reconnaissance include the following:

- geological evaluation of ground surface and classification of surface soils
- condition of ground surface (e.g. undisturbed, scarified, bladed, discolored, etc)
- evidence of subsidence (e.g. depressions, cracks, etc)
- nature and condition of any vegetation
- evidence of animal activity (e.g. burrows, nests, fecal material, tracks, etc)
- any evidence of waste disposal or other activities.

These items will be noted on a topographic map and in a controlled field logbook. Specific areas for surface soil sampling will be identified and indicated on field maps. Where necessary, points in the field will be located relative to grid points using a Brunton compass and tape. Where appropriate, stakes will be driven to indicate specific sampling locations or survey lines.

Additional information to be recorded in the field logbook include weather conditions, health and safety data (instrument readings, descriptions of any observed hazards, etc), summaries of pre-job safety meetings, and names of personnel involved on each day.

It is anticipated that the surface reconnaissance will require approximately five days. Soil sample collection will be carried out after the reconnaissance is completed. It is anticipated that approximately 60 samples will be collected. These samples will be submitted to Weyerhauser

Environmental Laboratory for analysis under the direction of the Office of Sample Management. Samples will be analyzed for inorganic and organics analytes in accordance with the EPA Statements of Work for the Contract Laboratory Program (CLP). In addition to the CLP Target Analyte List (inorganics) and Target Compound List (organics), selected samples will also be analyzed for asbestos fibers. In addition to the 60 samples discussed above, approximately 40 replicate samples will be collected and submitted to U.S. Testing for more rapid analysis under SW-846 protocols. The purpose of the replicate samples is to provide more timely data for planning vadose zone drilling operations. Table 2 presents specific analytical methods.

4. DELIVERABLES

The final deliverable will be an annotated map and a letter report summarizing the findings and making recommendations as to the location of vadose zone holes and groundwater monitoring wells, as well as any additional work that may be required to complete Phase 1 of the remedial investigation for the Horn Rapids Landfill.

1 Elongate trench running approximately NNW-SSE from the vicnity of J2 to G8. This trench appears to be a burial cell. It appears to have been operated as a landfill, progressing from the SSE to the NNW. The exposed face in the vicinity of grid node H5 appears to be northern extent of landfill, however, geophysical data suggest the anomaly continues to the NNW. Dimensions are 80 to 120 ft wide and 350 to 700 ft long. (The maximum length is based on extension of geophysical anomalies NNW of observed face.) On the air photos, the trench is indicated by a slight darkening of the ground surface combined with changes in vegetation and overall texture. EMI, Magnetometer, Metal Detector and GPR anomalies were observed across the trench. Because of the presence of geophysical anomalies close to the surface, nodes in the immediate vicinity of this trench were not sampled for soil gas. Concentrations of PCE were detected at nodes H2 and J3. TCE was detected at J6, and traces of CCl_4 were found at H7, J6 and K5. The southern extent of this site is posted with signs indicating asbestos burial.

2. Elongate trench running approximately NNW-SSE from the vicinity of K5 to between H8 and J8. The northern part, between two spoil piles, has not been backfilled, and contains numerous tires. The feature is indicated by geophysical data, and by variations in ground surface color and texture. Dimensions are approximately 70 ft wide and 320 ft long.

3. Elongate trench running approximately NNW-SSE from immediately north of K3 toward H7. The feature has been completely backfilled. It is indicated by geophysical data, and by variations in ground surface color and texture. Dimensions are approximately 70 to 100 ft wide and 380 ft long.

4. Elongate trench running approximately NNW-SSE from north of L5 to J9. The feature has been backfilled. It is indicated by geophysical data, and by variations in ground surface color and texture. Dimensions are approximately 60 ft wide and 460 ft long.

5. Irregular depression within the area bounded by N10, P10, P9 & N9. Has a relatively flat surface and appears to have been part of a diked impoundment. Dimensions are approximately 60 ft wide (E-W) and 100 ft long (N-S). Does not appear to be associated with geopysical or soil gas anomalies.

6. Irregular depression within the area bounded by P10, R10, R9, & P9. Has a more irregular surface than #5. Also contains evidence of various waste disposal episodes, including possible septic tank waste, paint cans, and broken laboratory glassware.

7. Irregular depression between (and to the south of) S6 & T6.

8. Rectangular mound immediately east of L7. Approximately 60 ft long (E-W), 30 ft wide (N-S) and 3-4 ft high (from topo).

9. Broad irregular area which may have been backfilled. Inside a triangular area bounded by BB1, F7 & G1, which appears to have been excavated. Maximum depth of excavation in this area appears to be 8-10 ft. The area is also characterized by two soil gas anomalies, both of which contain concentrations of trichloroethylene (TCE) and 1,1,1 Trichloroethane (TCA)

10. Large irregular area within L1, K2, L6, P8, R8, S5, S4, N2, L1. No definitive evidence from aerial photographs. 4 relatively large geophysical anomalies within this area are designated 10a, 10b, 10c, and 10d.

11. Oval discolored area witin pit in area defined by L14, L16, M16 & M14. 11a designates geophysical anomaly not entirely coincident with surface expression observed in air photographs.

12. Circular area approximately 100 ft in diameter located SE of H14. No definitive evidence of waste disposal. Appears to be a gravel pit.

13. Circular area approximately 50 ft in diameter located SE of J13. Generally similar to #12.

14. Irregular discolored area extending to E-SE from spoil pile near K9.

Table 2
SW-846 Test Methods

Inorganics

Constituent	Extraction	Test Method	MDL g/g	Sample Size
Antimony	3050	ICP / 6010	10	10g
Barium	"	"	0.6	"
Beryllium	"	"	0.3	"
Cadmium	"	"	0.2	"
Chromium	"	"	1	"
Cobalt	"	"	2	"
Vanadium	"	"	0.5	"
Zinc	"	"	0.5	"
Arsenic	"	AA / 7060	0.5	10g
Lead	"	AA / 7421	0.5	10g
Selenium	"	AA / 7740	0.5	10g
Thallium	"	AA / 7841	1	10g
Mercury		AA / 7471	0.2	10g
Cyanide	9010A	9010	0.5	50g

Table 2
(cont'd)
SW-846 Test Methods

Organics

Constituent	Extraction	Test Method	MDL g/g	Sample Size
Benzene		GC/MS 8240	0.005	10g
Carbon Tetrachloride		"	0.005	"
Chloroform		"	0.005	"
p-Dichlorobenzene		"	0.005	"
1,1 Dichloroethane		"	0.005	"
1,2 Dichloroethane		"	0.5	"
trans-1,2 Dichloroethylene		"	0.005	"
Methyl Ethyl Ketone (2-Butanone)		"	0.01	"
Methylene Chloride (Dichloromethane)		"	0.005	"
Tetrachloroethylene		"	0.005	"
Toluene		"	0.005	"
1,1,1-Trichloroethane		"	0.005	"
1,1,2-Trichloroethane		"	0.005	"
Trichloroethylene		"	0.005	"
Vinyl Chloride		"	0.01	"
Xylene		"	0.005	"
Chlorinated Benzenes	3540/3550	GC/MS 8270	1	50g
Cresol	"	"	1	
Napthalene	"	"	1	"
Pentachlorohenol	"	"	5	
Phenol	"	"	1	"
Endrin	"	GC/ECD 8080	0.01	50g
Lindane (& isomers)	"	"	0.01	"
Methoxychlor	"	"	1	"
Toxaphene	"	"	1	"
Aldrin	"	"	0.01	"
Chlordane	"	"	1	"
4,4'DDD	"	"	0.01	"
4,4-DDE	"	"	0.01	"
g4,4'-DDT	"	"	0.01	"
Endosulfan I	"	"	0.01	"
Endosulfan II	"	"	0.01	"
Endosulfan Sulfate	"	"	0.05	"
Heptachlor	"	"	0.01	"
Heptachlor Epoxide	"	"	0.01	"
Dieldrin	"	"	0.01	"
Chlorobenzilate	"	"	0.3	"
Polychlorinated Biphenyls	"	"	1	"

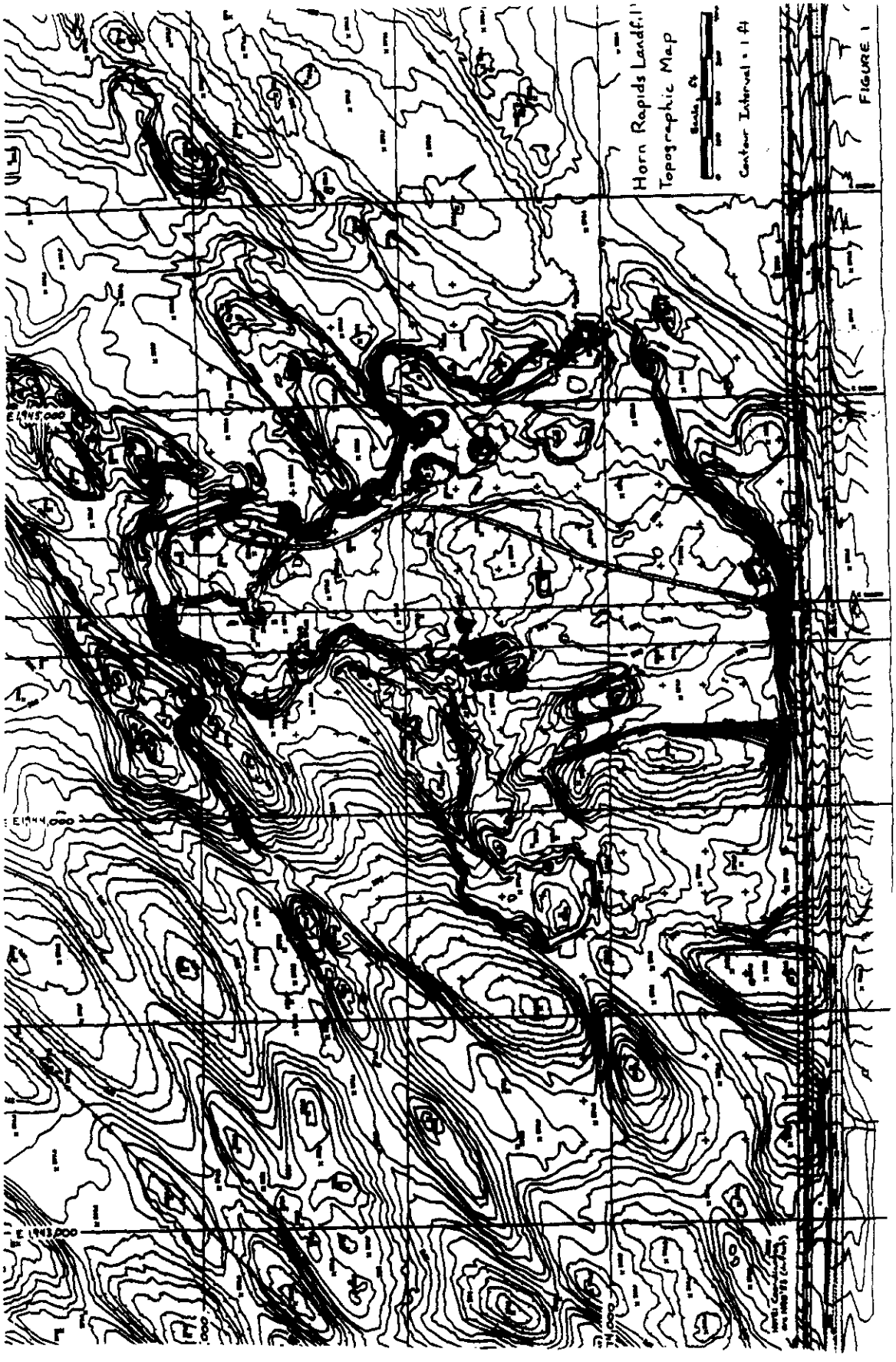

Horn Rapids Landfill
Topographic Map
Scale, ft
Contour Interval = 1 ft
E 1945,000
E 1944,000
E 1943,000
N 7,000
N 6,000

FIGURE 1

Horn Rapids Landfill
Geophysical Surveys
Soil Gas Surveys
Areas of possible burial trenches as indicated by geophysical data
Total soil gas > 1 µg/l

FIGURE 2

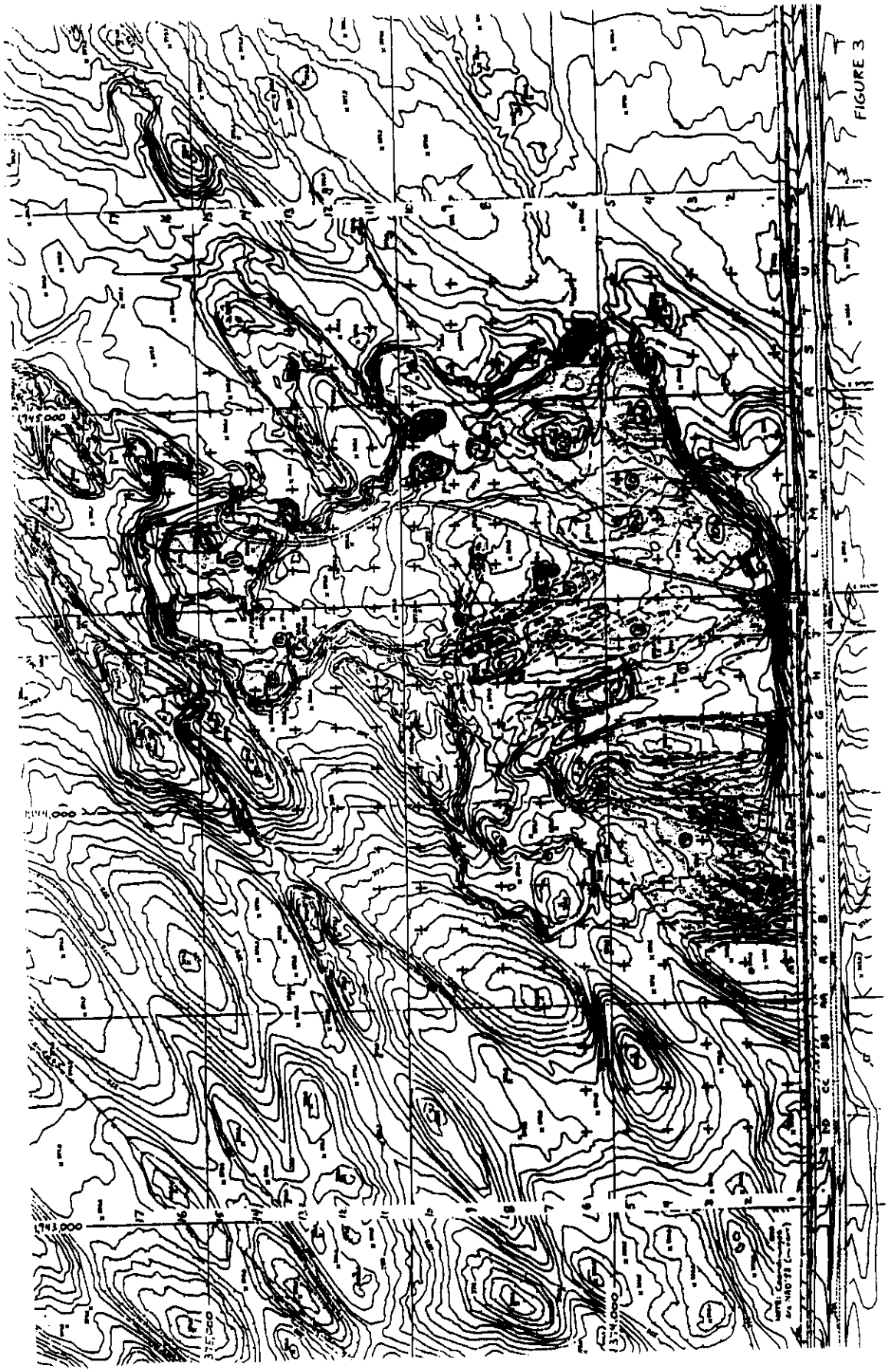


FIGURE 3

11.1
NRC
File

February 24, 1988

To: Memo to Files
From: Kathy Cramer

Subject: The 1100-4 Antifreeze Tank

In a recent conversation with Dennis Poor, Westinghouse Hanford Company, he explained the soil sampling effort used to characterize the soil beneath the suspected leaking antifreeze tank (1100-4) in the 1171 Bus Garage. The first sample was obtained before the tank was removed from the excavtion on the south side approximately 2 feet from the bottom of the tank. The second sample taken after the tank was taken out of the ground, on the north side of the pit approximately 6" from the surface of the hole. The third sample was taken at 30" from the surface also on the north side of the excavation. The three samples were then submitted for analysis at Hanford Environmental Heath Foundation (HEHF). The samples showed no evidence of ethylene glycol contamination.

cc: R. G. McCain

11.115.2C
NRC
FILE

MEMO: To File

DATE: 8/6/87

FROM: K. H. Cramer

SUBJECT: Personal conversation with Michael Gillum
Regard Richland City Recharge Wells and Water Supply System

There are 14 recharge wells that are within 3 miles of the Hanford Site boundary. These wells have depths that range from 40 to 134 feet. The recharge well system is part of the city's overall water supply system. The recharge wells are designed to be used in conjunction with the Water Supply holding ponds located beside the wells. The recharge well system is used during peak water demand periods and when the Columbia River Water Pump System is down for maintenance. The recharge system operates with water being pumped to the holding ponds from the Columbia River. The water in the ponds then seeps through the soil to the aquifer where it is pumped by the recharge wells to the city's water supply system. The recharge wells are tied into the overall water supply system, which means that the water from the wells is mixed with the Columbia River water and distributed throughout the city.

Cramer, K., PNL [Memo to File] August 6, 1987

509 943 9161

MICHAEL GILLUM
Associate Engineer
Utility Administration Division
Water & Waste Utilities Department

505 SWIFT BOULEVARD ECS 150 RICHLAND WASHINGTON 99352

Ref. 2.1

CITY OF RICHLAND

WATER SYSTEM DATA

A. PRODUCTION

The City of Richland's water supply comes from two major sources:

1. Water Treatment Plant: The Water Treatment Plant uses the "Micro-Floc" process for water treatment (see attached flow diagram). Its present design production capacity is 30 million gallons per day. The plant can be expanded to a maximum production capacity of 45 MGD.

2. Wells: The 18 wells are located in five well fields. The total production capacity of all the wells is 18.2 MGD. The North Richland well field groundwater is recharged artificially through the use of recharge basins (see attachment). The wells are recharged through the months of April to November.

The production capacities can be summarized as follows:

Source	# Wells	Capacity
Columbia Well Field	1	0.8 MGD
Duke Well Field	2	2.0 MGD
North Richland Well Field & D-5	11	11.0 MGD
Wellsian Way Well Field	3	3.0 MGD
Willowbrook Well	1	1.4 MGD
Water Treatment Plant		30.0 MGD
TOTAL	18	48.2 MGD

B. STORAGE

The City of Richland's water system has a water storage capacity of 23.67 millic gallons. The major elevated storage, a five and ten million gallon reservoir, i located west of the Yakima River. The other elevated storage consists of five additional reservoirs, with a capacity of 4.47 million gallons and are also loca west of the Yakima River, serving the Badger Mountain Area. Water from the rema ing reservoirs is pumped into the system by booster pumps.

Storage can be summarized as follows:

Storage		Capacity
Two (2) one-million gallon reservoirs (1182)		2.0 MG
Five million gallon reservoir		5.0 MG
Ten million gallon reservoir		10.0 MG
Water Treatment Plant Clearwell reservoir		2.2 MG
Tapteal I reservoir (reservoir #1)		0.75 MG
Tapteal I reservoir (reservoir #2)		2.6 MG
Tapteal II reservoir (reservoir #1)	Upper Pressure Zone	0.18 MG
Tapteal II reservoir (reservoir #2)	Upper Pressure Zone	0.7 MG
Country Ridge reservoir	Upper Pressure Zone	0.24 MG
TOTAL		23.67 MG

Ref.

C. TRANSMISSION

All water transmission lines, 10" or larger, are shown on the utility map of the City of Richland. The major transmission lines are shown on the attached facilities location map.

D. PRESSURE ZONES

The City of Richland has three pressure zones:

1. Richland City core area.
2. Badger Mountain/Meadow Springs area (area west of Yakima River) - Tapteal I pressure zone.
3. Badger Mountain/Meadow Springs area (higher elevations west of Keene Road and portion of Hills West area) - Tapteal II pressure zone.

The Badger Mountain/Meadow Springs area water is pumped from the Richland City core pressure zone to the higher Badger Mountain pressure zone. The booster pump station for this zone is located at the five and ten million gallon reservoirs.

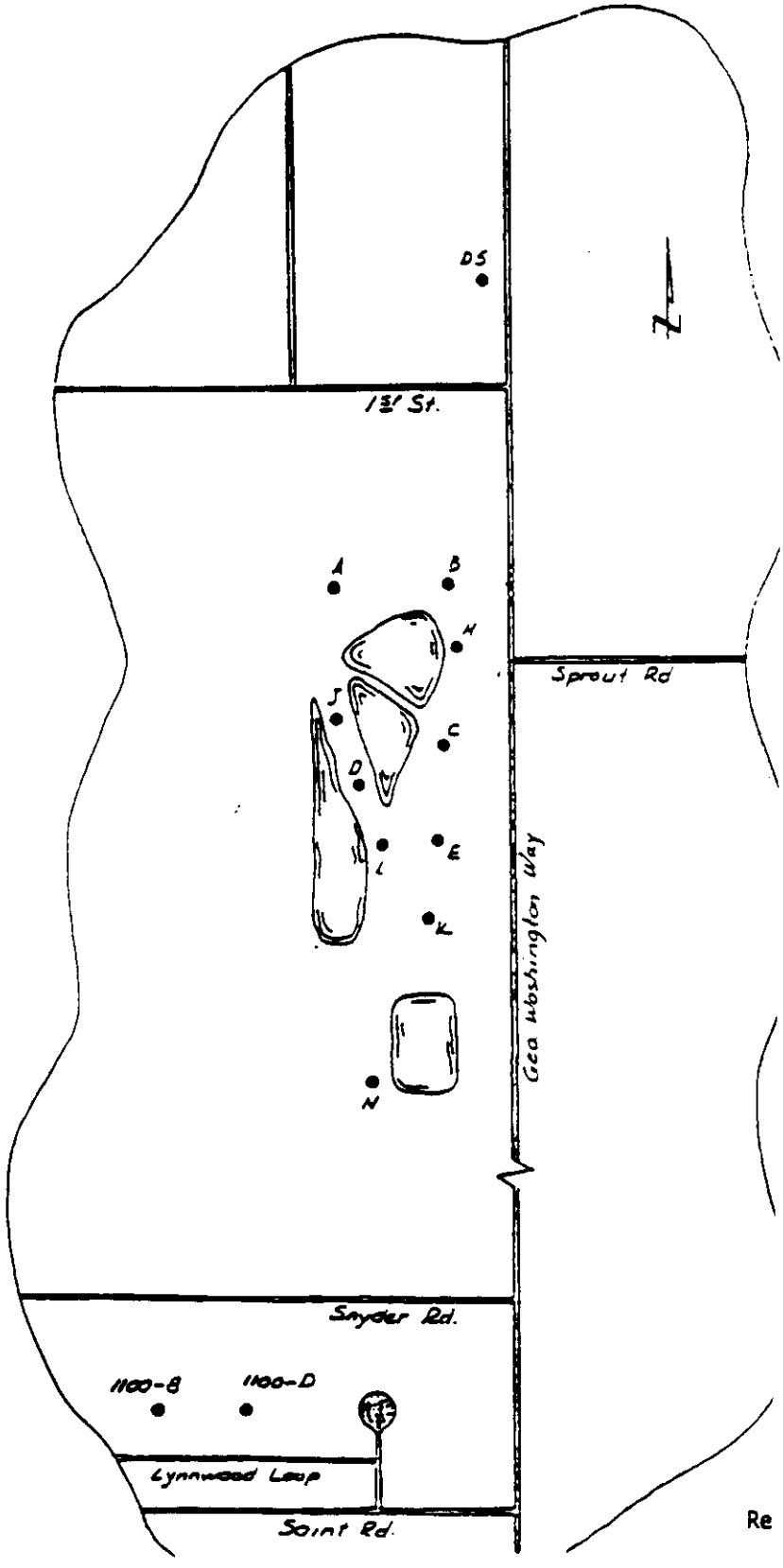
The third pressure zone is supplied by (1) a pumping station off High Meadows Street and currently serves the majority of homes on High Meadows Street, Hillview Drive and all homes west of Orchard Court on Orchard Way and Greenview Drive, and (2) a pumping station on Keene Road at Country Ridge and serves the Country Ridge/ Keene Village area.

7-9-84

NORTH RICHLAND WELLS

North Richland Well Field

Well #	Depth
3000-A	88'
3000-B	87'
3000-C	64'
3000-D	75.3'
3000-E	61.8'
3000-H	56'
3000-J	71'
3000-K	59'
3000-L	83'
3000-N	40'
3000-DS	134'

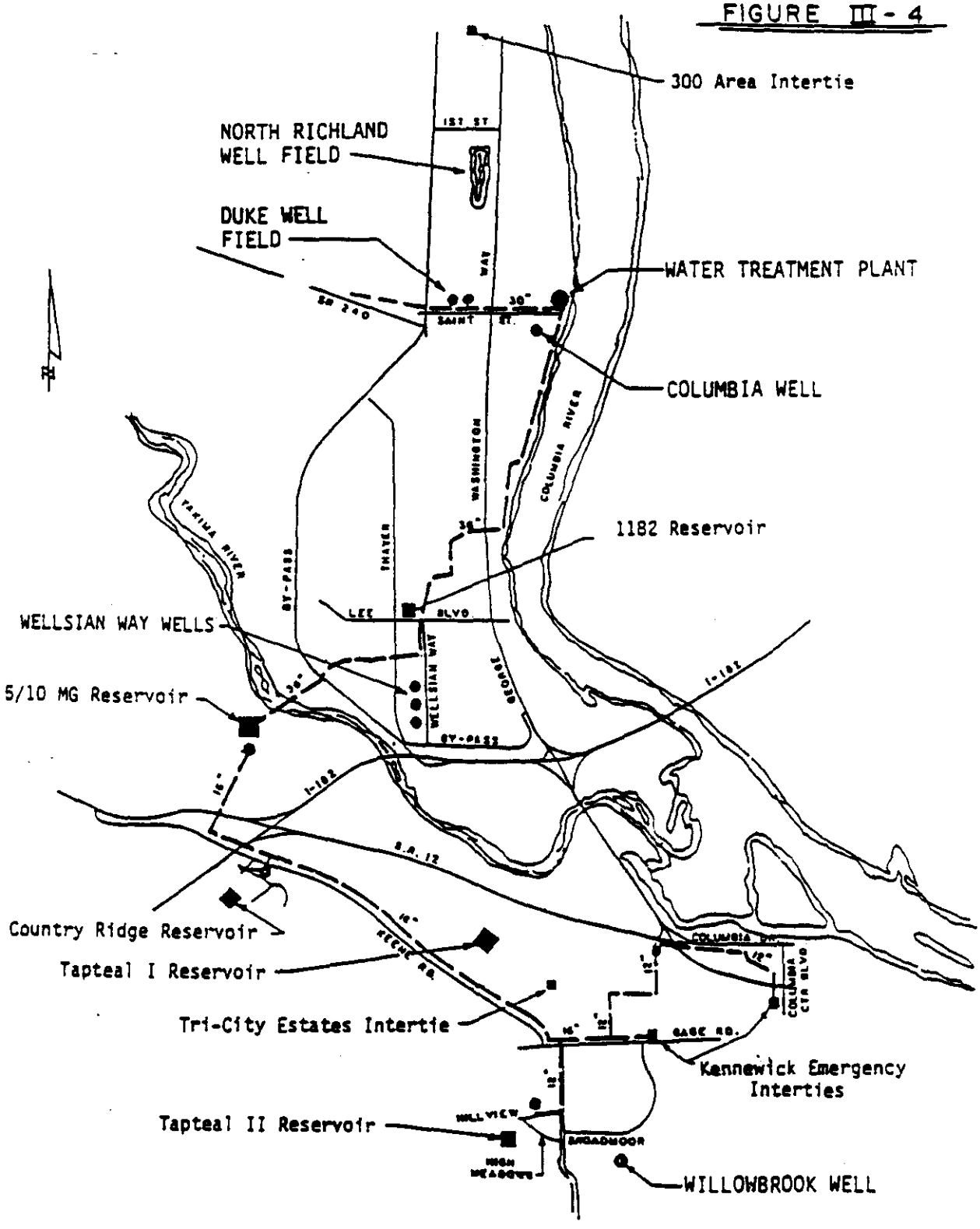


Duke Well Field

Well #	Depth
1100-B	120'
1100-D	86'

Re

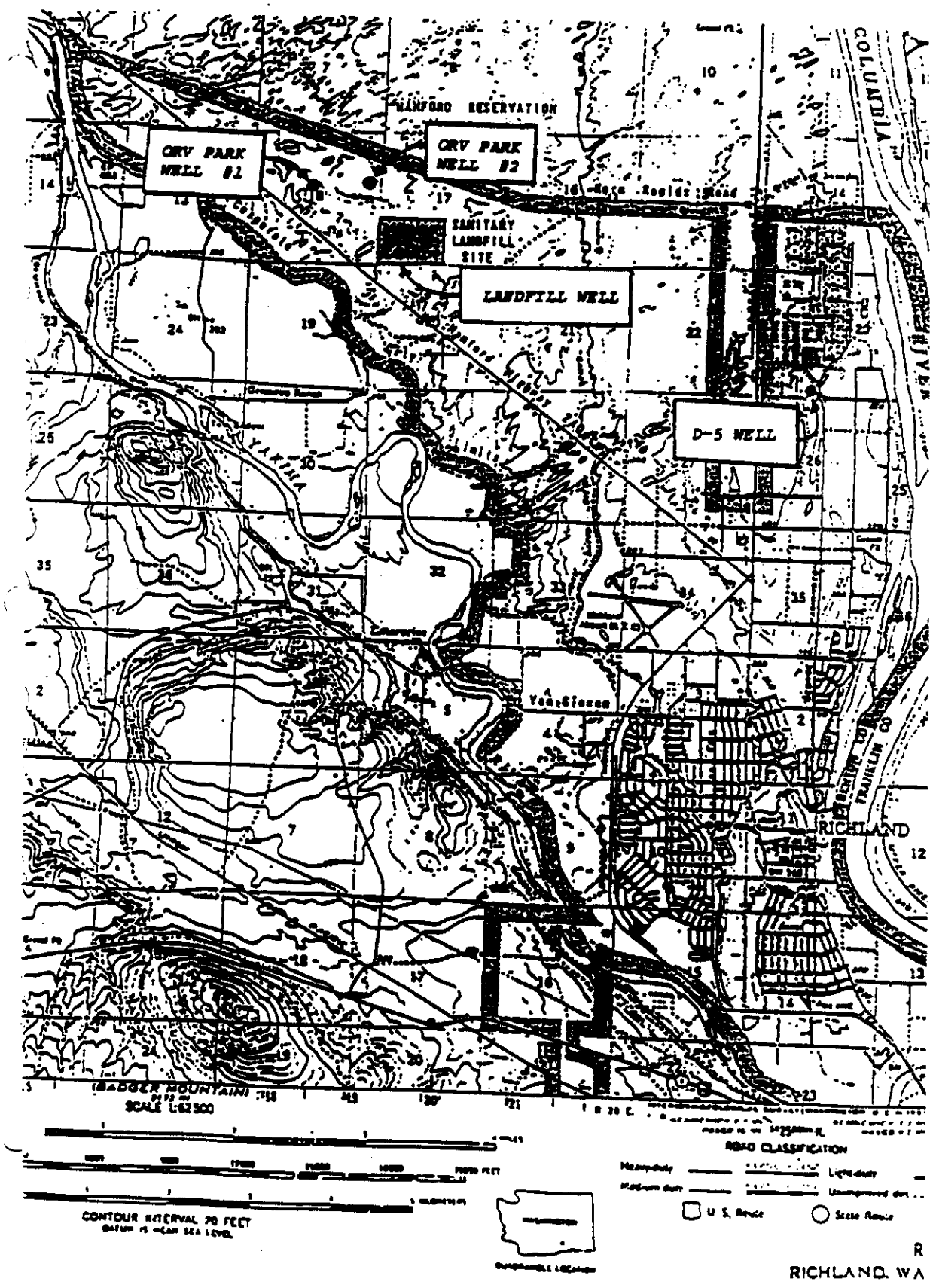
FIGURE III - 4

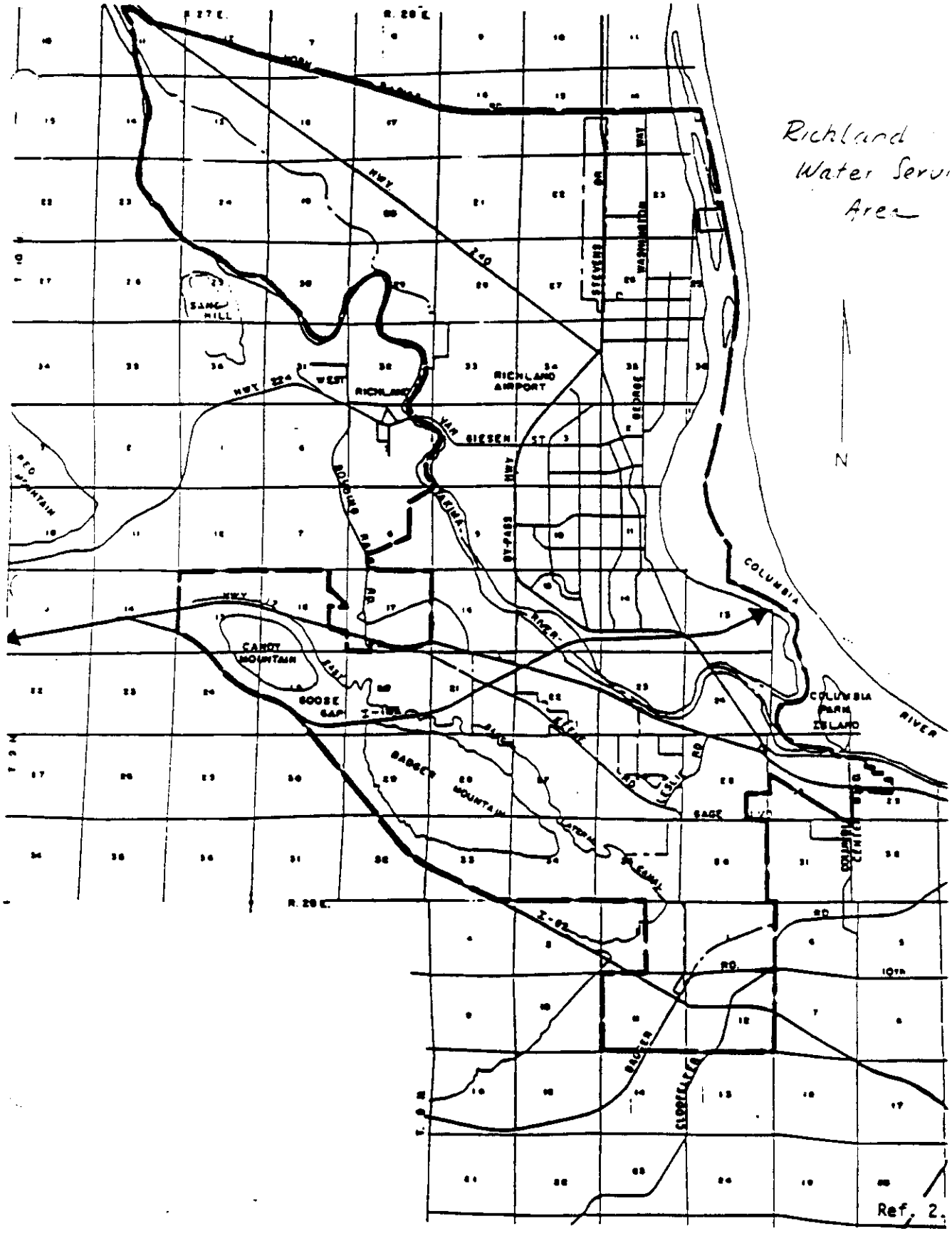


CITY OF RICHLAND

WATER SYSTEM SOURCE and STORAGE FACILITIES LOCATION MAP

Ref. 2.5


HANFORD RESERVATION
ORV PARK WELL #1
ORV PARK WELL #2
SANITARY LANDFILL SITE
LANDFILL WELL
D-5 WELL
YAKIMA
RICHLAND
BADGER MOUNTAIN
SCALE 1:62500
CONTOUR INTERVAL 20 FEET
ROAD CLASSIFICATION
U. S. Route
State Route
RICHLAND, WA


Richland
Water Servi
Area
N
R. 28 E.
R. 29 E.
HWY 240
HWY 224
WEST RICHLAND
RICHLAND AIRPORT
VAN GIESEN ST
BY-PASS HWY
WASHINGTON WAY
SEELYEN RD
BEDROSE
SAND HILL
RED MOUNTAIN
CARROT MOUNTAIN
GOOSE GAP
BADGER MOUNTAIN
COLUMBIA PARK ISLAND
COLUMBIA RIVER
SAGE
10th
RD.
BADGER
CLODELLAN
Ref. 2.

11.115
1990
NRC
FILE

Westinghouse
Hanford Company

From: Environmental Engineering Group 81220-90-120
Phone 6-5122 H4-55
Date April 12, 1990
Subject: TECHNICAL MEMORANDUM DOCUMENTING PROCEDURES FOR SURFACE SOIL SAMPLING IN THE 1100-EM-1 OPERABLE UNIT

To S. W. Clark H4-55

cc: R. P. Henckel H4-55
RMM: File/LB

PROPERTY OF
GOLDER ASSOCIATES LIBRARY
4104 148th AVE. N.E.
REDMOND, WA 98052

SCOPE

This technical memorandum documents the procedures used for surface soil sampling done as part of the Phase I Remedial Investigation at suspected waste disposal sites in the 1100-EM-1 Operable Unit. Surface soil samples were taken at the Horn Rapids Landfill, at the 1100-2 and 1100-3 disposal pits, at the UN-1100-6 site, at background vadose zone borehole sites, at a road construction materials site called "Pit 1", and at an ephemeral pond which collects runoff from parking lots around the 1171 Building.

PROCEDURES

All surface soil sampling was conducted following the procedures contained in the Environmental Investigations and Site Characterization Manual, (WHC-CM-7-7); in particular, Section EII 5.2, Soil and Sediment Sampling. Sampling activities at specific sites are discussed in the attachments. In general, surface soil samples represent the very top three to four inches of material at a site. All sample locations at operable subunits were referenced to grid points established by a licensed surveyor. Sample locations are shown on attached topographic maps and sketches

Contract Laboratory Program (CLP) samples were collected at the 1100-2 and 1100-3 disposal pits, at the UN-1100-6 site, at "Pit 1", and at the ephemeral pond over a five-day period from August 31 to September 7, 1989. A reconnaissance program of surface sampling was completed at the Horn Rapids Landfill between November 9 and December 5, 1989. Surface samples at background vadose zone borehole sites were taken on January 25, 1990.

RESULTS

The results of CLP analyses of surface soil samples taken at all sites are summarized on the attached sheets. Tabulations of rapid turnaround assays performed by U. S. Testing for Health and Safety purposes are included in the Horn Rapids Landfill Reconnaissance Summary which follows the CLP analyses.

RECORDS

Copies of Logbooks WHC-N-293 2 and WHC-N-205 are in the possession of R. M. Mitchell and R. G. McCain, respectively. Records of validation of CLP assays are maintained by the Office of Sample Management. Copies of assays by U. S. testing are in the custody of S. W. Clark.

R. M. Mitchell
Principal Scientist

jew

Attachments

Westinghouse Hanford Company

Interna
Memo

From: Geology Section 81232-90-055
Phone: 6-5005 H4-56
Date: June 26, 1990
Subject: REVIEW COMMENTS FOR THE 1100-EM-1 REMEDIAL INVESTIGATION REPORT AND OTHER DATA NEEDS OF GOLDER ASSOCIATES, INC.

To: S. W. Clark H4-55

cc: D. G. Horton DGH 6/26/90 H4-56 w/o attachment
JWL File/LB

Please find attached to this internal memo the following items for Golder Associates, Inc. of Redmond, Washington:

Attachment 1: Update of 1100-EM-1 Operable Unit and Vicinity Well Inventory

Attachment 2: Field-Analyzed Well Characterization Sampling Data for the Second Round of Groundwater Samples, 1100-EM-1 Operable Unit

Attachment 3: 1100-EM-1 RI Review Comments from V. Johnson and B. Ford
1100-EM-1 RI Review Comments from K. Singleton

Attachment 4: Water Table Elevations at 1100-EM-1 Wells, May 23, 1990

A reference that may be used to cite the data base containing groundwater quality data from well 041 (in Figure 3-36 in the 1100-EM-1 RI draft report) is:

Pacific Northwest Laboratory, Feb. 1990, Hanford Ground-Water Data Base Management Guide: PNL-MA-558, Pacific Northwest Laboratory, Richland, WA

J. W. Lindberg
Field Team Leader

dyl

Attachment: 1, 2, and 4

Hanford Operations and Engineering Contractor for the US Department of Energy

ATTACHMENT 1

UPDATE OF 1100-EM-1 VICINITY WELL INVENTORY (TASK G-90-7)

Bill Wright of Golder Associates requested Westinghouse support to better define the existence of receptor wells (i.e. withdrawal wells, exclusive of environmental monitoring wells or test wells) in and adjacent to the 1100-EM-1 Operable Unit. The inventory of receptor wells will be used to update the current draft of the Phase I Remedial Investigation Report for the 1100-EM-1 Operable Unit and a risk assessment.

The staff made several attempts to locate and determine use of wells illustrated in Figure 3-41 (of the RI draft report). Many of the wells in the figure were investigated. However, some were not located because of concerns associated with trespassing on private property. Others were investigated, but well existence could not be verified.

The following changes should be made to Figure 3-41:

1. Delete the following wells: 040, 047, 049, 050, 051, 019, and 022. These wells are known to be resource protection wells.

2. Well 049 is used to irrigate alfalfa fields by Battelle.

3. The other wells located on Figure 3-41 that were not identified as resource protection wells (as in 1. above) are either water supply wells or wells used for heat pumps. Because their use cannot be identified, a conservative estimate is that they are potential groundwater receptor points.

ATTACHMENT 2. WELL CHARACTERIZATION SAMPLING DATA

WELL	DATE SAMPLED	PURGE VOLUME (gal)	PH	TEMP (C)	CONDUCT (umho/cm)	TURBIDITY (NTU)	SAMPLE NUMBER
6-S41-E11	17-MAY-90	29.21	7.84	16.8	536		B G9,H0,H1,H2
(MW-1)			7.88	16.8	536		
			7.89	16.8	536		
			7.91	16.9	536		
6-S34-E10	16-MAY-90	32.93	8.21	17.2	337		B G4,G5,G6,G7
(MW-2)			8.26	17.7	350		
			8.26	17.9	356		
6-S41-E12	16-MAY-90	330	7.58	19.9	1100		B J2,J3,J4,J5
(MW-3)			7.50	19.7	1050		
			7.50	19.5	1100		
			7.46	19.7	1100	35.0	
6-S38-E12A	21-MAY-90	24.3	8.05	17.2	296		B J8,J9,L0,K0,K1
(MW-4)			8.13	17.2	315		
			8.25	17.0	311		
			8.30	17.0	315		
6-S38-E12B	21-MAY-90	71.6	8.27	16.8	286		B K2,K3,K4,K5
(MW-5)			8.26	17.1	271		
			8.23	17.2	276		
6-S37-E11	17-MAY-90	27.89	8.02	17.5	347		B H3,H4,H5,H6,J6,
(MW-6)			8.20	17.7	356		J7
			8.20	17.9	354		
6-S38-E11	17-MAY-90	30.72	8.11	17.0	386		B H7,H8,H9,J0
(MW-7)			8.12	17.2	392		
			8.10	17.0	394		
6-S31-E8	14-MAY-90	26	8.15	15.7	500		B 70,71,72,73
(MW-8)			8.12	15.9	500		
			8.12	16.1	500		
6-S32-E8	14-MAY-90	130.5	8.35	16.3	290		B 74,75,76,77
(MW-9)			8.46	16.8	300		
			8.47	17.0	300		
			8.48	17.0	300		
6-S30-E10A	14-MAY-90	23.6	7.78	16.3	850		B 78,79,80,81
(MW-10)			7.89	16.5	850		
			7.90	16.7	850		
6-S30-E10B	15-MAY-90	24.53	7.55	16.5	870		B 83,84,85,86
(MW-11)			7.72	16.8	880		
			7.73	16.5	880		
			7.77	16.5	880		
6-S31-E10A	15-MAY-90	21.95	7.75	17.0	990		B 87,88,89,90
(MW-12)			7.73	17.1	980		B 91,92,93,94
			7.74	17.1	980		
6-S31-E10B	15-MAY-90	13.97	7.80	17.7	920		B 95,96,97,98
(MW-13)			7.84	17.9	910		
			7.89	17.9	910		
6-S31-E10C	15-MAY-90	40.91	7.90	17.7	900		B 200,F5,F6,F7
(MW-14)			7.89	17.7	930		
			7.86	17.7	950		
6-S31-E10D	16-MAY-90	16.09	7.92	17.2	691		B G0,G1,G2,G3
(MW-15)			7.98	17.7	700		B F8,F9
			7.98	17.5	696		
6-S41-E13C	22-MAY-90	133.8	8.20	16.5	240		B L1,L2,L3,L4
(MW-17)			8.25	17.0	254		B L5,L6,9W9,9X0
			8.23	17.0	246		

ATTACHMENT 2. WELL CHARACTERIZATION SAMPLING DATA

WELL	DATE SAMPLED	PURGE VOLUME (gal)	PH	TEMP (C)	CONDUCT (umho/cm)	TURBIDITY (NTU)	SAMPLE NUMBER
6-S27-E14	23-MAY-90	379.86	7.84	17.5	457		B 9Z1,9Z2,9Z3,9Z4
			7.85	17.5	457		
			7.89	17.5	456	0.2	
6-S29-E12	23-MAY-90	165.96	7.55	16.8	439		B 9X9,9Y0,9Y1,9Y2
			7.58	17.0	430		
			7.60	17.0	429	0.4	
6-S30-E15A	24-MAY-90	70.61	7.61	16.8	394		B 9Y7,9Y8,9Y9,9Z0
			7.63	16.8	406		
			7.62	16.8	415	0.4	
6-S31-E13	24-MAY-90	188.84	7.57	16.3	488		B 9Y3,9Y4,9Y5,9Y6
			7.58	16.5	492		
			7.58	16.5	489	1.5	
6-S32-E13A	24-MAY-90	187.74	7.81	16.2	455		B 9X5,9X6,9X7,9X8
			7.78	16.3	463		
			7.76	16.3	463	10.5	
6-S37-E14	22-MAY-90	19.2	8.27	14.7	280		B M6,M7,M8,M9
			8.26	14.7	280		
			8.30	15.0	280	0.3	
6-S40-E14	22-MAY-90	26.7	7.94	13.0	139		B 9W5,9W6,9W7,9W8
			8.02	13.2	145		
			8.06	13.0	147		
6-S41-E13A	21-MAY-90	19	8.50	16.5	237		B L7,L8,L9,M0
			8.38	16.5	271		
			8.38	16.7	278		
6-S41-E13B	21-MAY-90	63	8.16	17.0	444		B M1,M2,M3,M4
			8.12	17.0	434		
			8.12	16.8	424		
			8.12	17.0	423		
6-S43-E12	22-MAY-90	19	7.72	18.4	709		B K6,K7,K8,K9
			7.73	18.4	709		
			7.77	18.4	718		
			8.12	17.0	423		
RICH-EAST	20-MAY-90	NA	8.15	12.1	147		B B07,B08,B09,B10
			8.11	12.5	151		B11
RICH-WEST	20-MAY-90	NA	8.11	13.2	146		B B12,B13,B14,B15
			8.12	13.4	147		
ANF-14	24-MAY-90	NA	NA	NA	NA		B 9Z8
ANF-15	24-MAY-90	NA	NA	NA	NA		B B02
ANF-16	24-MAY-90	NA	NA	NA	NA		B B06
FEB-WATER	24-MAY-90	NA	NA	NA	NA		B B16,B17,B18,B19
FEB-MANIFLD	24-MAY-90	NA	NA	NA	NA		B B20,B21,B22,B23

ATTACHMENT 4

Attachment 4 shows the results of depth to water measurements collected May 23, 1990, except for well 6-S27-E14 which was measured May 29, 1990. The wells listed below are all 600 Area wells with the well prefix of 699 or 6 which has been omitted for this listing.

WELL	DEPTH TO WATER	ELEVATION
S27-E14	56.77	342.98
S29-E12	42.17	345.77
S30-E10A (MW-10)	43.86	348.43
S30-E10B (MW-11)	43.16	348.91
S30-E15A	56.61	343.52
S31-1	84.25	375.84
S31-E10A (MW-12)	36.55	348.02
S31-E10B (MW-13)	35.01	348.71
S31-E10C (MW-14)	34.31	348.60
S31-E10D (MW-15)	32.07	348.51
S31-E13	47.80	346.25
S31-E6 (MW-8)	21.74	353.03
S32-E13A	43.91	346.54
S32-E13B	47.93	346.78
S32-E6 (MW-9)	16.90	358.89
S34-E10 (MW-2)	29.92	352.45
S36-E12A	Not measured, inside a manhole underground	
S36-E12B	47.37	351.66
S36-E13A	47.70	351.59
S37-E11 (MW-6)	47.24	352.06
S37-E14	56.92	351.34
S38-E11 (MW-7)	45.81	352.79
S38-E12A (MW-4)	52.94	352.01
S38-E12B (MW-5)	52.98	352.02
S40-E14	Not measured, well obstructed by probe	
S41-E11 (MW-1)	48.07	353.29
S41-E12 (MW-3)	49.69	Elev. of casing not known
S41-E13A	57.90	352.66
S41-E13B	57.44	352.66
S41-E13C (MW-17)	58.13	352.55
S43-E12	52.59	353.01
11-34-13	42.87	348.12
11-41-13C (3000-D-1)	53.79	351.07
30-45-16 (F-2)	61.24	345.65
30-47-18B (3000-F)	30.77	343.19

Westinghouse Hanford Company

Internal Memo

From: Geology Section
Phone: 5-5005 H4-56
Date: May 11, 1990
Subject: TECHNICAL MEMORANDUM-DRILLER'S LOG FOR WELL 6-S32-E13B (Temporary No. STES #7)

81232-90-042

11.115.8
NRC
FILE

Geology Section, WHC [Technical Memo 81232-90-042 to S. Clark, WHC] May 11, 1990

To: S. W. Clark

cc: D. G. Horton JWH 5/11/90 H4-56
M. A. Olascoaga H4-55
K. M. Singleton H4-56
JWL File/LB

This technical memorandum is to document the driller's log for well 6-S32-E13B (Temporary No. STET #7) in the CERCLA 1100-EM-1 Operable Unit. The driller's log for this well contains some useful geological information but has not been reported in any Hanford Site reports to date. Please find a copy of the log attached to this internal memorandum.

J. W. Lindberg
Team Leader

ljp

Attachment

ALSO A0522563 6-S32-E13A
LJP 5/16/90

Hanford Operations and Engineering Contractor for the US Department of Energy

S32-E13B

DRILLING LOG

RIG NUMBER 22W	WELL NUMBER #7	DATE 9/26/79	PROJECT NUMBER
DRILLER L O Bultema	FOREMAN	SHIFT	DEPTH BEGINNING OF SHIFT
			DEPTH COMPLETION OF SHIFT

DRILLING TIME	DRILLING DEPTH	CORING TIME	CORING DEPTH	TYPE SOIL	OTHER DELAYS TIME	OTHER DELAYS EXPLANATION
						Moved Rig from River Near 100F to Well Site Set up and Hauled tools, Water and other equipment to Drill With.
						8 HRS.

REMARKS

S34-E13B

DRILLING LOG

NUMBER 22 W	WELL NUMBER #7	DATE 9/27/79	PROJECT NUMBER
TEST L.D. Bultena	FOREMAN	SHIFT	DEPTH BEGINNING OF SHIFT 0'
			DEPTH COMPLETION OF SHIFT 20'

DRILLING TIME	DRILLING DEPTH	CORING TIME	CORING DEPTH	TYPE SOIL	OTHER DELAYS TIME	OTHER DELAYS EXPLANATION
				0-5 Brown Sand		Drilled Surface Casing
				5-20 -- Cobbles		Down to 20' (10")
				and Brown Sand		

REMARKS

8 HRS

6 DSL-E13D

DRILLING LOG

U NUMBER 22W	WELL NUMBER ~~24~~ 7	DATE 9/28/79	PROJECT NUMBER
DRILLER LO Bulton	FOREMAN	SHIFT	DEPTH BEGINNING OF SHIFT 20'
			DEPTH COMPLETION OF SHIFT 35'

DRILLING TIME	DRILLING DEPTH	CORING TIME	CORING DEPTH	TYPE SOIL	OTHER DELAYS TIME	EXPLANATION
				20' to 35		Welded 8" Drive Shoe
				& Cobbles		on and Changed Bits
				and Brown Sand		and Drilled from 20'
						to 35'

REMARKS

The Cobbles are Cemented, Hard to Drill and Drive Casing through.

8 HRS.

352-E150

DRILLING LOG

RIG NUMBER 28W	WELL NUMBER #7	DATE 10/1/79	PROJECT NUMBER
DRILLER LDBulkna	FOREMAN	SHIFT	DEPTH BEGINNING OF SHIFT 35'
			DEPTH COMPLETION OF SHIFT 54'

DRILLING TIME	DRILLING DEPTH	CORING TIME	CORING DEPTH	TYPE SOIL	OTHER DELAYS TIME	OTHER DELAYS EXPLANATION
			35-50	L Cobbles Brown Sand		Drilled 35' to 50' in L Cobbles and Brown Sand. Hit Water at 50' and Changed into Smaller gravel and Sand through 54'
			50-54	Medium gravel and Brown Sand		

REMARKS

The futher into the Water table, the baser gravel.

END 10 HRS.

SDZ-LIDD

DRILLING LOG

R NUMBER: 23W	WELL NUMBER: 47	DATE: 10/2/79	PROJECT NUMBER:
DRILLER: Bailey	FOREMAN:	SHIFT:	DEPTH BEGINNING OF SHIFT: 54'
			DEPTH COMPLETION OF SHIFT: 79'

DRILLING TIME	DRILLING DEPTH	CORING TIME	CORING DEPTH	TYPE SOIL	OTHER DELAYS TIME	OTHER DELAYS EXPLANATION
			54-68	Medium Grain Brown Sand Some Silt		Drilled from 54' to 68' in Compacted gravel.
			68-76	Clay, Silt and Brown Sand		Hit Clay, Silt and Brown Sand to 76'. Then went into
			76-79	Compacted gravel		Compacted Grayish-Black gravel from 76' to 79'

REMARKS

10 HRS.

DSL-EIPB

DRILLING LOG

RIG NUMBER: 22W	WELL NUMBER: #7 BNV	DATE: 10/3/79	PROJECT NUMBER
DRILLER: L D'Bultena	FOREMAN	SHIFT	DEPTH BEGINNING OF SHIFT: 79'
			DEPTH COMPLETION OF SHIFT: 96'

DRILLING TIME	DRILLING DEPTH	CORING TIME	CORING DEPTH	TYPE SOIL	OTHER DELAYS TIME	OTHER DELAYS EXPLANATION
				79-100		Drilled from 79' to 96'
				Compacted		in Grayish-Black Compacted
				gravel		gravel (Tight enough to Drill
						without Casing)
						10 HRS

REMARKS

S32-E13A

DRILLING LOG

RIG NUMBER	WELL NUMBER 1	DATE 9-21-79	PROJECT NUM
DRILLER	TOWNSHIP	SHIFT	DEPTH BEGINNING OF SHIFT 0'
			DEPTH COMPLETION OF SHIF 100'

DRILLING TIME	DRILLING DEPTH	CASING TIME	CASING DEPTH	INTERVAL	OTHER DELAYS TIME	EXPLANATION
	0-4					blue sand
	4-50					sand, tan + silty, med.
	50-52					cobbles to boulders, and 3"-grave fine black sand with gravel some cobbles + boulders
	52-75	20'	50 slot	50-70'		fine black + white sand (tuffaceous) w/pebbles
	75-76					brown clay with some sm. gra
	76-80					blue clay with some gravel
	80-86					dark brown clay
	86-100					small gravel, cemented

REMARKS

Hit water table at about 50 ft.

Well completed 9-25-79; total depth 100 ft

Westinghouse
Hanford Company

In-House
Memo

From Geosciences Group 91232-90-017
Phone 6-5005 H4-56
Date March 20, 1990
Subject TECHNICAL MEMORANDUM DOCUMENTING VADOSE ZONE DRILLING AND SAMPLING PROCEDURES IN THE 1100-EM-1 OPERABLE UNIT

Geosciences Group, WHC [Technical Memo 91232-90-017 to S. Clark, WHC] March 20, 1990

To: S. W. Clark H4-55

cc: K. R. Fecht H4-56
W. H. Price S0-03
JWL File/LB

Scope

This technical memorandum summarizes vadose drilling and sampling activities in the 1100-EM-1 operable unit. Vadose drilling and sampling refers to work under the direct control and supervision of the Environmental Field Services Group (EFSG), Westinghouse Hanford Company (WHC), at wells classified as geotechnical test borings. Work is inclusive of drilling to groundwater, collecting soil samples for physical and chemical testing, well abandonment and surveying. Vadose drilling and sampling activities do not include work performed at resource protection wells (i.e., permanent ground water monitoring wells), except in the case of well MW-3. Groundwater well MW-3 was afforded the same administrative and procedural controls as vadose zone boreholes, from ground surface to the water table. From the top of the water table and through completion of well MW-3, site controls were that of the typical ground water monitoring well (see technical memorandum for ground water monitoring well).

Purpose

The purpose of vadose drilling and sampling activities are to:

Investigate sources of contamination/potential contamination identified during review of existing data and site reconnaissance

Identify physical characteristics of soil which may affect the retention or transport of contaminants

Collect soil samples representative of the nature and extent of contamination present in the 1100-EM-1 operable unit

Collect, maintain and provide sample documentation consistent with protocols for legally defensible samples/data.

Hanford Operations and Engineering Contractor for the US Department of Energy

The data will provide input to:

Determine characteristics of primary contaminant transport pathways in the vadose zone

Identify candidate remedial action technologies

Assess the threat to public health and to conduct risk assessments

Protect worker health and safety during remedial investigation.

Location

Field vadose drilling and sampling activities were initiated 6-07-89 and completed 12-12-90 in 1100-EM-1 Operable Unit. Table 1 (attachment) identifies each of the 23 sample sites and date drilled by operable subunit.

Administrative and Procedural Controls

Activities associated with vadose drilling and sampling were controlled by WHC-CM-7-7, Environmental Investigations and Site Characterization Manual plus other site-wide procedures and policies governing radiation surveys and packaging and shipping of samples.

Drilling procedures include:

EII 6.1 Activity Reports of Field Operation
-----Used to document daily drilling activity

EII 6.5 Plugging and Abandoning of Characterization Boreholes
-----Provides direction for plugging and abandoning boreholes

EII 6.7 Groundwater Well and Borehole Drilling
----Provides instruction for controlling drilling operation

EII 9.1 Geologic Logging

EII 5.4 Decontamination of Drilling Equipment
----Provides instruction for decontaminating drilling equipment and equipment used for collecting samples (i.e. drive barrel) for physical testing or to advance the well.

Sampling procedures include:

EII 1.5 Field Logbook
----Contains detailed information pertaining to sampling protocols specific to each sample collected

EII 5.1 Chain of Custody. In addition to EII 5.1, Bills of Lading and shippers signature and tally record were used to document sample custody

EII 5.2 Soil and Sediment Sampling
----Describes sample collection methods and protocols

EII 5.5 Decontamination of Equipment for RCRA/CERCLA Sampling
----Provides instruction for decontaminating sampling equipment that comes in direct contact with samples submitted for chemical testing

WHC-CM-4-10 Radiation Protection

WHC-CM-2-14 Hazardous Material Packaging and Shipping
----Provides instruction for shipping hazardous sample

WHC-CM-2-3 Property Management
----Provides instruction for shipping samples.

Records

Documents generated by the drilling and sampling activity include: field log books, geologic logs, chain of custody records, sample analysis request forms, drilling decontamination records, sampling equipment decontamination records, cable tool activity reports and hazardous material shipping records.

Three logbooks detailing the sampling efforts are maintained by the EFSG in their project file. Logbook numbers are WHC-N-253-1, WHC-N-253-2, and WHC-N-253-3. Other records maintained by the EFSG include decontamination records, drilling activity reports, and shipping records. Geologic logs are maintained by the Geoscience Group, WHC in the project file.

The Office of Sample Management (OSM), WHC maintains copies of chain of custody forms, sample analysis request forms and all information generated by the laboratories analyzing soil samples. For samples collected and analyzed per United States Environmental Protection Agency (EPA) Contract Laboratory Protocol, OSM validates analytical data following EPA guide lines. Original records are currently maintained by the analytical laboratories for a period of six months after the last sample is submitted. The last sample was submitted on February 12, 1990.

S. W. Clark
Page 4
March 20, 1990

81232-90-017

All original records generated from the 1100-EM-1 operable unit vadose drilling and sampling activity will be retained for permanent storage per EII 1.6 Records Management.

J. W. Lindberg
Field Team Leader

dyl

Attachment

Attachment

TABLE 1.

Operable Subunit	Borehole Name	Date Drilled
1100-1	BAP-1	08-07-89 through 08-09-89
1100-1	BAP-2	06-19-89 through 06-27-89
1100-2	DP-4	07-12-89 through 07-14-89
1100-2	DP-5	07-18-89 through 07-19-89
1100-2	DP-6	07-21-89 through 07-25-89
1100-2	DP-9	09-13-89 through 09-20-89
1100-3	DP-1	08-01-89 through 08-03-89
1100-3	DP-2	07-28-89 through 08-01-89
1100-3	DP-3	07-27-89 through 07-28-89
1100-3	DP-7	06-07-89 through 06-14-89
1100-3	DP-8	09-26-89 through 09-28-89
1100-4	AST-1 1A, 1B 1C	11-01-89 through 11-10-89
1100-4	MW-3	02-07-90 through 02-12-90
*HRL	HRL-1	06-28-89 through 06-29-89
HRL	HRL-2	01-18-90 through 01-19-90
HRL	HRL-3	01-22-90 through 01-29-90
HRL	HRL-4	01-25-90 through 01-29-90
HRL	HRL-5	01-08-90 through 01-10-90
HRL	HRL-6	01-09-90 through 01-16-90
HRL	HRL-7	01-31-90 through 02-02-90
HRL	HRL-8	02-19-89 through 12-12-89
HRL	HRL-9	01-12-90 through 01-17-90
HRL	HRL-10	01-22-90 through 01-25-90

*Horn Rapids Landfill

5/90 NRC File

Westinghouse Hanford Company

Memo

81232-90-018

From: Geosciences Group
Phone: 6-5005 H4-56
Date: March 20, 1990
Subject: TECHNICAL MEMORANDUM DOCUMENTING DEPTH-TO-WATER MEASUREMENTS

To: S. W. Clark H4-55

cc: K. R. Fecht H4-56
JWL File/LB

Scope

This technical memorandum summarizes depth-to-water measurements that were taken during drilling, well development, borehole camera logging and to establish the elevation of the ground water table in the 1100-EM-1 Operable Unit. Water level measurements are under the direct control and supervision of Westinghouse Hanford Company (WHC) at new ground water monitoring wells during and after construction and at existing ground water monitoring wells.

Purpose

The main purpose of depth-to-water measurements is to determine ground water table elevations at the wells. These data are used to prepare ground water table maps. Another purpose is to document the depth to the water table in a borehole during drilling. These data are used as a guide in the placement of the final well screen and well completion materials. Water level measurements are also taken during well development activities and downhole camera surveys to help position pumps or the TV camera in the wells.

Depth-to-water measurements in the 1100-EM-1 Operable Unit were collected in response to data quality objectives as outlined by the Work Plan (DOE/RL-88-23).

Location

Water levels were taken at all the ground water monitoring wells (MW-1 through MW-15 and MW-17) during well construction at the start of each day's shift after the water table was encountered. The wells were constructed between October 23, 1989 and February 22, 1990. Well development activities after each well was completed occurred between January 22, 1990 and February 28, 1990. Borehole camera surveys were run between January 29, 1990 and March 1, 1990. Special ground water elevation surveys were run on all the MW-series wells and on numerous other wells in the 1100 area to make a water table map. The special surveys were run on March 2, 1990 and March 5, 1990.

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Water levels were determined using a Solinst electric water level meter with 300-foot tape and stainless steel probe in the monitoring wells during well construction, well completion, well development, and for special ground water elevation surveys. For the borehole camera survey the Rees R94 downhole camera system was used to determine the water level.

Administrative and Procedural Controls

Water level measurements were controlled by WHC-CM-7-7, Environmental Investigations and Site Characterization Manual. The applicable procedures are:

EII 9.1, Geologic Logging
----The apparent water table at the beginning of each shift is documented in the Borehole Log

EII 10.2, Measurement of Ground-water Levels
----Establishes methods for performing and documenting measurements of ground-water levels in monitoring wells

EII 1.5, Field Logbook
----Ground water levels from special surveys were written in controlled logbooks

EII 6.4, Groundwater Resource Protection Well Maintenance
----Establishes methods for borehole camera survey of wells.

The borehole logs, field activity report (well maintenance), and field logbooks are maintained by the WHC Geosciences Group in the project file. Field logbooks used for the special survey are numbered WHC-N-306-2, WHC-N-306-4, and WHC-N-306-5.

All original records generated from the 1100-EM-1 Operable Unit activities will be retained for permanent storage per EII 1.6, Records Management.

J. W. Lindberg
J. W. Lindberg
Field Team Leader

dyl

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File

Westinghouse
Hanford Company

memo

From: Geosciences Group
Phone: 6-5005 H4-56
Date: March 20, 1990
Subject: TECHNICAL MEMORANDUM DOCUMENTING WELL DEVELOPMENT PROCEDURES AND RESULTS

81232-90-019

To: S. W. Clark H4-55

cc: K. R. Fecht H4-56
JWL File/LB

TO S. CLARK, WHC, MARCH 20, 1990

Scope

This technical memorandum summarizes well development activities in the 1100-EM-1 operable unit that were accomplished to satisfy data requirements of the Remedial Investigation/Feasibility Study Work Plan (DOE/RL 88-23). These activities were performed under the direction of the Geosciences Group, Westinghouse Hanford Company (WHC). Kaiser Engineers Hanford (KEH) provided physical support (i.e. setting and removal of development pumps). Well development was performed in all 16 wells that will be used for groundwater monitoring purposes within the 1100-EM-1 operable unit. These wells are designated MW-1 through MW-17 with MW-16 designation not being used in the activity.

Purpose

The purpose of well development activities are to :

Remove residue material from the well which may have been generated during well constructing activities

Remove fines from the screen pack and surrounding formation to increase porosity and permeability of the formation directly surrounding the well

Obtain a water turbidity of 5 Nephelometric Turbidity Units (NTU) or less.

Location

Well development activities were initiated January 22, 1990 and completed on February 28, 1990 with the following turbidity results:

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GOLDER ASSOCIATES LIBRARY
4104 - 148TH AVE. N.E.
REDMOND, WA 98052

Well Designation	Date Performed	Total Gallons Pumped	Final NTU
MW-1	2/01/90	138	3.5
MW-2	2/08/90	565	4.0
MW-3	2/28/90	735	4.5
MW-4	1/30/90	239	4.6
MW-5	1/31/90	345	4.0
MW-6	2/01/90	390	4.0
MW-7	1/31/90	536	4.1
MW-8	1/22/90	1087	4.0
MW-9	2/09/90	565	4.7
MW-10	1/27/90	133	4.5
MW-11	1/29/90	324	4.9
MW-12	2/09/90	90	4.8
MW-13	1/26/90	139	3.4
MW-14	1/26/90	446	4.5
MW-15	1/23/90	363	3.0
MW-17	2/05/90	1196	4.5

Administrative and Procedural Control

Well development activities were controlled by WHC-CM-7-7, Environmental Investigations and Site Characterization Manual. The following are instruction which are found within that manual are were pertinent to these activities:

EII 1.5 Field Logbooks: Controlled the methods to handle information placed within field logbooks

EII 1.6 Records Management: Controlled the methods to handle records generated by instructions used

EII 5.4 Decontamination of Drilling Equipment: Controlled the steps to follow when decontaminating the pump and associated equipment

EII 6.4 Groundwater Resource Protection Well Maintenance: Controlled the steps used to install and remove the well development pump

EII 10.2 Measurement of Ground-Water Levels: Controlled the steps to be taken in making ground-water level measurements

EII 10.4 Well Development Activities: Controlled the methods to use and steps to follow during the development of a well.

S. W. Clark
Page 3
March 20, 1990

81232-90-019

Records

Documents generated by well development activities are considered to be field logbooks and forms identified in instructions used in the above mentioned activities.

One logbook was used in these activities WHC-N-306-3. This logbook along with any forms generated by these activities are stored in a fireproof locking file cabinet located at 450 Hills Street, Richland Washington.

J W Lindberg

J. W. Lindberg
Field Team Leader

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Westinghouse Hanford Company

Ir File

memo

From: Geosciences Group
Phone: 6-5005 H4-56
Date: March 20, 1990
Subject: TECHNICAL MEMORANDUM DOCUMENTING AQUIFER TEST PROCEDURES

81232-90-020

To: S. W. Clark H4-55

cc: K. R. Fecht H4-56
JWL File/LB

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BOOZ ALLEN ASSOCIATES LIBRARY
[illegible] 148TH AVE. N.E.
REDMOND, WA 98052

Geosciences Group, WHC [Technical Memo 81232-90-020 to S. Clark, WHC] March 20, 1990

Scope

This technical memorandum summarizes aquifer testing activities in the 1100-EM-1 operable unit. These activities were performed under the direction of the Geosciences Group, Westinghouse Hanford Company. Kaiser Engineers Hanford Company provided physical support (i.e., movement of the slugging rod in and out of the well). Aquifer testing was performed in all 16 wells that will be used for groundwater monitoring purposes within the 1100-EM-1 operable unit. These wells are designated MW-1 through MW-17 with MW-16 designation not being used in the activity. The method of testing was slug injection and slug withdrawal. The aquifer testing was done to satisfy data requirements of the 1100-EM-1 Work Plan (DOE/RL 88-23).

Purpose

The purpose of aquifer testing activities was to :

Determine the hydrological characteristic of the aquifer which was penetrated by the above mentioned wells.

Location

Aquifer testing activities were initiated January 22, 1990 and completed on February 28, 1990. The follow information identifies the date and location of each test. In every case an injection and withdrawal test was performed. Some of the wells had testing performed twice on two different days.

Well Designation	Date Performed
MW-1	2/01/90 and 2/02/90
MW-2	2/08/90
MW-3	2/28/90
MW-4	2/07/90
MW-5	2/07/90
MW-6	2/02/90
MW-7	2/02/90
MW-8	1/22/90 and 1/23/90
MW-9	2/12/90
MW-10	1/29/90
MW-11	2/02/90
MW-12	2/14/90

Hanford Operations and Engineering Contractor for the US Department of Energy

Well Designation	Date Performed
MW-13	1/29/90
MW-14	1/29/90
MW-15	1/24/90
MW-17	2/08/90

Administrative and Procedural Control

Aquifer testing activities were controlled by WHC-CM-7-7, Environmental Investigations and Site Characterization Manual and an Aquifer Test Plan for Phase I of the Remedial Investigation. The following are instruction which are found within that manual are were pertinent to these activities:

EII 1.5 Field Logbooks: Controlled the methods to handle information placed within field logbooks

EII 1.6 Records Management: Controlled the methods to handle records generated by instructions used

EII 5.4 Decontamination of Drilling Equipment : Controlled the steps to follow when decontaminating the slugging rod and leader cable

EII 10.1 Aquifer Testing: Controlled the methods to use and steps to follow during aquifer testing

EII 10.2 Measurement of Ground-Water Levels : Controlled the steps to be taken in making ground-water level measurements.

Records

Documents generated by aquifer testing activities are considered to be field logbooks and forms identified in instructions used in the above mentioned activities. The Aquifer Test Plan is stored with aquifer testing results of well MW-1.

One logbook was used in these activities WHC-N-306-3. This logbook along with any forms generated by these activities are stored in a fireproof locking file cabinet located at 450 Hills Street, Richland Washington.

J. W. Lindberg
Field Team Leader

dyl

NRC File

Westinghouse Hanford Company

In. Memo

From: Geosciences Group 81232-90-021
Phone: 6-5005 H4-56
Date: March 21, 1990
Subject: TECHNICAL MEMORANDUM CONCERNING 1100-EM-1 GROUNDWATER SAMPLING FIELD PROCEDURES AND RESULTS

To: S. W. Clark H4-55

cc: K. R. Fecht H4-56
JWL File/LB

Geosciences Group, WHC [Technical Memo 81232-90-021 to S. Clark, WHC] March 21, 1990

SCOPE

The information summarized in this technical memorandum concerns groundwater sampling and analysis activities that were conducted in support of the 1100-EM-1 monitoring well development and groundwater characterization during the period January 22, 1990 until March 2, 1990. The sampling was done in response to data requirements in the 1100-EM-1 Operable Unit Work Plan (DOE/RL 88-23). Groundwater was collected from twenty-one wells within the operable unit for field and laboratory analysis. Additionally, two composite samples were collected from eight wells that comprise the Richland Well Field.

PURPOSE

Samples collected during well development were field/laboratory screened for a limited number of parameters for the purpose of:

- Indicating well installation problems that could be detected by aberrations in the groundwater chemistry
- Providing an indication of potential contamination within the groundwater system.

Groundwater characterization samples were collected for the purpose of:

- Investigating potential sources which may be contaminating the groundwater
- Determining the nature and extent of potential contamination to the groundwater
- Providing data to improve hydrogeologic conceptual models
- Providing data to conduct a preliminary baseline risk assessment
- Providing data for use in the modelling of contaminant transport.

Hanford Operations and Engineering Contractor for the US Department of Energy

FIELD MEASUREMENTS AND SAMPLING

Administrative and Procedural Controls

Activities associated with the groundwater sampling were controlled by WHC-CM-7-7, Environmental Investigations and Site Characterization Manual, as well as other site-wide procedures and policies governing radiation surveys and the packaging and shipping of samples.

General sampling procedures are described in Appendix C of EII 5.8 for all wells except MW-3 for which Appendix H of EII 5.8 applies. Additional details concerning sampling and other field measurements made for this initial sampling episode of the Phase I characterization effort are as follows.

Field Measurements

Field measurements of pH, conductivity, and temperature were made with HACH, Company (HACH) digital instrumentation (HACH 1 meter). The sensors or probes were immersed in an open, flow-through container into which the entire purgewater stream was directed. A constant water volume of approximately six liters was maintained with a small wier-type overflow in one side of the container. This configuration provided a continuous flow of water past the electrodes and a residence time of water in the container of approximately one minute. The short residence time and relatively large mass of water also served to minimize cooling of the sample stream around the temperature probe (Near-freezing temperature conditions prevailed during much of the sampling episode). Calibration checks were made before and after sampling events using HACH pH buffers (7 and 10) and a HACH conductivity standard. The digital thermometer was checked against a laboratory grade thermometer. Details of standards and calibration checks are in Field Logbook WHC-N-370 and associated Ground Water Sample Reports.

Dissolved oxygen was measured using a modified Winkler method (HACH Digital Titrator Method, DREL/5). Samples were taken shortly after collection of the volatile organic analysis VOA samples using a clear, 60 ml BOD-type bottle. The sample leg tubing on the sampling manifold was placed near the bottom of the biological oxygen demand (BOD) bottle and the water allowed to overflow from the lip of the BOD bottle until no bubbles were observed. Reagents were added to the BOD bottle immediately after collection and the sample titrated in the field with the HACH digital titrator equipped with pre-standardized titrant cartridges. The samples were titrated to the disappearance of the straw yellow color on a white background.

Sample Collection

In general, one single sample set included 19 bottles which were divided into two groups for analysis by separate laboratories. One group was analyzed for Primary/Secondary Drinking Water constituents and indicator parameters. The remaining bottles were shipped to an offsite Contract Laboratory Program (CLP) laboratory for analysis for Target Compound List constituents. Appropriate Quality Control (QC) samples were collected as defined in the 1100-EM-1 Work Plan and are described in the QC Samples section below.

After the prescribed volume of purgewater was removed from the well in accordance with EII 5.8, Appendix C, a stainless steel sample T was attached to the discharge T of the well head assembly. The sample Ts consisted of Swagelok connectors, a union T and 3/8 inch stainless tubing with a Stainless steel valve (all Teflon and stainless internal parts) on the discharge side of the sample leg. A pre-cleaned sample T was used for each sampling event. Sample T's were cleaned using the same Environmental Protection Agency protocol as used on all other sampling equipment used in this investigation (EII 5.5, Rev 1). A stainless steel shutoff valve was attached to the discharge leg of the sample T assembly through which the sample stream was allowed to flow prior to sampling. Approximately 5 liters of water were allowed to flow through the sample leg as well as the discharge leg of the sample T prior to sampling. Except for the filtration step, the discharge leg valve was closed during sampling. For the filtered water sample (taken for metal analyses), the discharge line was initially open and then slowly closed to divert all of the sample stream through the filter. This was done to avoid overpressurizing and rupturing the filter. The filter assembly consisted of a 45 mm diameter, SamplePro (QED, Environmental Systems, Inc., FF-8100) sealed unit fitted with a 0.45 nm filter. The filter housing was attached directly to the valve on the sampling leg of the sample T with a threaded, stainless steel connector (a separate, pre-cleaned connector was used for each sampling event). 500 ml of sample were passed through each filter prior to sample collection as a pre-conditioning/rinse.

Flow rate during sampling was adjusted by controlling the stroke rate of the pneumatic drive head with the air control ball valve. Sampling rates were approximately 1-2 L/min during filling of the large containers and a few hundred ml/min for the VOA samples and dissolved oxygen. Breathing quality compressed air was used to actuate the pneumatic drive head to avoid contamination of VOA samples with airborne fumes associated with gasoline driven compressors (the driver head air exhaust exits approximately 2 ft from the sample T.).

Development Water

Samples of water were taken at the beginning, midway, and end of each development pumping regime. The samples were analyzed in the laboratory for pH and conductivity, usually within one day of collection using the same equipment as used for the field measurements. Some of these samples were analyzed for nitrate using the HACH Cadmium Reduction method (DREL/5 with NitraVer 5 reagent). Turbidity samples were taken periodically in the field during development pumping using a HACH turbidimeter (Model #16800).

Quality Control Samples

A trip blank, which consisted of a set of VOA bottles, was prepared using distilled deionized water and submitted for analysis for each sample day. Intralaboratory duplicate samples were collected from wells MW-5 and MW-11. Interlaboratory split samples (CLP sets only) were collected from wells MW-17 and MW-8. A field equipment blank was collected on the final day of sampling.

The field equipment blank was obtained by passing distilled deionized water (source water) from a pre-cleaned (ICHEM) collapsable, polyethylene container through a sample T assembled as described for sampling. The container and sample T were connected with a short length (2cm) of pre-cleaned, polythylene tubing. The direct connection between the source water in the collapsable container and the sample T provide a closed system, thus preventing introduction of airborne contaminants. Five liters of source water were passed through each leg of the sample T prior to filling the sample bottles. A complete set of samples was taken of both the source water and the water after passing through the sample T. The field equipment blank samples were all handled in identical fashion as actual samples.

Field Sampling Data

Included in Attachments 1 and 2 are the sampling dates and field analysis results. Attachment 1 contains the development phase sampling results for the sixteen new groundwater monitoring wells that were installed during this phase of the 1100-EM-1 operable unit investigation. Refer to the "Technical Memorandum on Well Development Procedures and Results" for details concerning physical development. Development samples collected from these wells were analyzed in the laboratory as described in the field measurements and sampling section below. Attachment 2 contains field sampling/screening data collected during the characterization phase.

RECORDS

Documents generated by the groundwater sampling and analysis activities include: a field log book, ground water sample reports, laboratory bench sheets, chain-of-custody records, sample analysis request forms, sampling equipment decontamination records, and hazardous material shipping records. The logbook (WHC-N-370), ground water sample reports, laboratory bench sheets and equipment decontamination records are maintained in the Geoscience's project file. The Westinghouse Hanford Company Office of Sample Management maintains copies of all other records as well as the results from contract laboratories that performed analyses on the collected water.

J. W. Lindberg
Field Team Leader

dyl

Attachment

ATTACHMENT 1. WELL DEVELOPMENT SAMPLING RESULTS

WELL	DEVEL DATE	PH START	PH END	CONDUCT START (umho/cm)	CONDUCT END (umho/cm)	NO3 (mg/L)
MW-1	01-Feb-90	7.95	7.88	610	690	3.5
MW-2	08-Feb-90	8.59	8.08	380	460	--
MW-3	28-Feb-90	7.5	7.27	1210	1260	--
MW-4	30-Jan-90	8.04	8.14	350	350	1.4
MW-5	31-Jan-90	7.8	8.25	300	360	--
MW-6	01-Feb-90	8.04	8.15	400	400	3
MW-7	31-Jan-90	8.22	8.18	460	430	3.5
MW-8	22-Jan-90	8.01	7.97	600	520	--
MW-9	09-Feb-90	9.2	8.25	390	250	--
MW-10	27-Jan-90	7.87	7.97	910	830	168
MW-11	29-Jan-90	8.61	7.98	620	880	155
MW-12	09-Feb-90	8.6	7.73	860	970	--
MW-13	26-Jan-90	7.93	7.9	800	900	160
MW-14	26-Jan-90	8.16	7.86	890	960	160
MW-15	23-Jan-90	7.93	8.06	850	790	130
MW-17	05-Feb-90	8.32	8.2	380	300	--

ATTACHMENT 2. WELL CHARACTERIZATION SAMPLING DATA

WELL	DATE SAMPLED	PURGE VOLUME (gal)	PH *	TEMP (C) *	CONDUCT (umho/cm) *	D OXYGEN (mg/L)	SAMPLE NUMBER
MW-1	07-Feb-90	50	7.76	16.1	770		B 23,24
			7.78	16.2	770		
			7.86	16.1	720	0.9	
MW-2	12-Feb-90	55	8.20	15.5	440		B 33,34
			8.02	15.6	440		
			--	15.5	440		
			7.90	15.5	440	4.4	
MW-3	02-Mar-90	70	7.30	16.9	1280		B 63,64,65
			7.25	17.1	1280		
			7.26	16.9	1280		
			7.28	17.1	1280		
			7.28	16.9	1280	3.5	
MW-4	08-Feb-90	52	8.04	15.6	320		B 26,25,27
			8.05	15.6	330		
			8.05	15.6	330	6.2	
MW-5	12-Feb-90	130	8.19	15.5	350		B 29,28,30,31,32
			8.15	15.2	350		
			8.17	15.4	350	4.2	
MW-6	07-Feb-90	50	7.94	15.4	410		B 21,22
			7.94	15.8	400		
			7.94	15.8	410		
			7.94	15.9	400	3.6	
MW-7	07-Feb-90	51	--	15.2	450		B 19,18,20
			--	15.3	440		
			--	15.4	420		
			--	15.4	430	7.2	
MW-8	29-Feb-90	50	7.98	15.7	--		
			7.95	15.7	--		
			7.94	15.8	--		
			7.95	15.9	--	--	
MW-8	13-Feb-90	50	7.63	15.0	510		B 41,42
			7.67	15.6	510		
			7.69	15.5	510	5.8	
MW-9	12-Feb-90	130	7.88	15.5	250		B 35.36
			7.87	15.5	250		
			7.89	15.5	250		
			7.91	15.5	250		
			7.92	15.5	250	0.9	
MW-10	06-Feb-90	53	7.67	15.5	870		B 16,17
			7.70	15.4	860		
			7.70	15.5	870		
			7.72	15.5	870	6.5	
MW-11	06-Feb-90	55.7	7.87	15.5	900		B 13,11,12,14,15
			7.89	15.4	920		
			7.90	15.3	900		
			7.97	15.1	880	6.0	
MW-12	14-Feb-90	36.6	7.46	15.9	990		B 50,51

ATTACHMENT 2. WELL CHARACTERIZATION SAMPLING DATA

WELL	DATE SAMPLED	PURGE VOLUME (gal)	PH *	TEMP (C) *	CONDUCT (umho/cm) *	D OXYGEN (mg/L)	SAMPLE NUMBER
			7.49	15.9	990		
			7.51	15.9	990		
			7.53	15.9	990	2.1	
MW-13	05-Feb-90	33	7.78	16.4	930		B 9,10
			7.78	16.7	930		
			7.80	16.4	920	6.0	
MW-14	05-Feb-90	50	7.85	16.0	950		B 6,7,8
			7.85	16.1	960		
			7.89	15.9	950		
			7.91	15.8	890		
			7.93	15.9	930	3.3	
MW-15	30-Jan-90	50	7.80	15.6	800		B 3,4,5
			7.80	16.0	790		
			7.81	16.0	790		
			7.81	16.0	800	7.2	
MW-17	13-Feb-90	223	5.35	15.2	270		B 38,37,39,40
			5.80	15.0	270		
			7.53	15.3	280		
			7.54	15.3	280		
			7.65	15.1	280		
			7.70	14.9	280		
			7.76	14.9	280		
			7.79	14.8	280	0.6	
6-S37-E14	21-Feb-90	19	8.14	14.4	210		B 53,52,54
			8.16	14.4	210		
			8.16	14.4	210		
			8.16	14.4	210	7.3	
6-S40-E14	21-Feb-90	26.7	8.14	6.6	190		B 48,49
			8.17	6.6	190		
			8.19	6.6	190	11.4	
6-S41-E13A	14-Feb-90	31.5	7.77	14.3	260		B 46,47
			7.83	14.6	260		
			7.85	14.6	260	--	
6-S41-E13A	21-Feb-90	19	8.10	15.3	280		B 57
			8.11	15.3	280		
			8.12	15.2	270		
			8.13	15.2	260		
			8.14	15.2	250	9.4	
6-S41-E13B	14-Feb-90	105	7.38	14.6	500		B 44,43,45
			7.42	14.6	500		
			7.48	14.6	500		
			7.53	14.6	500		
			7.53	14.7	500	1.2	
6-S43-E12	21-Feb-90	19	7.61	17.1	550		B 55,56
			7.62	17.1	540		
			7.65	17.1	540		
			7.71	16.9	525	6.8	

ATTACHMENT 2. WELL CHARACTERIZATION SAMPLING DATA

WELL	DATE SAMPLED	PURGE VOLUME (gal)	PH *	TEMP (C) *	CONDUCT (umho/cm) *	D OXYGEN (mg/L)	SAMPLE NUMBER
RICH-EAST	25-Feb-90	NA	8.08	10.1	210		B 61,62
			8.08	10.1	200		
			8.08	10.1	210	10.4	
RICH-WEST	25-Feb-90		8.02	7.6	200		B 58,59,60
			8.02	7.6	200		
			8.02	7.6	200	10.7	

* Time series readings of pH, conductivity and temperature during purgewater removal are listed in the order in which they were recorded during each sampling event. The original ground water sample sheets should be consulted for specific details.

Westinghouse Hanford Company

Intern
Mem

From: Geosciences Group
Phone: 6-5005 H4-56
Date: May 1, 1990
Subject: TECHNICAL MEMORANDUM DOCUMENTING PROCEDURES USED DURING WELL DRILLING, AND CONSTRUCTION

81232-90-038

To: S. W. Clark H4-55

cc: K. R. Fecht H4-56
W. H. Price S0-03
KRF File/LB

Scope

This technical memorandum summarizes well drilling and well construction activities in the 1100-EM-1 Operable Unit and soil sampling associated with well drilling. These activities are under the direct control and supervision of Westinghouse Hanford Company. Aquifer testing and well development are discussed in other technical memoranda.

Purpose

The purpose of ground water monitoring well drilling and sampling activities are to:

- Identify physical characteristics of soil which may affect the retention or transport of contaminants and any potential remediation alternatives
- Collect soil samples representative of subsurface material
- Construct resource protection wells to collect water quality samples, water level data, and geologic data.

The data will provide input to the CERCLA Remedial Investigation and Feasibility Study of the 1100-EM-1 Operable Unit.

Location and Dates of Activities

Monitoring wells are located at the Horn Rapids Landfill and other areas in the 1100 Area. Ground water monitoring well drilling (MW-1 through MW-15 and MW-17) commenced on October 23, 1989 and ended on February 16, 1990. Well construction commenced on November 1, 1989 and ended on February 22, 1990 except MW-3 surface configuration work. Because of the location of MW-3, it required below ground completion to accommodate heavy vehicle traffic. Borehole camera surveys were run between January 29, 1990 and March 1, 1990.

Hanford Operations and Engineering Contractor for the US Department of Energy

Administrative and Procedural Controls

Ground water well drilling, soil sampling, and well construction were controlled by WHC-CM-7-7, Environmental Investigations and Site Characterization Manual; WHC-S-014 Revision 3, Generic Specification and the 1100-EM-1 Operable Unit Work Plan (DOE/RL 88-23). Work was accomplished by utilizing the following procedures:

EII 1.4, Deviation from Environmental Investigations Instructions --- Establishes the requirements and methods for revision of Environmental Investigations Instructions

EII 1.5, Field Logbooks --- Establishes the requirements for entering information into field logbooks

EII 4.2, Interim Control of Unknown Waste --- Establishes a system to control the containment, labeling and tracking of drums of unknown waste generated during well drilling and well development activities

EII 5.1, Chain of Custody --- Establishes the requirements for documenting and maintaining the chain of custody for environmental samples from taking the sample to receipt at the physical testing laboratory at 2101M Building in 200 East Area

EII 5.2, Soil and Sediment Sampling --- Establishes the general requirements applicable to soil sampling activities and to provide descriptive guidelines for performing various individual sampling techniques

EII 5.4, Documentation of Drilling Equipment --- Establishes methods for performing decontamination of drilling equipment, straightness testing casing, downhole development equipment, and sample collecting equipment for physical samples

EII 6.1, Activity Reports of Field Operations --- Provides directions for documenting daily field activities

EII 6.4, Groundwater Resource Protection Well Maintenance --- Establishes methods for installing development pumps, installing Hydrostar pumps, and performing borehole camera survey of wells.

EII 6.7, Groundwater Well and Borehole Drilling --- Provides requirements and generalized steps for the drilling of groundwater monitoring wells

EII 6.8, Well Completion --- Specifies requirements for the completion of groundwater monitoring wells

EII 9.1, Geologic Logging --- Establishes methods and format for geologic logging of material from the drilling of groundwater monitoring wells

EII 10.2, Measurement of Ground-water Levels --- Establishes methods for performing and documenting measurements of ground-water levels in monitoring wells.

Records

Documents generated by the drilling, sampling, and construction activity include: field log books, borehole logs, well summary sheets, chain of custody records, sample analysis request forms, equipment decontamination records, cable tool field activity reports, Washington state water well completion report, well completion logs, drilling planning and release forms, and well completion forms.

Daily drilling and sampling activity was recorded in field activity reports, borehole logs, and field logbooks. Field logbook numbers are WHC-N-306, WHC-N-306-1, WHC-N-306-2, WHC-N-306-3, WHC-N-306-4, and WHC-N-306-5. Well construction activity was recorded in field activity reports, well completion logs, and field logbooks. Other records were generated as needed. The well construction report and well summary sheets provide a concise verbal and graphic summary of each well.

All documents or copies of documents are kept by the WHC Geosciences Group in the project file. All original records generated from the 1100-EM-1 Operable Unit activities will be retained for permanent storage per EII 1.6, Records Management.

J. W. Lindberg, Scientist
Geosciences Group

dyl

NRC File 5-4-89

Westinghouse Hanford Company

Int Memo

From: Environmental Technology Group
Phone: 6-1038 H4-54
Date: May 4, 1989
Subject: 1100 AREA BIOTIC SURVEYS

80210-89-042

To: M. R. Adams H4-55

cc: J. W. Cammann H4-54
R. G. McCain H4-55
R. M. Mitchell H4-55
R. V. Roeck H4-55
DSL File/LB

The attached letter report statuses the biotic surveys which have been conducted during March and April at the Horn Rapids Landfill, 1100-2 Disposal Site, 1100-3 Disposal Site, 1100 Area Battery Acid Pit, and Discolored Soil Site. This report is a revision to the one previously transmitted to you on April 28, 1989.

If you have any questions, please contact me at 6-1038 or 3-5544.

D. S. Landeen

D. S. Landeen
Scientist

iar

Attachment

Landeen, D. WHC [Memo to M. Adams, WHC] May 4, 1990

Hanford Operations and Engineering Contractor for the US Department of Energy

BIOTIC SURVEY STATUS REPORT

Introduction

This letter report gives the status of the biotic surveys that were conducted at some of the 1100 Area RCRA sites. These surveys are conducted in accordance with procedure EII 5.3 Biotic Sampling, Rev 0. The sites that are statused in this report include the following: Horn Rapids Landfill, Discolored Soil Site, 1100 Area Battery - Acid Pit, 1100-2 Disposal Site and the 1100-3 Disposal Site. Information on each site is given in the following sections along with any recommendations for future efforts. Site maps are also included depicting major habitat types and disturbances. It needs to be pointed out that due to a relatively cold spring these surveys have probably been conducted a little early to document some of the migratory species that may use some of these sites. Some follow up surveys should be conducted in May and early June at some of the sites.

Battery Acid Pit (1100 Area)

The battery acid disposal site is a very small area that is located directly behind the 1100 Area vehicle maintenance shop and the motor pool. There are no obvious signs that this area was ever used for disposal and in fact part of the area may have been paved over. This site is completely devoid of any flora or fauna and is not an area that would be utilized to any significant degree by plants or animals in the future due to its proximity to the 1100 area maintenance activities. There is no need to conduct any more biotic surveys at this site and any kind of future work here will not have any negative impacts to the biotic environment.

Discolored Soil Site

It is not immediately obvious that this area is a hazardous waste disposal site; however, upon closer examination it appears that some surface disposal may have occurred there in the past (possibly petroleum products). This site as well as the immediate surrounding environs shows lots of manmade disturbances. Major plant species occurring on this site include rabbitbrush, tumbleweeds, tansy mustard, cheatgrass and Sandberg's blue grass. The fact that there are no sagebrush residing on this site indicate past disturbance. None of the plants growing on this site show any visible signs of stress due to possible uptake of contaminants. In fact, the plants actually growing on the discolored areas (rabbitbrush and cheatgrass) appear to be doing well.

Very few visible signs of small mammals in the form or mounds or casts were observed. Sometime in the distant past a badger dug some shallow exploratory holes in the sloped sides. White crowned sparrows were observed at this site on one occasion. A marsh hawk has been observed foraging in this area. This site should be looked at in May and early June to document any migratory bird species that may utilize this site.

1100-2 Disposal Site

This site which is located adjacent to the main highway and the nearby railroad tracks near the 300 Area has obviously been disturbed by heavy equipment blading and scraping operations in the past. Most of the top soil has been removed exposing the underlying cobbles. Very little plant cover exists on the cobbled area which is between the highway and the railroad track. The major plant species which do occur to some limited extent on the cobbled area include rabbitbrush, cheatgrass and tumbleweeds.

The other small part of this site which is located on the other side of the railroad track has not been disturbed by heavy equipment operations and has some sagebrush and Sandberg's blue grass which indicate the lack of manmade

disturbances in this area. Pocket mouse excavations are common here and there are signs of past badger excavations. The only two bird species observed at this site were the meadowlark and horned lark. The horned lark may be using the cobbled surfaces as a nesting area.

Some follow up surveys should be conducted at this site during May and early June.

1100-3 Disposal Site

This site is obviously a manmade pit that has undergone lots of disturbance. The pit itself and the sides show lots of exposed cobbles with very little topsoil left. Most of the vegetation at this site occurs on the outer rim; however, some invader species like tumbleweed and cheatgrass are growing in the pit. On the outer edges rabbitbrush, Sandberg's blue grass and sagebrush can be seen.

No signs of small mammal activity were observed in the pit itself. Horned larks may be nesting among the cobbles and starling have been seen foraging in the pit.

Some spot surveys could be conducted here in May and June just to verify previous observations.

Horn Rapids Landfill

This is a large site and has the most diversity in terms of flora and fauna than all the other sites combined. The area has obviously been disturbed by heavy equipment in the past and there is lots of visual evidence that this area was used as a disposal site. There are numerous pits and depressions scattered throughout the site as well as excavated berms. The whole site has been disturbed by fire at one time, probably about 10 years ago.

Major plant species observed at this site include rabbitbrush, cheatgrass, Sandberg's blue grass, tumbleweed, and plantain. Other plant species observed include phlox, prickly pear cactus, bitterbrush, yarrow, goatsbeard, tansy mustard, tumblemustard, aster, and some native wheatgrass. Because the area has been burned only a few sagebrush remain at this site. The bitter brush is found growing in and immediately around the tire pit area which is located centrally on the site.

Mammals observed (includes tracks) at this site include a small colony of Townsend ground squirrels, pocket mice, cottontail rabbits, coyotes, mule deer, and badgers. Some of the badger excavations near the ground squirrel colony are recent. One excavation observed in a berm may be a den. Only further observations could substantiate this.

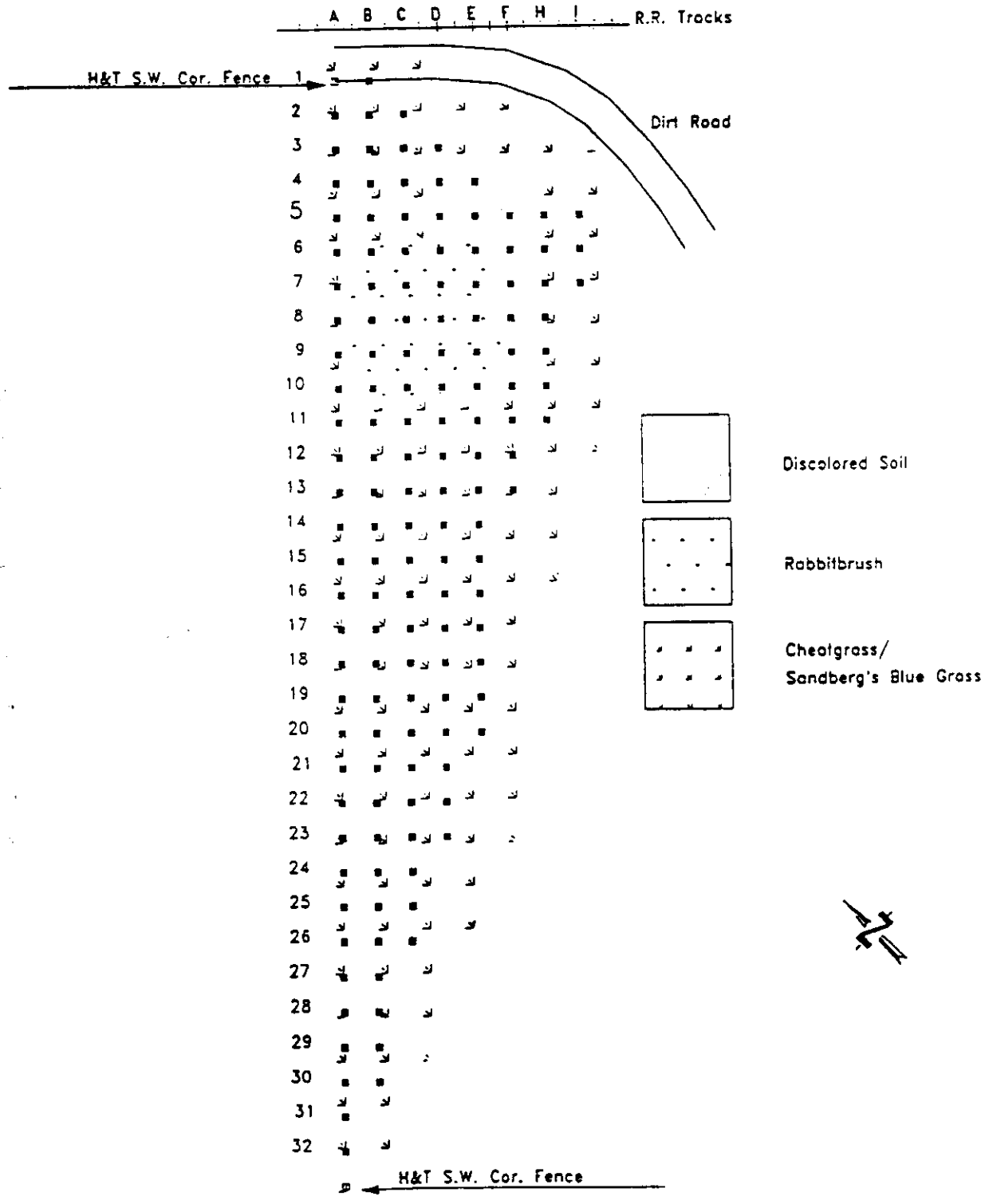
Bird species observed at this site include ring billed gulls, killdeers, ravens, marsh hawks, meadowlarks, horned larks, and long billed curlews. The surveys have probably been conducted a little too early to document other migratory bird species that utilize this area. The long billed curlews have been observed 50 to 150 yards off the site and no more than two pair have ever been observed. It does not appear that this site or the surrounding environs have very many pair of curlews that are actually nesting at this site. Any impact from sampling operations planned at the landfill should have a negligible impact on the curlews. The long billed curlews are the principal bird species of concern and further observations should verify whether or not curlews are actually nesting and foraging on the landfill site.

Due to the large number of abandoned badger burrows and relative lack of human interference this site should support burrowing owls, but as yet burrowing owls have not been observed on the site. Further observations in May and June should determine if the owls are residing on this site. If further observations determine that burrowing owls are residing on the site then measures should be taken to mitigate any potential disturbances.

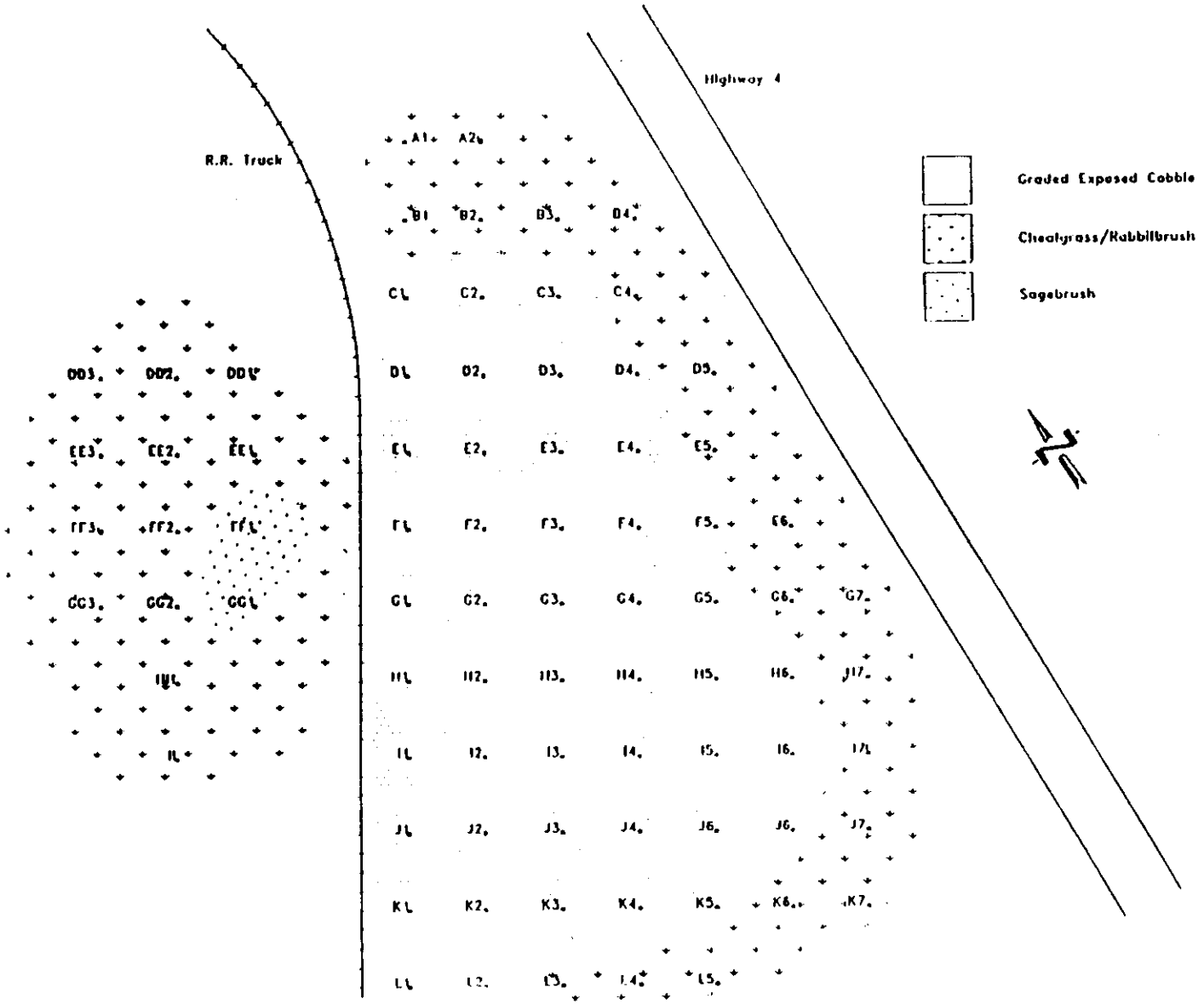
Summary

No visible evidence of plant or animal stress was observed at any of the hazardous waste sites mentioned above. At the present time there are no recommendations to collect or sample any of the flora or fauna for hazardous waste constituents. If during the course of future observations, uptake or transport of hazardous waste constituents is suspected then recommendations for sampling will be provided.

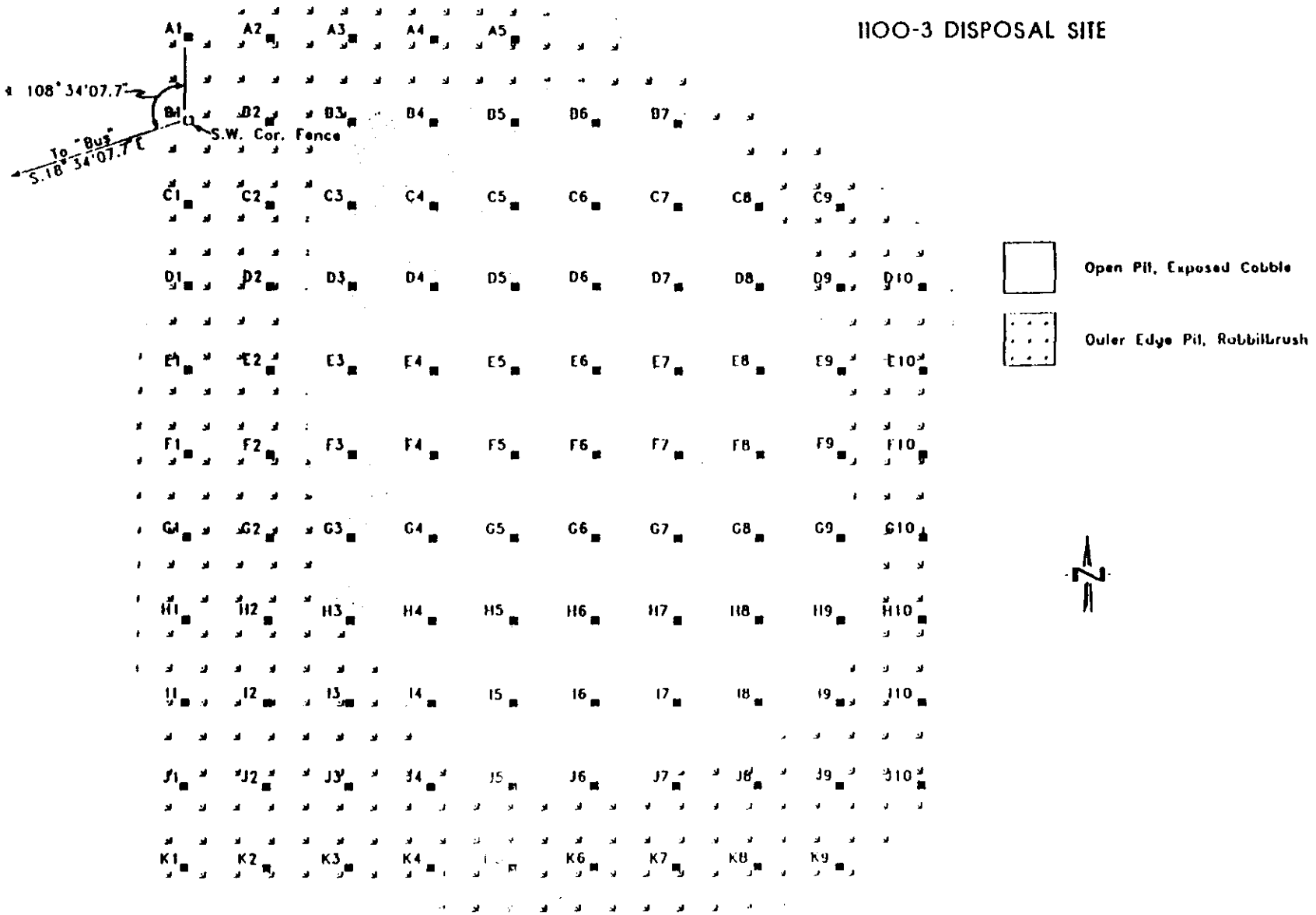
DISCOLORED SOIL SITE



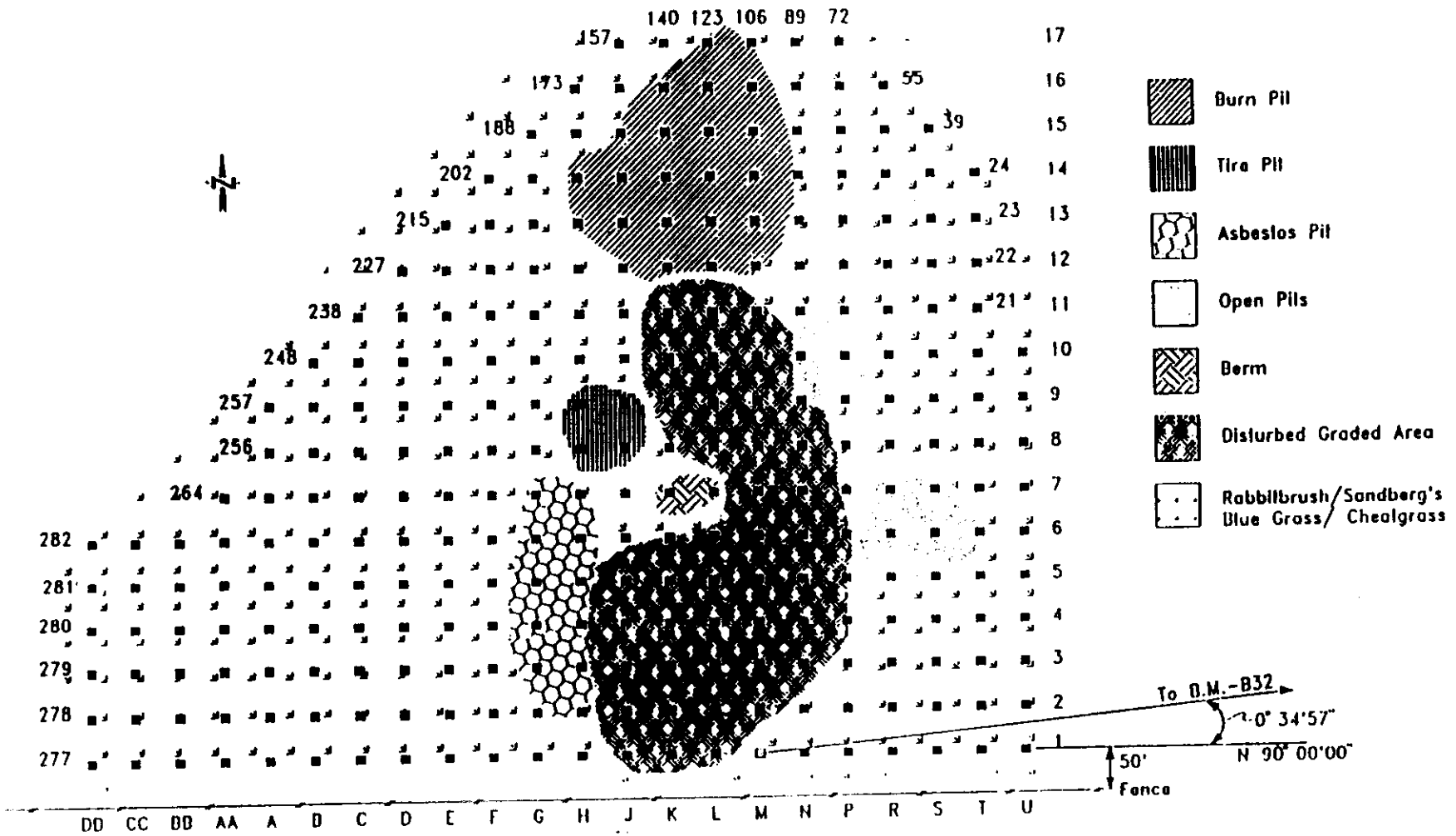
1100-2 DISPOSAL SITE



1100-3 DISPOSAL SITE



HORN RAPIDS LANDFILL



11.113.25
NRC
File

Washington
Department of Ecology

MEMORANDUM

TO: Russ Taylor

THROUGH: Clar Pratt

FROM: Jim Milton and Dennis Bowhay

SUBJECT: Exxon Nuclear (meeting November 3, 1986)

DATE: October 31, 1986

Milton, J., and D. Bowhay, Ecology
[Memo to R. Taylor, Ecology] October 31, 1986

On October 28, 1986 Mr. Charles W. Malody called to set up a meeting with Russ et. al. on the possible sale of all or part of Exxon Nuclear to a German Corporation. Mr. Malody relayed five specific concerns of the clients investigating purchase. They are as follows with my associated response.

1. What are future liabilities concerning 1982 JUB Engineering's study of leaking lagoons?

   On June 1983 we received a copy of a report to NRC describing the leakage of wastewater from the Exxon treatment lagoons. The report described a plume 40 to 50 feet deep by 500 to 600 feet wide by 1000 to 11000 feet long extending northwesterly from the Exxon facilities. Contaminant levels were judged not to have a detrimental impact on the public due to restricted land use in the area (south part of 300 area) and no effect on the Columbia River, which the plume is projected to reach in 75 years. Contamination levels exceed EPA drinking water standards as follows: NO_3 standard of 10 mg/l exceeded by a high of 70 mg/l; Fluorides standard of 2 mg/l exceeded by a high of 17 mg/l; and a SO_4 standard of 250 exceeded by a high of 423.

   Remedial action has been taken with the installation of double lined lagoon with monitoring required by the State Waste Discharge Permit.

   Figure 9 page 18 of JUB Engineer's Report shows test wells and the location of the projected plume of contaminated groundwater. The downstream plume area should be investigated to ensure that there are no conduits for downward migration of pollutants into the lower aquifer.

   The report submitted basically complies with requirements for designation under Part III of WDOE Cleanup Policy, Ground Water

Protection Levels. This spill has not bee through the formal process because it preceded the Policy. Follow up for Protection Cleanup Levels requires long term monitoring to verify that there is no threat to public health or the environment. This is a condition of the State Waste Discharge Permit. No additional requirements are anticipated other than monitoring of the plume and ensuring that lower aquifers are not vulnerable.

2. Are there any changes regarding Gaseous Fluorides Emissions and/or testing.

   In 1983 the NRC required that the fluoride stack sampling method used by Exxon Nuclear be approved by the State of Washington. A report was submitted along with a sampling program. That program was approved by this office, after consultation with WDOE monitoring experts, March 23, 1983. No major changes to Fluoride limits or testing procedures have occurred since that time which would result in the need for modification.

3. WDOE Policy on G.W. use and discharge to it?

   G.W. use is by permit evaluated on a case by case basis. There are no known pre-existing uses or conditions which would impair addition withdrawals in that area.

   Discharge requires known reasonable and available treatment prior to discharge and protection of groundwaters (drinking water standards) for additional future uses. SEPA review, an engineering report and P & S approval is required for treatment and/or disposal facilities.

4. Waste discharge permit renewal?

   The current permit expires May 27, 1987.

   If and when the City of Richland gets up to full speed on their pretreatment program the permitting responsibility could shift to the city with state oversight. It is not anticipated that this would have a material impact on the discharge requirements unless problems with the city's WWTP are traced to the Exxon discharge.

5. Dangerous waste designation of Waste Storage lagoon?

   There is the need to determine if individual waste streams and/or the combined wastes are dangerous waste. The only point which has previously been evaluated has been the discharge to Richland STP. Since the new lagoons are built to dangerous waste lagoon standards they have been assigned a low priority for follow up.

   Last information we have is that their Waste Storage Impoundments were being evaluated by Olympia - Status unknown?

This appears to be major area for potential future impact on this facilities. Such impact would basically be administrative assuming no unusual findings.

JM:ch

Northwest EnviroService Inc.

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REDMOND, WA

(RHO)] November 5, 1986).

MEMORANDUM

TO MIKE ROMSOS, RHO

FROM JOE NESSEL, CHEMIST
NORTHWEST ENVIROSERVICE INC.

DATE NOVEMBER 5, 1986

RE TANK IN 1171 BUS GARAGE (ANTIFREEZE TANK)

On October 27, 1986 employees of Northwest EnviroService removed material from and cleaned an underground tank in Building 1171 Bus Garage. This tank has been cleaned to the degree that any material except potable water may be placed into it without being contaminated by the material previously contained in the tank.

3-22

P.O. Box 24443 • Seattle, WA 98124 • 1500 Airport Way South • Seattle, WA 98134 • Phone (206) 622-1090

Battelle
Pacific Northwest Laboratories

Project Number _____

Internal Distribution

RE Fitzner
RH Gray
LE Rogers
File/LB

Date December 8, 1988

To Roy Gephart

From Bill Rickard WH Rickard

Subject NESTING BIRDS NEAR HORN RAPIDS LANDFILL

Rickard, B., PNL [Memo to R. Gephart, PNL] December 8, 1988

Two species of wild birds nest in the vicinity of the Horn Rapids landfill that require special attention because their populations are diminishing in eastern Washington and are being considered by federal and/or state agencies as candidates for special protection under the endangered species act. These are the long-billed curlew, Numenius americanus and swainson's hawk, Buteo swainsoni. The curlew nests on the ground in sparse stands of cheatgrass and the hawk nests in trees that are isolated from human intrusions.

The most critical time in nest desertion caused by human intrusion is in the egg-laying and early incubation stages of nesting. Long-billed curlews arrive on the Hanford Site on or about March 15. They begin to nest by April 1 and the young are out of the nest by May 1. Swainson's hawks arrive in mid-April, nesting begins by May 1 and the young are in the nest by June 1. Hawks remain around the nest through the summer and leave by early September. The birds are not on the Hanford Site in autumn and winter months.

There is a Swainson's hawk nest in a black locust tree located about 1.5 km west of the landfill on the Hanford Site. It has a history of successful nesting. The landfill is probably far enough removed from the nest that hawks would probably not desert the nest under normal construction activities at the landfill. However, workers should be advised not to approach the nest by foot or by automobile during the nesting season.

Long-billed curlews nest near the landfill largely because the absence of human disturbance provided by the security fence around the Hanford Site. Workers should be advised to confine their activities to the immediate work area at the landfill and do not drive or walk through the area other than along the access road.

Some useful reference are listed below.

REFERENCES

Poole, L. D., N. V. Marr, and S. M. McCorquodale. 1988. Productivity, Mortality and Response to Disturbance of Nesting Swainson's Hawks on the Hanford Site. PNL-6496.

Fitzner, R. E. 1978. Behavioral Ecology of the Swainson's Hawk (Buteo swainsoni) in Southeastern Washington. Ph.D. Thesis Washington State University, Pullman, Washington.

RECEIVED
DEC - 8 1988
R. F. GEPHART

Roy Gephart
December 8, 1988
Page 2

Allen, J. N. 1980. "The ecological Behavior of the Long-Billed Curlew in Southeastern Washington." Wildlife Monograph, 73.

WHR:mae

APPENDIX B
GEOPHYSICAL SURVEY RESULTS

The results from the geophysical survey are summarized on the 11 figures provided in this appendix. The figures were obtained from Sandness et al. (1989).

Sandness, G.A., E.V. Allen, and D. K. Larsen, 1989, *Report on Geophysical Surveys at Four Inactive Waste Burial Sites in the 1100-EM-1 Operable Unit*, WHC-MR-0073, Westinghouse Hanford Company, Richland, Washington.

Appendix B Contents

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Figure B-2. Buried Waste Materials Located by GPR and Metal Detector Surveys for the 1100-2 Operable Subunit	B-2
Figure B-3. Buried Waste Materials Located by EMI and Magnetic Surveys for the 1100-2 Operable Subunit	B-3
Figure B-4. Buried Waste Materials Located by Geophysical Surveys for the 1100-2 Operable Subunit	B-4
Figure B-5. Buried Waste Materials Located by GPR and Metal Detector Surveys for the 1100-3 Operable Subunit	B-5
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Figure B-11. Buried Waste Materials Located by Geophysical Surveys for the Horn Rapids Landfill Operable Subunit	B-11

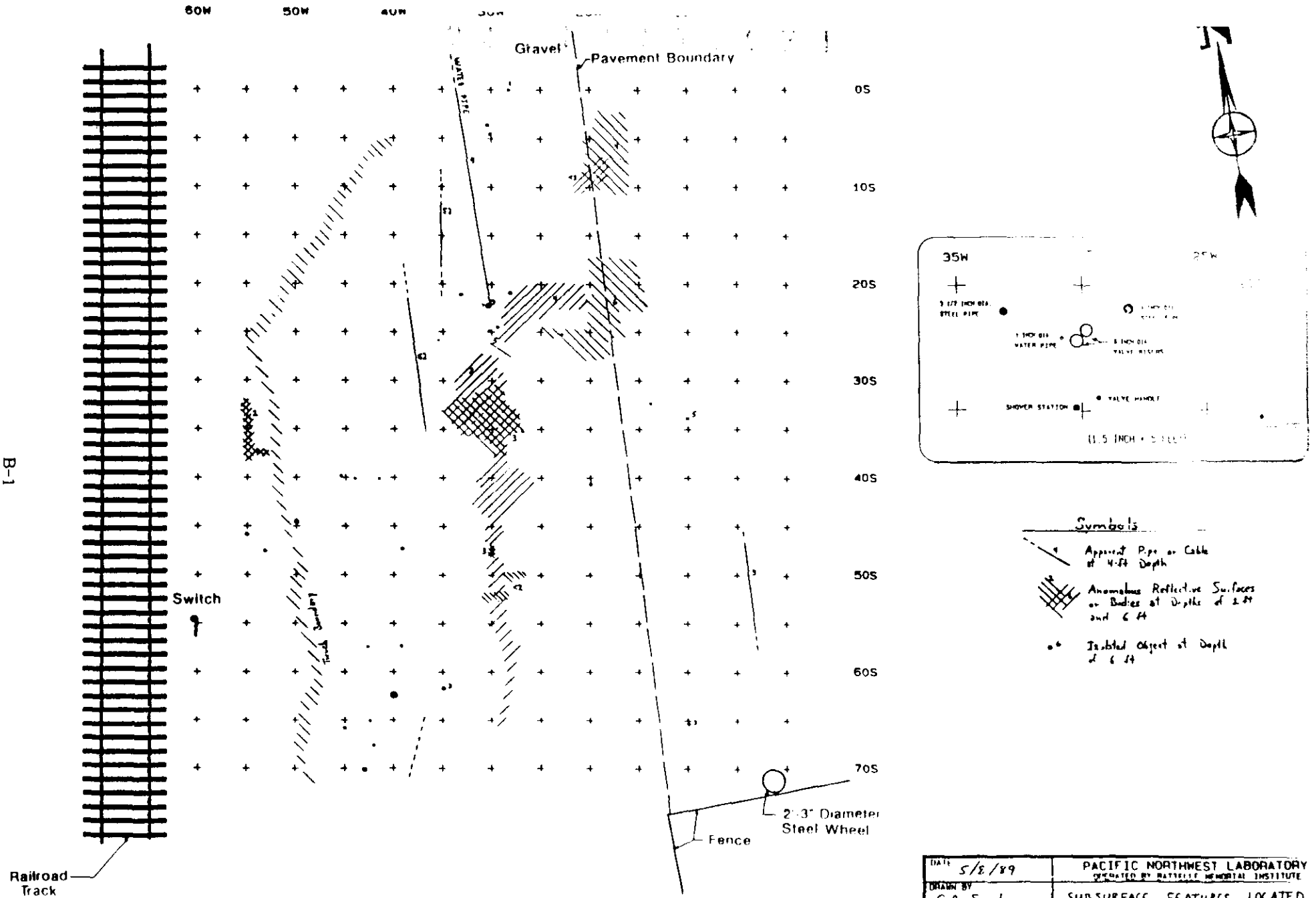


Figure B-1. Subsurface Features Located by GPR and Metal Detector for the 1100-Operable Subunit

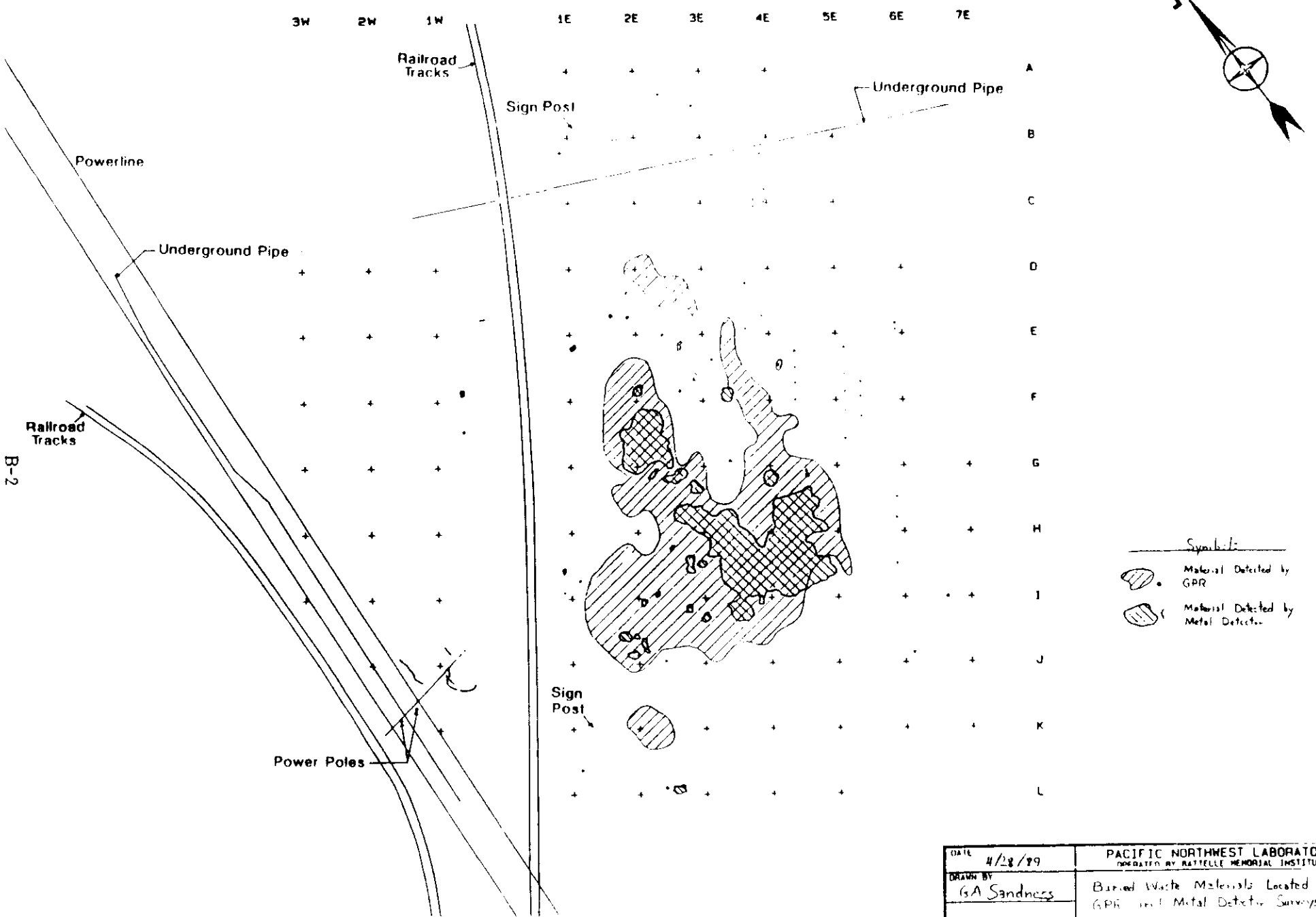


Figure B-2 Buried Waste MaterialsLocated by GPR and Metal Detector Surveys

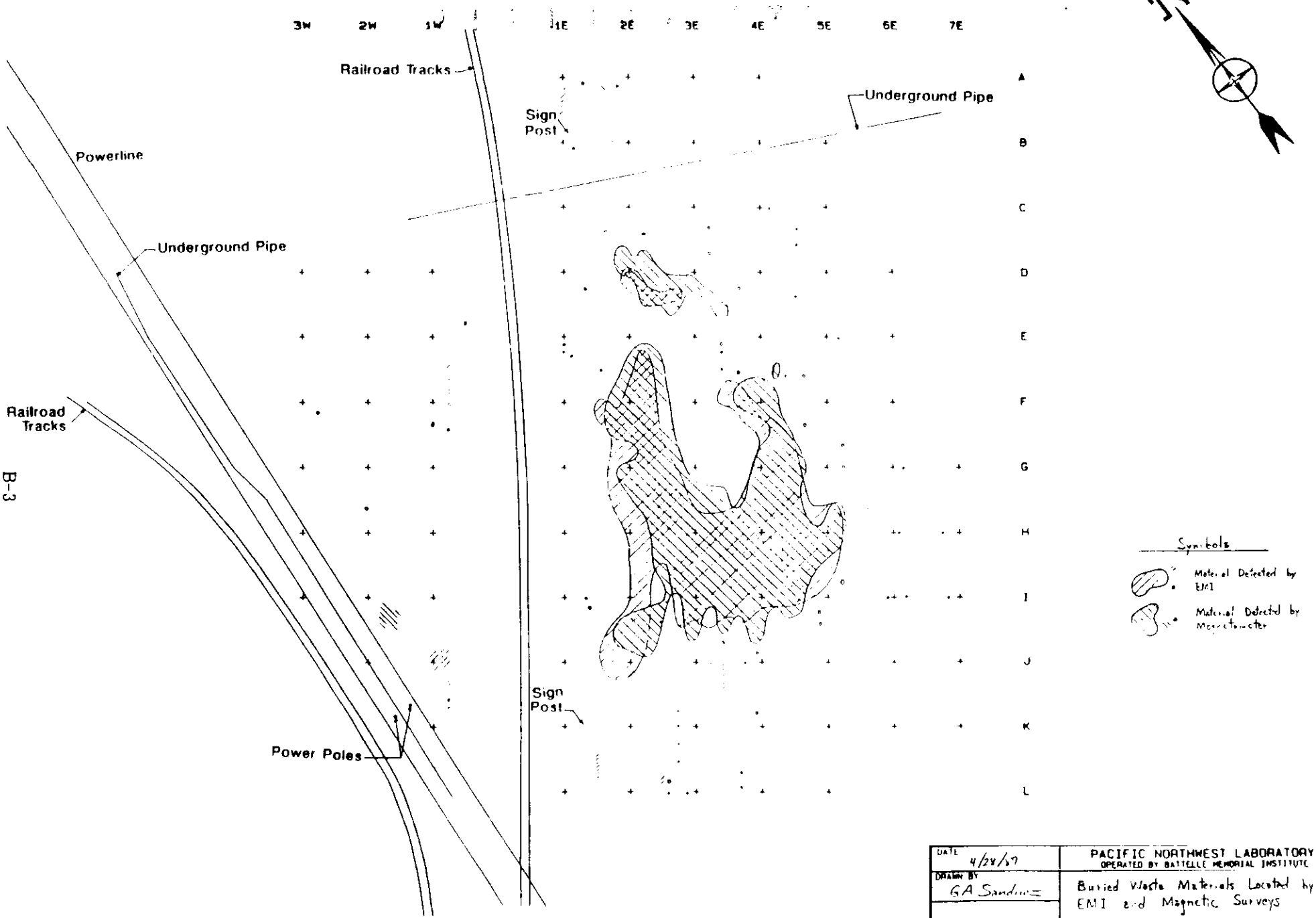


Figure B-3. Buried Waste Materials Located by EMI and Magnetic Surveys for the 1100-2 Operable Subunit

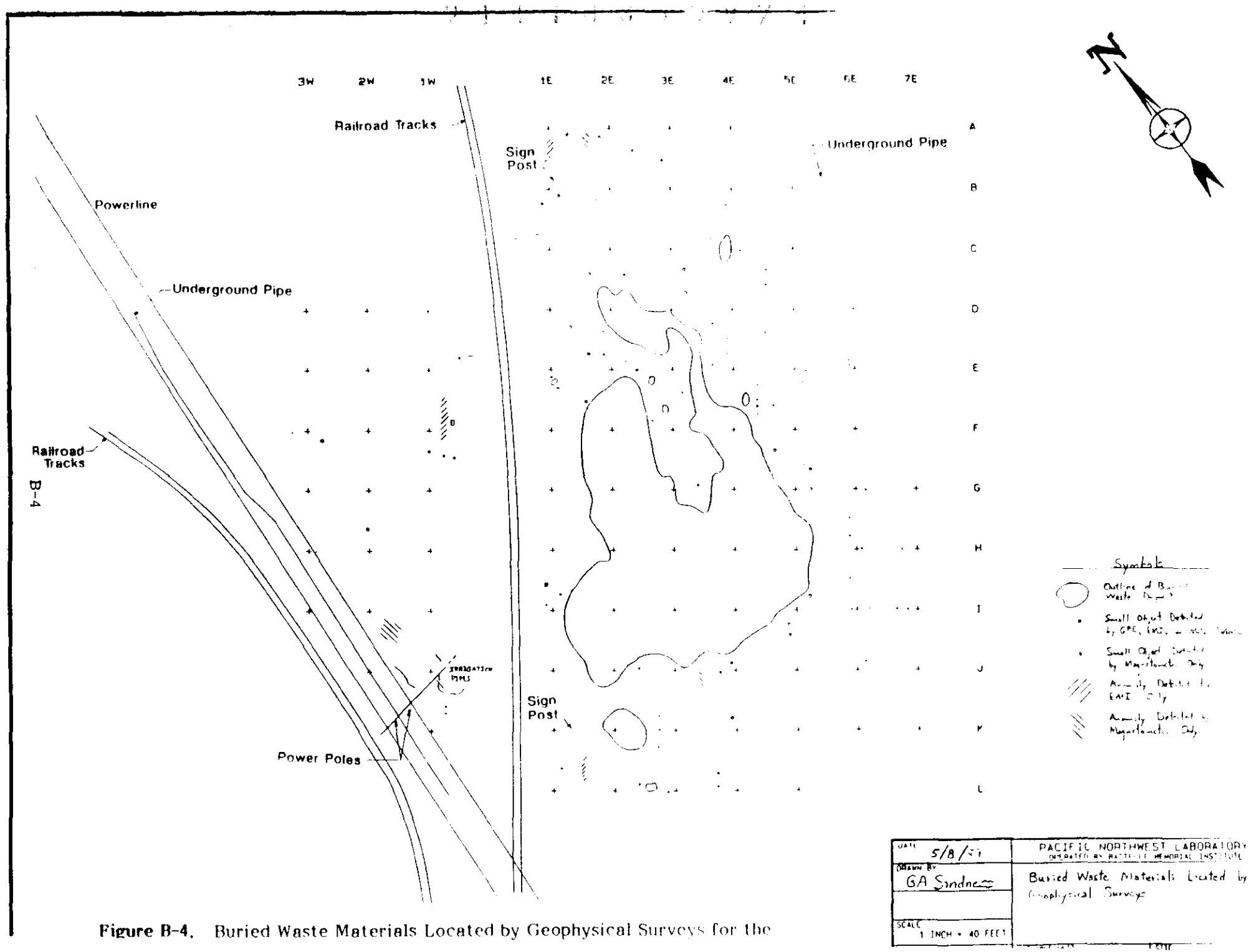
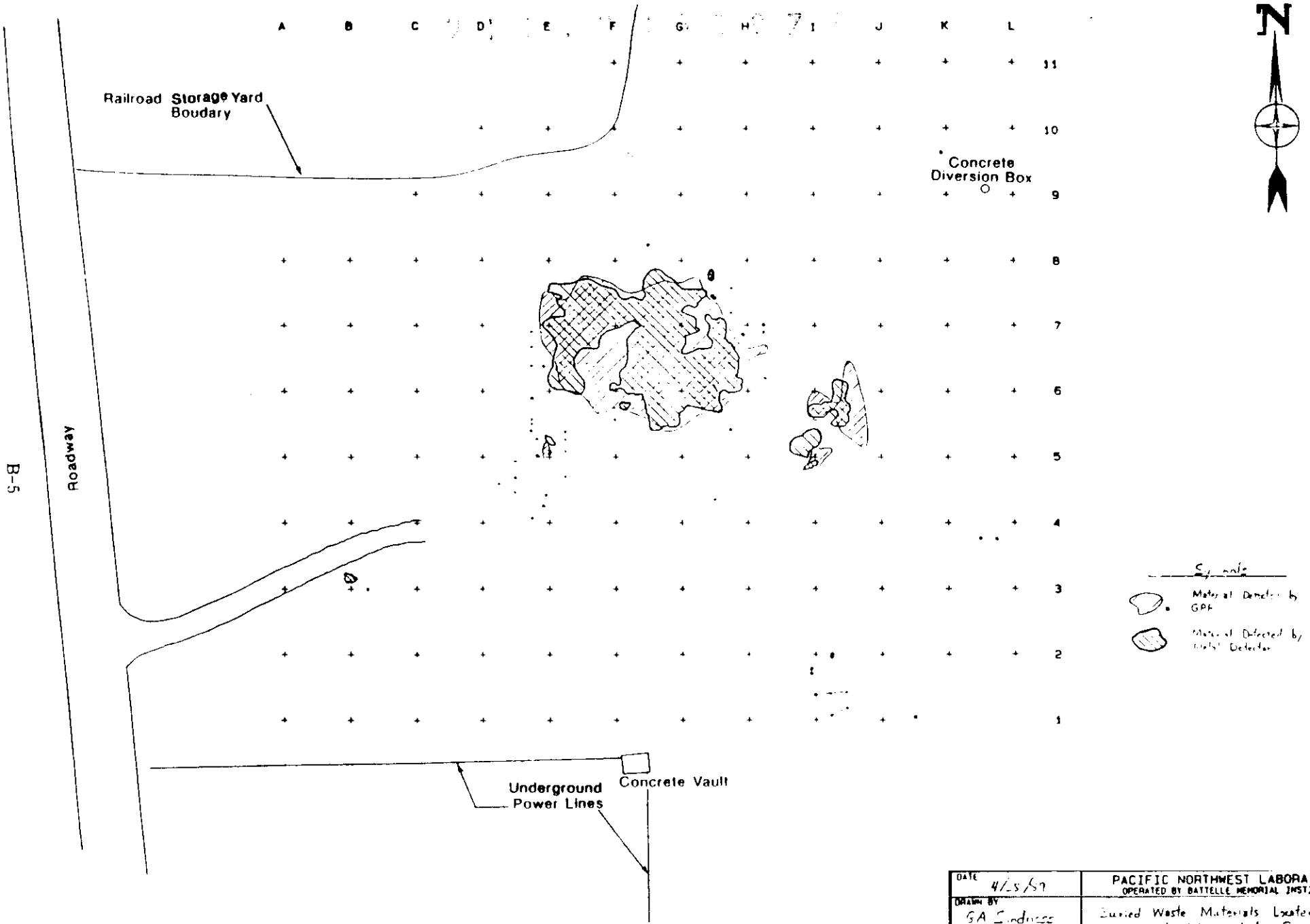
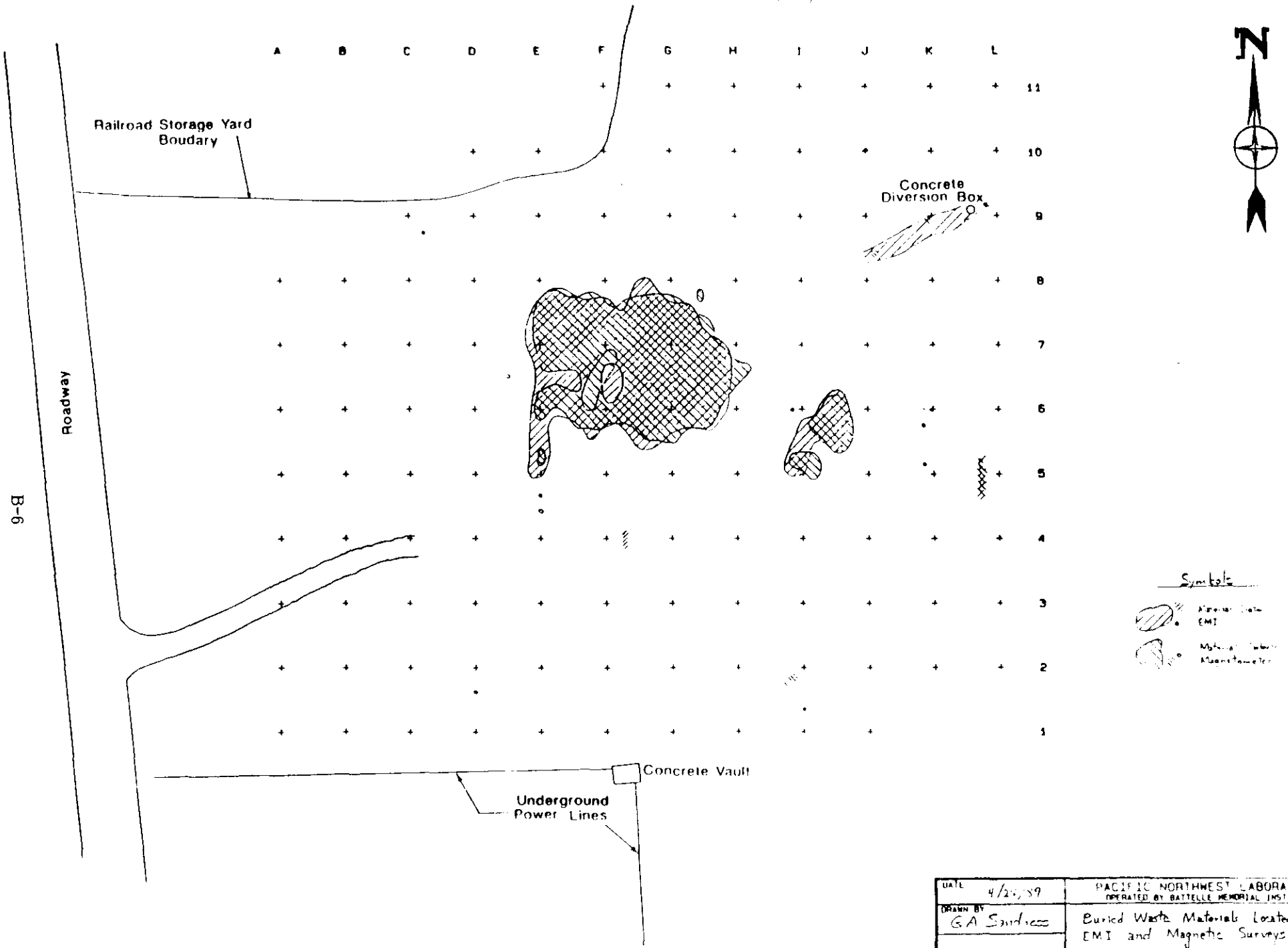


Figure B-4. Buried Waste Materials Located by Geophysical Surveys for the



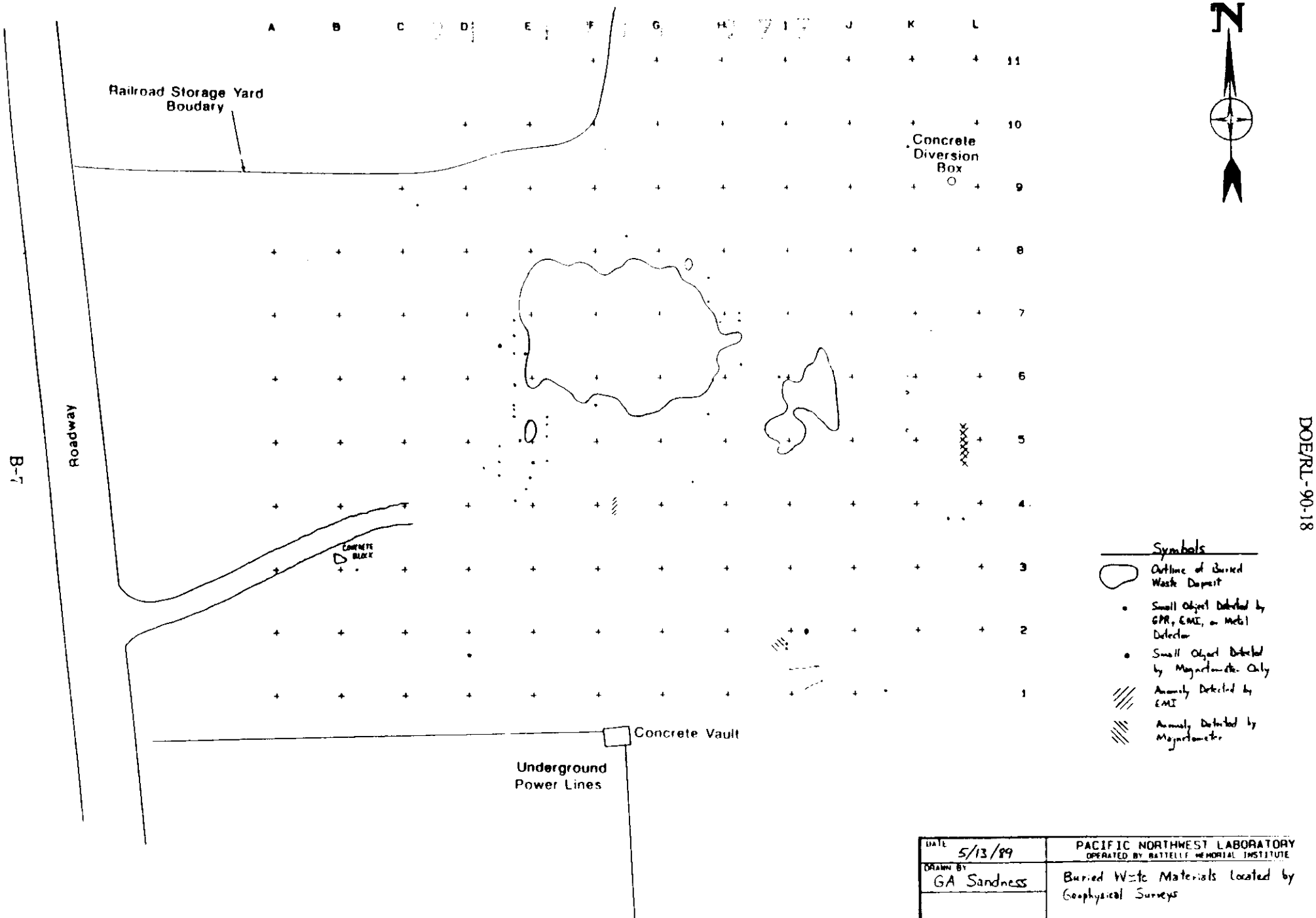
DATE 4/25/89	PACIFIC NORTHWEST LABORATORY OPERATED BY BATTELLE MEMORIAL INSTITUTE
DRAWN BY GA Sindness	Buried Waste Materials Located by GPR and Metal Detector Surveys
SCALE 1 INCH = 40 FEET	
MAP NO 5	OPERABLE UNIT 1100-EM-1 / SITE 1100-3

Figure B-5. Buried Waste Materials Located by GPR and Metal Detector Surveys for the 1100-3 Operable Subunit



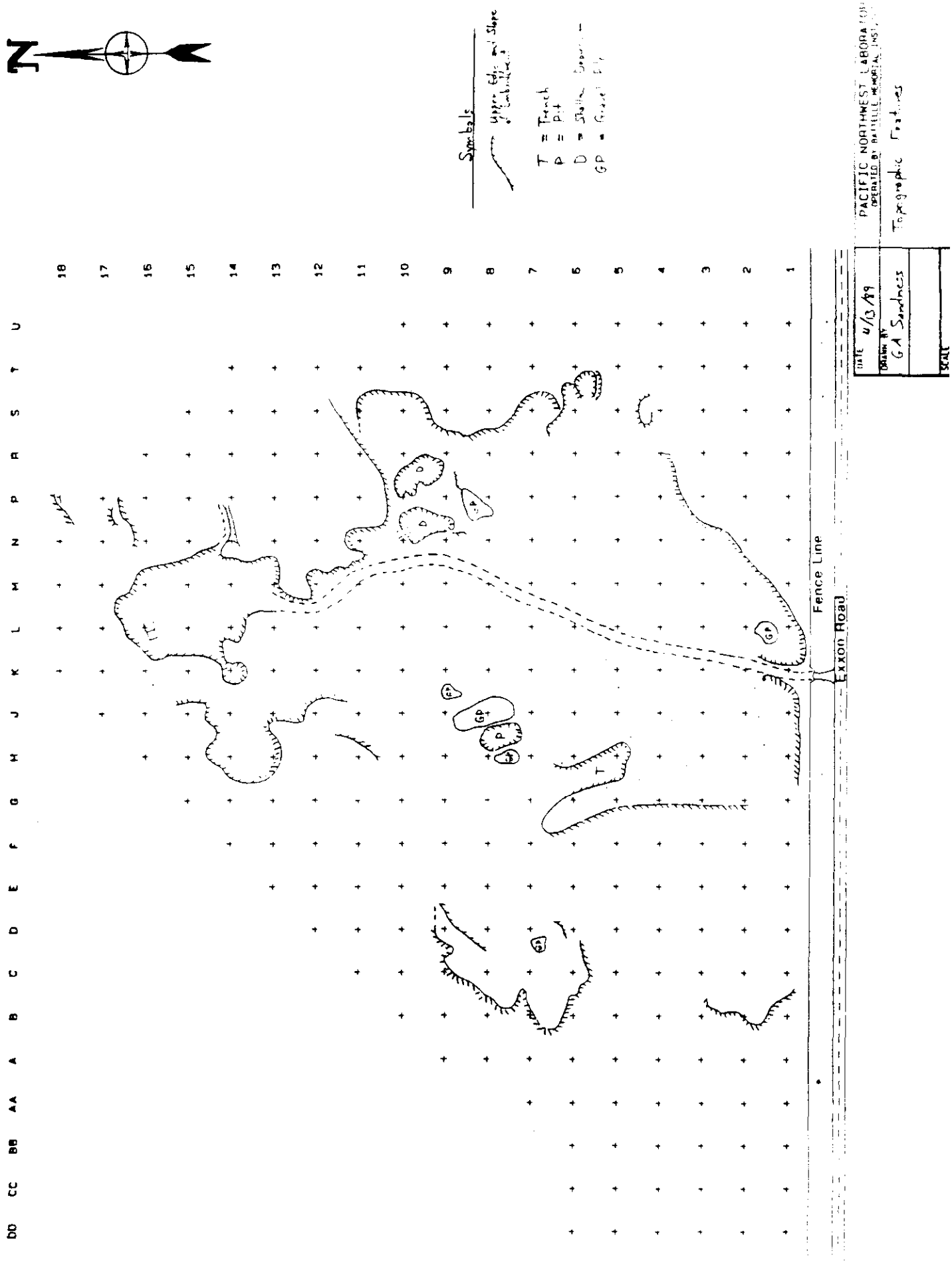
DATE 4/25/89	PACIFIC NORTHWEST LABORATORY OPERATED BY BATTELLE MEMORIAL INSTITUTE
DRAWN BY G.A. Sandness	Buried Waste Materials Located by EMI and Magnetic Surveys
SCALE 1 INCH = 40 FEET	

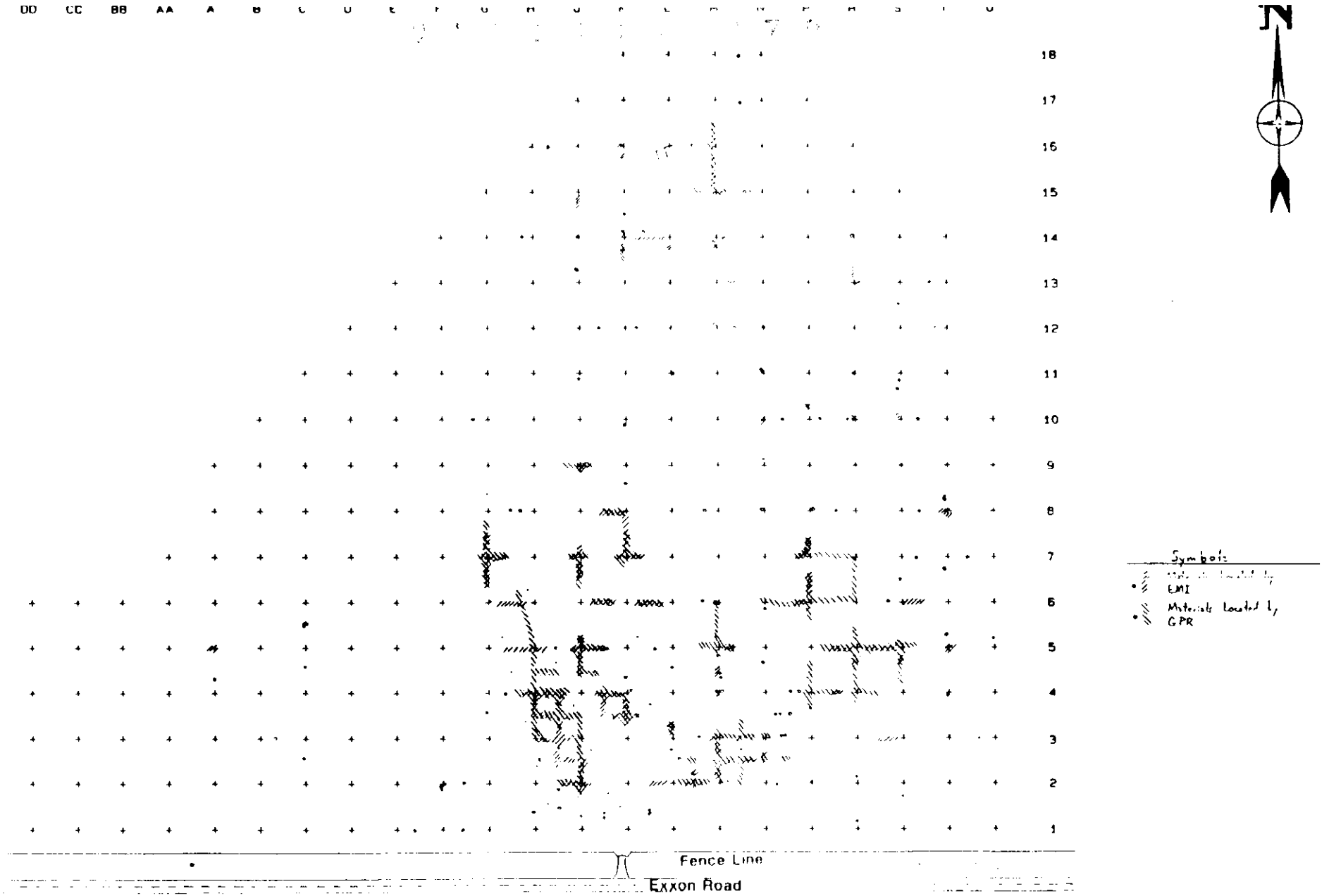
Figure B-6. Buried Waste Materials Located by EMI and Magnetic Surveys



DATE 5/13/89	PACIFIC NORTHWEST LABORATORY OPERATED BY BATTELLE MEMORIAL INSTITUTE
DRAWN BY GA Sandness	Buried Waste Materials Located by Geophysical Surveys
SCALE 1 INCH = 40 FEET	
MAP NO 7	OPERABLE UNIT 1100-EM-1 / SITE 1100-3

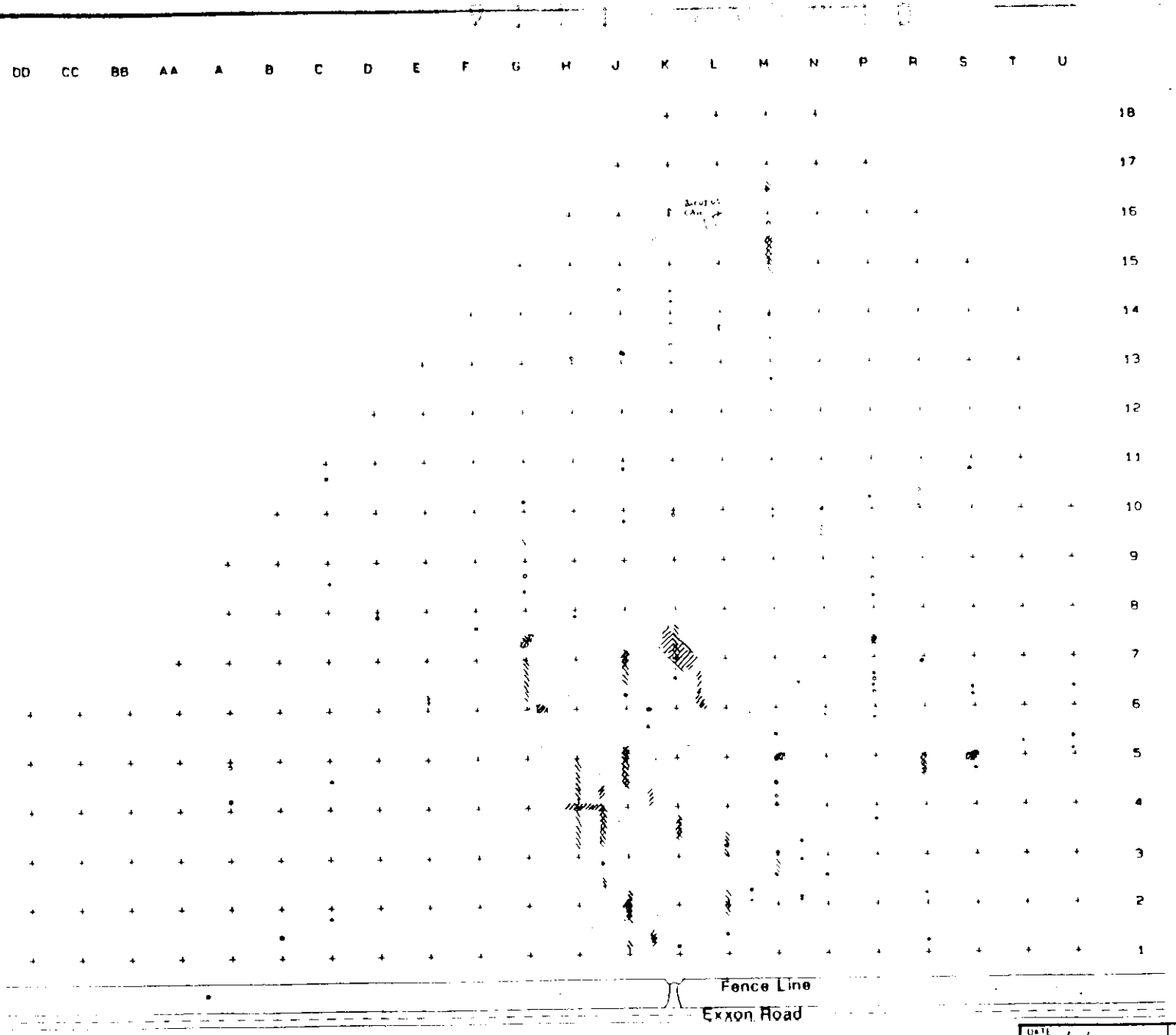
Figure B-7. Buried Waste Materials Located by Geophysical Surveys for the 1100-3 Operable Subunit


Symbols
T = Trench
P = Pit
GP
Fence Line
Exxon Road
PACIFIC NORTHWEST LABORATORY
Topographic Features
DATE 4/13/89
DRAWN BY G A Sandness
SCALE



DATE 5/2/91	PACIFIC NORTHWEST LABORATORY OPERATED BY BATTELLE MEMORIAL INSTITUTE
DRAWN BY G A Sandness	Buried Waste Materials Located by EMI and GPR
SCALE 0 67 Inch = 100 Feet	
MAP NO 9	OPERABLE UNIT 100-EM-1
	SITE Horn Rapids Landfill

Figure B-9. Buried Waste Materials Located by EMI and GPR for the Horn Rapids Landfill Operable Subunit

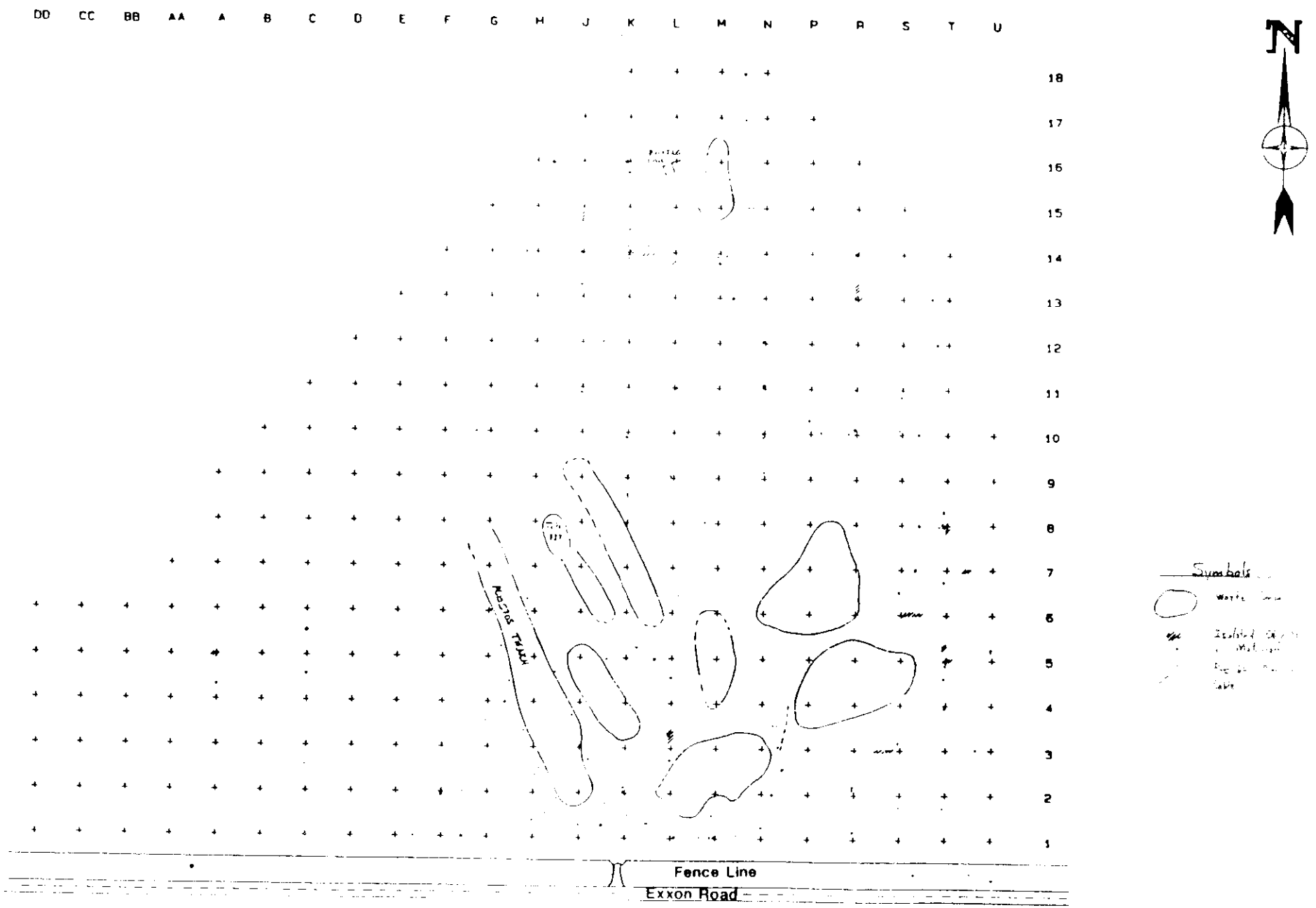


Symbols

- Materials located by Metal Detector
- Materials located by Magnetometer

DATE 4/29/91	PACIFIC NORTHWEST LABORATORY OPERATED BY BATTELLE MEMORIAL INSTITUTE
DRAWN BY GA Sandness	Buried Waste Materials Located by Metal Detector and Magnetometer
SCALE 0.67 Inch = 100 Feet	

Figure B-10. Buried Waste Materials Located by Metal Detector and Magnetometer



DATE 4/27/89

PACIFIC NORTHWEST LABORATORY
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APPENDIX C
SOIL GAS SURVEY RESULTS

The results from the soil gas survey conducted in September 1989 by PNL are provided in the tables in this appendix. The results are from Evans (1989). Results from 1100-3 are not provided in this appendix because the results were omitted from Evans (1989). Sampling locations are noted in Figures 2-5, 2-6, 2-7 and 2-8 in Section 2 of the text. Analyses for tetrachloroethene (PCE), 1, 1, 2-trichloroethene (TCE), 1, 1, 1-trichloroethane (TCA) are provided in this appendix.

Evans, J.C., 1989, *1100-EM-1 Soil Gas Survey Final Report*, WHC-MR-0072, Westinghouse Hanford Company, Richland, Washington.

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Appendix C Contents

	Description	Page
Table C-1	Target Compounds for the 1100-EM-1 Soil Gas Surveys	C-1
Table C-2	1100-1 Battery Acid Pit Soil Gas Data	C-2
Table C-3	1100-2 Paint and Solvent Pit Soil Gas Data	C-3
Table C-4	Horn Rapids Landfill Soil Gas Data	C-5

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Table C-1. Target Compounds for the 1100-EM-1 Soil Gas Surveys

benzene
carbon tetrachloride
chlorobenzene
chloroform
1,1-dichloroethane
1,2-dichloroethane
cis-dichloroethene
trans-dichloroethylene
ethyl benzene
heptane
hexane
methylene chloride
methylethyl ketone
methylisobutyl ketone
octane
tetrachlorethene
toluene
1,1,1-trichloroethane
trichloroethene
m+p-xylene
o-xylene

Table C-2. 1100-1 Battery Acid Pit Soil Gas Data

Site ID	Collection Date	TCA (µg/L)	PCE (µg/L)
1100-1-SG-CEN-1A	6/26/89	0.01	0.005
1100-1-SG-CEN-2A	6/30/89	0.05	0.006
1100-1-SG-CEN-3A	6/26/89	0.04	0.012
1100-1-SG-NE-1A	6/30/89	0.03	0.013
1100-1-SG-SE-1A	6/30/89	0.02	0.004

Source: Evans 1989

Table C-3. 1100-2 Paint and Solvent Pit Soil Gas Data

Site ID	Collection Date	PCE (µg/L)
1100-2-SG-A1A	03/09/89	0.071
1100-2-SG-A2A	03/09/89	0.010
1100-2-SG-A3A	03/10/89	0.003
1100-2-SG-B1A	03/09/89	0.011
1100-2-SG-B3A	03/10/89	0.013
1100-2-SG-B4A	03/10/89	<0.005
1100-2-SG-C1A	03/08/89	0.016
1100-2-SG-C2A	02/21/89	0.004
1100-2-SG-C3A	02/23/89	0.039
1100-2-SG-C4A	03/13/89	0.005
1100-2-SG-C5A	03/13/89	0.013
1100-2-SG-D1A	03/08/89	0.021
1100-2-SG-D2A	02/21/89	0.010
1100-2-SG-D3A	02/22/89	<0.002
1100-2-SG-D5A	03/14/89	<0.002
1100-2-SG-E1A	03/08/89	0.017
1100-2-SG-E2A	02/21/89	<0.002
1100-2-SG-E3A	02/22/89	<0.002
1100-2-SG-E4A	03/14/89	<0.002
1100-2-SG-E5A	03/14/89	<0.002
1100-2-SG-EE1A	03/07/89	<0.002
1100-2-SG-F1A	02/27/89	0.006
1100-2-SG-F2A	02/21/89	<0.002
1100-2-SG-F3A	02/22/89	0.010
1100-2-SG-F4A	03/14/89	<0.002
1100-2-SG-F6A	02/10/89	<0.002
1100-2-SG-FF1A	03/07/89	<0.002
1100-2-SG-FF2A	03/02/89	0.290
1100-2-SG-G1A	02/27/89	0.007
1100-2-SG-G2A	02/17/89	<0.002
1100-2-SG-G2B	02/21/89	<0.002
1100-2-SG-G3A	02/22/89	0.003
1100-2-SG-G4A	02/17/89	0.002
1100-2-SG-G5A	03/14/89	<0.002
1100-2-SG-G6A	03/14/89	0.006
1100-2-SG-GG1A	03/02/89	0.011
1100-2-SG-H1A	02/27/89	0.120
1100-2-SG-H2A	02/17/89	0.020
1100-2-SG-H2B	02/21/89	0.020
1100-2-SG-H3A	02/22/89	0.140
1100-2-SG-H4A	02/17/89	0.020
1100-2-SG-H5A	03/14/89	0.007
1100-2-SG-H6A	03/14/89	0.011
1100-2-SG-H7A	03/14/89	0.014
1100-2-SG-HH1A	03/02/89	0.049
1100-2-SG-I1A	02/23/89	0.440
1100-2-SG-I1B	02/23/89	1.200

Table C-3. (Cont'd.)

Site ID	Collection Date	PCE (µg/L)
1100-2-SG-I1C	02/23/89	0.270
1100-2-SG-I2A	02/17/89	1.200
1100-2-SG-I3A	02/17/89	1.700
1100-2-SG-I3B	02/21/89	2.500
1100-2-SG-I4A	02/17/89	0.220
1100-2-SG-I4B	02/21/89	0.310
1100-2-SG-I5A	03/15/89	0.751
1100-2-SG-I6A	03/14/89	0.570
1100-2-SG-I7A	03/14/89	0.596
1100-2-SG-II2A	03/07/89	0.009
1100-2-SG-J1A	02/23/89	17.000
1100-2-SG-J2A	02/23/89	727.000
1100-2-SG-J2B	02/23/89	521.000
1100-2-SG-J2C	02/23/89	676.000
1100-2-SG-J3A	02/23/89	9.500
1100-2-SG-J3B	02/23/89	5.800
1100-2-SG-J3C	02/23/89	9.600
1100-2-SG-J4A	02/23/89	0.039
1100-2-SG-J5A	03/15/89	2.200
1100-2-SG-K1A	02/28/89	3.300
1100-2-SG-K2A	03/20/89	4.780
1100-2-SG-K2B	03/20/89	5.400
1100-2-SG-K2C	03/23/89	14.000
1100-2-SG-K2D	03/23/89	10.610
1100-2-SG-K2E	03/23/89	11.600
1100-2-SG-K2F	03/23/89	9.800
1100-2-SG-K2G	03/29/89	6.080
1100-2-SG-K2H	03/29/89	6.300
1100-2-SG-K2I	03/29/89	5.920
1100-2-SG-K2J	03/29/89	6.900
1100-2-SG-K3A	03/15/89	17.300
1100-2-SG-K3B	03/16/89	5.070
1100-2-SG-L1A	02/28/89	1.300
1100-2-SG-L2A	03/01/89	3.430
1100-2-SG-L3A	03/01/89	1.200
1100-2-SG-L4A	03/01/89	0.370

Table C-4. Horn Rapids Landfill Soil Gas Data

Site ID	Collection Date	TCE (ug/L)	TCA (ug/L)	PCE (ug/L)
600-HRD-SG-A1A	03/30/89	0.200	0.110	0.006
600-HRD-SG-A2A	03/30/89	0.040	0.050	0.004
600-HRD-SG-A3A	03/30/89	<0.010	0.010	0.012
600-HRD-SG-A4A	04/03/89	0.010	0.010	<0.002
600-HRD-SG-A5A	04/03/89	0.010	0.050	0.002
600-HRD-SG-A6A	04/03/89	<0.010	0.010	<0.002
600-HRD-SG-A7A	04/03/89	<0.010	<0.010	<0.002
600-HRD-SG-A8A	04/03/89	0.022	0.023	0.017
600-HRD-SG-A9A	04/03/89	<0.010	0.020	0.012
600-HRD-SG-AA1A	03/30/89	0.030	0.080	0.006
600-HRD-SG-AA2A	03/30/89	<0.010	0.020	0.003
600-HRD-SG-AA3A	03/30/89	0.030	0.120	0.147
600-HRD-SG-AA4A	03/30/89	<0.010	0.030	0.002
600-HRD-SG-AA6A	03/29/89	<0.010	<0.010	<0.002
600-HRD-SG-AA6C	03/29/89	<0.010	<0.010	<0.002
600-HRD-SG-AA7A	03/29/89	<0.010	0.010	<0.002
600-HRD-SG-B1A	04/04/89	0.070	0.010	<0.002
600-HRD-SG-B2A	04/04/89	0.190	0.060	0.002
600-HRD-SG-B3A	04/04/89	0.030	0.030	<0.002
600-HRD-SG-B4A	04/04/89	0.200	0.240	0.010
600-HRD-SG-B5A	04/04/89	0.030	0.030	0.004
600-HRD-SG-B6A	04/04/89	0.030	<0.010	<0.002
600-HRD-SG-B7A	04/03/89	0.010	0.020	0.004
600-HRD-SG-B8A	04/03/89	0.020	0.030	0.004
600-HRD-SG-B9A	04/03/89	<0.010	<0.010	<0.002
600-HRD-SG-B10A	04/03/89	<0.010	<0.010	0.002
600-HRD-SG-BB1A	03/30/89	<0.010	0.050	0.009
600-HRD-SG-BB2A	03/29/89	<0.010	0.050	0.007
600-HRD-SG-BB3A	03/29/89	0.010	0.060	0.013
600-HRD-SG-BB4A	03/29/89	0.010	0.010	<0.002
600-HRD-SG-BB5A	03/29/89	<0.010	0.040	0.010
600-HRD-SG-BB6A	03/30/89	<0.010	<0.010	<0.002
600-HRD-SG-C1A	04/04/89	0.820	0.160	0.007
600-HRD-SG-C2A	04/04/89	1.940	0.500	0.025
600-HRD-SG-C3A	04/04/89	0.340	0.070	0.003
600-HRD-SG-C4A	04/05/89	0.220	0.080	0.004
600-HRD-SG-C5A	04/05/89	0.022	0.050	0.004
600-HRD-SG-C6A	04/05/89	0.090	0.060	0.004
600-HRD-SG-C6B	04/05/89	0.090	0.050	0.004
600-HRD-SG-C7A	04/05/89	0.070	0.050	0.005
600-HRD-SG-C8A	04/05/89	0.105	0.060	0.006
600-HRD-SG-C9A	04/05/89	0.030	0.020	0.002
600-HRD-SG-C10A	04/05/89	0.120	0.040	0.003
600-HRD-SG-C11A	04/05/89	0.030	<0.010	<0.002
600-HRD-SG-CC1A	03/30/89	0.010	0.090	0.015
600-HRD-SG-CC2A	03/29/89	<0.010	0.020	0.002

Table C-4. (Cont'd.)

Site ID	Collection Date	TCE (ug/L)	TCA (ug/L)	PCE (ug/L)
600-HRD-SG-CC3A	03/28/89	<0.010	<0.010	<0.002
600-HRD-SG-CC4A	03/28/89	<0.010	0.060	0.003
600-HRD-SG-CC5A	03/28/89	<0.010	0.020	0.004
600-HRD-SG-CC6A	03/28/89	<0.010	0.020	0.002
600-HRD-SG-D1A	04/06/89	4.740	1.190	0.035
600-HRD-SG-D1B	04/06/89	4.700	1.400	0.045
600-HRD-SG-D2A	04/06/89	1.670	0.360	0.009
600-HRD-SG-D3A	04/06/89	0.730	0.100	0.004
600-HRD-SG-D4A	04/06/89	1.860	0.200	0.011
600-HRD-SG-D5A	04/06/89	2.760	0.100	0.012
600-HRD-SG-D6A	04/06/89	0.960	0.024	0.004
600-HRD-SG-D7A	04/10/89	0.780	0.070	0.006
600-HRD-SG-D8A	04/06/89	0.890	0.110	0.016
600-HRD-SG-D9A	04/06/89	0.100	0.020	0.004
600-HRD-SG-D10A	04/06/89	0.080	0.010	0.003
600-HRD-SG-D11A	04/05/89	0.150	0.060	0.004
600-HRD-SG-D12A	04/05/89	0.040	0.016	<0.002
600-HRD-SG-DD1A	03/28/89	<0.010	0.020	0.004
600-HRD-SG-DD2A	03/28/89	<0.010	0.010	<0.002
600-HRD-SG-DD3A	03/28/89	<0.010	<0.010	<0.002
600-HRD-SG-DD4A	03/28/89	<0.010	<0.010	<0.002
600-HRD-SG-DD5A	03/29/89	0.010	0.010	0.003
600-HRD-SG-DD6A	03/28/89	<0.010	<0.010	<0.002
600-HRD-SG-E1A	04/11/89	0.870	0.060	0.003
600-HRD-SG-E2A	04/11/89	0.810	0.060	0.007
600-HRD-SG-E3A	04/11/89	0.800	0.040	0.003
600-HRD-SG-E4A	04/12/89	0.120	0.010	0.005
600-HRD-SG-E5A	04/11/89	0.160	0.010	<0.002
600-HRD-SG-E5B	04/11/89	0.120	<0.010	<0.002
600-HRD-SG-E6A	04/10/89	0.020	<0.010	<0.002
600-HRD-SG-E6B	04/10/89	0.020	<0.010	<0.002
600-HRD-SG-E7A	04/10/89	0.110	<0.010	<0.002
600-HRD-SG-E8A	04/12/89	0.120	0.010	0.004
600-HRD-SG-E9A	04/10/89	0.160	0.020	0.004
600-HRD-SG-E10A	04/10/89	0.100	0.030	0.003
600-HRD-SG-E11A	04/10/89	0.010	<0.010	<0.002
600-HRD-SG-E12A	04/10/89	0.040	0.010	0.002
600-HRD-SG-E13A	04/10/89	0.050	0.010	0.002
600-HRD-SG-F1A	04/29/89	0.050	<0.010	<0.002
600-HRD-SG-F2A	04/20/89	0.010	<0.010	<0.002
600-HRD-SG-F3A	04/13/89	0.050	<0.010	<0.002
600-HRD-SG-F3B	04/13/89	0.040	<0.010	<0.002
600-HRD-SG-F4A	04/14/89	0.020	<0.010	<0.002
600-HRD-SG-F5A	04/13/89	0.020	<0.010	<0.002
600-HRD-SG-F6A	04/13/89	0.020	<0.010	<0.002
600-HRD-SG-F7A	04/14/89	0.090	0.010	<0.002

Table C-4. (Cont'd.)

Site ID	Collection Date	TCE (µg/L)	TCA (µg/L)	PCE (µg/L)
600-HRD-SG-F7B	04/14/89	0.100	<0.010	<0.002
600-HRD-SG-F8A	04/13/89	0.050	0.010	0.002
600-HRD-SG-F9A	04/13/89	0.140	0.040	0.007
600-HRD-SG-F10A	04/13/89	0.400	0.110	0.026
600-HRD-SG-F11A	04/13/89	0.010	<0.010	<0.002
600-HRD-SG-F12A	04/13/89	0.010	<0.010	<0.002
600-HRD-SG-F13A	04/13/89	0.020	<0.010	0.002
600-HRD-SG-F14A	04/13/89	0.010	<0.010	<0.002
600-HRD-SG-G1A	04/17/89	0.170	<0.010	0.002
600-HRD-SG-G2A	04/17/89	0.110	<0.010	<0.002
600-HRD-SG-G3A	04/17/89	0.020	<0.010	<0.002
600-HRD-SG-G4A	04/17/89	0.020	0.010	<0.002
600-HRD-SG-G4B	04/17/89	0.020	<0.010	<0.002
600-HRD-SG-G5A	04/18/89	0.040	<0.010	0.003
600-HRD-SG-G5B	04/18/89	0.150	0.020	0.005
600-HRD-SG-G12A	04/17/89	<0.010	<0.010	<0.002
600-HRD-SG-G13A	04/14/89	<0.010	<0.010	<0.002
600-HRD-SG-G14A	04/14/89	<0.010	<0.010	<0.002
600-HRD-SG-G15A	04/14/89	<0.010	<0.010	<0.002
600-HRD-SG-H1A	04/17/89	1.400	0.040	0.199
600-HRD-SG-H2A	04/18/89	0.420	0.020	0.270
600-HRD-SG-H7A	04/17/89	0.150	0.020	0.019
600-HRD-SG-H14A	05/10/89	0.010	<0.010	<0.002
600-HRD-SG-H15A	05/10/89	0.010	<0.010	<0.002
600-HRD-SG-H16A	05/10/89	0.010	<0.010	<0.002
600-HRD-SG-J1A	04/17/89	0.030	0.010	0.117
600-HRD-SG-J3A	04/18/89	0.090	<0.010	0.714
600-HRD-SG-J6A	04/18/89	0.980	0.040	0.040
600-HRD-SG-J12A	04/20/89	<0.010	<0.010	0.009
600-HRD-SG-J16A	05/10/89	<0.010	<0.010	<0.002
600-HRD-SG-J17A	05/10/89	<0.010	<0.010	<0.002
600-HRD-SG-K1A	04/18/89	0.330	<0.010	0.280
600-HRD-SG-K2A	04/18/89	0.060	<0.010	0.180
600-HRD-SG-K3A	04/18/89	0.080	<0.010	0.053
600-HRD-SG-K5A	04/18/89	0.380	0.020	0.046
600-HRD-SG-K11A	04/19/89	<0.010	<0.010	<0.002
600-HRD-SG-K12A	04/19/89	<0.010	<0.010	0.002
600-HRD-SG-K13A	04/20/89	0.007	<0.010	<0.002
600-HRD-SG-K13A	05/10/89	0.010	0.010	<0.002
600-HRD-SG-K15A	04/20/89	<0.010	<0.010	0.009
600-HRD-SG-K17A	05/10/89	<0.010	<0.010	<0.002
600-HRD-SG-K18A	05/10/89	<0.010	<0.010	<0.002
600-HRD-SG-L1A	04/18/89	0.710	<0.010	0.021
600-HRD-SG-L4A	04/19/89	0.020	<0.010	<0.002
600-HRD-SG-L5A	04/19/89	0.070	<0.010	0.008
600-HRD-SG-L6A	04/19/89	0.070	<0.010	0.002

Table C-4. (Cont'd.)

Site ID	Collection Date	TCE (µg/L)	TCA (µg/L)	PCE (µg/L)
600-HRD-SG-L7A	04/19/89	0.060	<0.010	<0.002
600-HRD-SG-L10A	04/19/89	0.030	<0.010	<0.002
600-HRD-SG-L11A	04/19/89	<0.010	<0.010	<0.002
600-HRD-SG-L12A	04/19/89	<0.010	<0.010	0.009
600-HRD-SG-L12B	04/19/89	<0.010	<0.010	0.008
600-HRD-SG-L17A	05/10/78	<0.010	<0.010	<0.002
600-HRD-SG-L17B	05/10/89	<0.010	<0.010	<0.002
600-HRD-SG-L18A	05/10/89	<0.010	<0.010	<0.002
600-HRD-SG-M1A	04/20/89	0.202	<0.010	0.005
600-HRD-SG-M7A	05/05/89	<0.010	<0.010	<0.002
600-HRD-SG-M8A	05/05/89	0.010	<0.010	<0.002
600-HRD-SG-M9A	05/05/89	<0.010	<0.010	<0.002
600-HRD-SG-M10A	05/05/89	<0.010	<0.010	<0.002
600-HRD-SG-M11A	05/05/89	<0.010	<0.010	<0.002
600-HRD-SG-M18A	05/04/89	<0.010	<0.010	<0.002
600-HRD-SG-N1A	05/05/89	0.860	0.020	0.006
600-HRD-SG-N7A	05/05/89	<0.010	<0.010	<0.002
600-HRD-SG-N14A	05/02/89	<0.010	<0.010	<0.002
600-HRD-SG-N15A	05/04/89	<0.010	<0.010	<0.002
600-HRD-SG-N16A	05/04/89	<0.010	<0.010	0.041
600-HRD-SG-N17A	05/04/89	<0.010	<0.010	0.032
600-HRD-SG-N18A	05/04/89	<0.010	<0.010	<0.002
600-HRD-SG-P1A	05/03/89	0.740	0.030	0.005
600-HRD-SG-P2A	05/03/89	0.080	<0.010	0.002
600-HRD-SG-P3A	05/03/89	0.230	0.010	0.007
600-HRD-SG-P9A	05/01/89	0.020	<0.010	<0.002
600-HRD-SG-P12A	05/01/89	<0.010	0.020	<0.002
600-HRD-SG-P13A	05/01/89	<0.010	0.010	0.023
600-HRD-SG-P14A	05/01/89	<0.010	<0.010	0.004
600-HRD-SG-P15A	05/04/89	0.010	<0.010	<0.002
600-HRD-SG-P17A	05/04/89	<0.010	<0.010	0.026
600-HRD-SG-R1A	05/03/89	0.060	<0.010	<0.002
600-HRD-SG-R2A	05/03/89	0.040	0.010	<0.002
600-HRD-SG-R3A	05/03/89	0.830	0.040	0.010
600-HRD-SG-R6A	05/03/89	0.050	<0.010	<0.002
600-HRD-SG-R8A	05/05/89	<0.010	<0.010	<0.002
600-HRD-SG-R9A	05/01/89	0.010	<0.010	<0.002
600-HRD-SG-R12A	05/02/89	0.050	0.040	0.005
600-HRD-SG-R13A	05/01/89	0.040	0.050	0.004
600-HRD-SG-R13B	05/01/89	0.020	0.030	0.003
600-HRD-SG-R14A	05/04/89	0.020	0.020	0.012
600-HRD-SG-R14B	05/04/89	0.010	0.010	0.007
600-HRD-SG-R15A	05/03/89	<0.010	<0.010	0.009
600-HRD-SG-R15B	05/03/89	<0.010	0.010	0.013
600-HRD-SG-R16A	03/27/89	0.010	0.010	0.013
600-HRD-SG-S1A	03/23/89	0.130	0.010	<0.002

Table C-4. (Cont'd.)

Site ID	Collection Date	TCE (µg/L)	TCA (µg/L)	PCE (µg/L)
600-HRD-SG-S2A	03/23/89	0.670	0.040	0.004
600-HRD-SG-S3A	03/23/89	1.290	0.100	0.014
600-HRD-SG-S4A	03/23/89	0.450	0.060	0.005
600-HRD-SG-S5A	03/23/89	0.010	<0.010	0.024
600-HRD-SG-S6A	03/27/89	<0.010	<0.010	<0.002
600-HRD-SG-S7A	03/28/89	2.470	0.080	0.021
600-HRD-SG-S7B	03/28/89	2.440	0.080	0.022
600-HRD-SG-S8A	03/27/89	1.880	0.130	0.054
600-HRD-SG-S9A	03/27/89	0.090	0.010	0.003
600-HRD-SG-S11A	03/27/89	0.010	<0.010	<0.002
600-HRD-SG-S12A	03/27/89	0.030	0.010	0.002
600-HRD-SG-S13A	03/27/89	0.110	0.020	0.006
600-HRD-SG-S13B	03/27/89	0.100	0.020	0.007
600-HRD-SG-S14A	03/27/89	0.100	0.040	0.018
600-HRD-SG-S15A	03/27/89	1.060	0.080	0.043
600-HRD-SG-T1A	03/23/89	0.012	<0.010	0.002
600-HRD-SG-T2A	03/23/89	0.070	<0.010	0.003
600-HRD-SG-T3A	03/23/89	0.395	0.045	0.005
600-HRD-SG-T4A	03/21/89	0.704	0.064	0.021
600-HRD-SG-T5A	03/21/89	0.193	<0.010	0.002
600-HRD-SG-T6A	03/23/89	0.058	<0.010	<0.002
600-HRD-SG-T6B	03/23/89	0.053	<0.010	<0.002
600-HRD-SG-T6C	03/23/89	0.041	<0.010	<0.002
600-HRD-SG-T7A	03/21/89	2.820	0.133	0.760
600-HRD-SG-T8A	03/21/89	1.340	0.122	0.027
600-HRD-SG-T9A	03/21/89	0.674	0.066	0.018
600-HRD-SG-T9B	03/21/89	0.604	0.060	0.046
600-HRD-SG-T10A	03/23/89	1.160	0.086	0.024
600-HRD-SG-T11A	03/23/89	0.793	0.081	0.016
600-HRD-SG-T12A	03/21/89	0.049	0.049	0.009
600-HRD-SG-T13A	03/20/89	1.100	0.298	0.041
600-HRD-SG-T14A	03/20/89	0.834	0.398	0.035
600-HRD-SG-U1A	03/17/89	<0.010	<0.010	<0.002
600-HRD-SG-U2A	03/17/89	0.029	<0.010	<0.002
600-HRD-SG-U3A	03/17/89	0.689	0.167	0.006
600-HRD-SG-U4A	03/20/89	0.720	0.053	0.006
600-HRD-SG-U5A	03/20/89	0.140	<0.010	<0.002
600-HRD-SG-U6A	03/20/89	0.320	<0.010	<0.002
600-HRD-SG-U7A	03/20/89	0.360	<0.010	<0.002
600-HRD-SG-U8A	03/20/89	0.340	0.031	0.012
600-HRD-SG-U9A	03/20/89	1.670	0.118	0.019
600-HRD-SG-U10A	03/20/89	1.690	0.108	0.022
600-HRD-SG-U10B	03/20/89	1.560	0.081	0.021

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APPENDIX D
METEOROLOGICAL DATA
CITY OF RICHLAND AIRPORT AND THE 300 AREA

This appendix presents wind velocity data from the Richland Airport and the 300 Area for the period 1982 through 1989. Both stations are operated by PNL, who provided the data on computer disk.

The average wind velocity is recorded on an hourly basis at both stations, yielding a total of 78,840 possible observations for the period covered. The data were generally complete with the exception of a large gap in the 300 Area data set from 1984 through most of 1985. Each hourly observation was entered onto a computer database. Average wind speed was recorded in mi/h and average wind direction was recorded to the nearest 10°.

In analyzing the data, individual hourly averages for wind speed and direction were combined to form daily averages to reduce the number of observations. The daily averages are shown on Figure D-1 through D-4 for the period of the data. The averaging process masks diurnal periodicities, but preserves the larger structural scale, such as seasonal and climactic periodicities.

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Appendix D Contents

Figure	Description	Page
D-1	Daily Average Wind Direction, 300 Area, 1982 - 1989	D-1
D-2	Daily Average Wind Direction, Richland Airport, 1982 - 1989	D-2
D-3	Daily Average Wind Speed, 300 Area, 1982 - 1989	D-3
D-4	Daily Average Wind Speed, Richland Airport, 1982 - 1989	D-4

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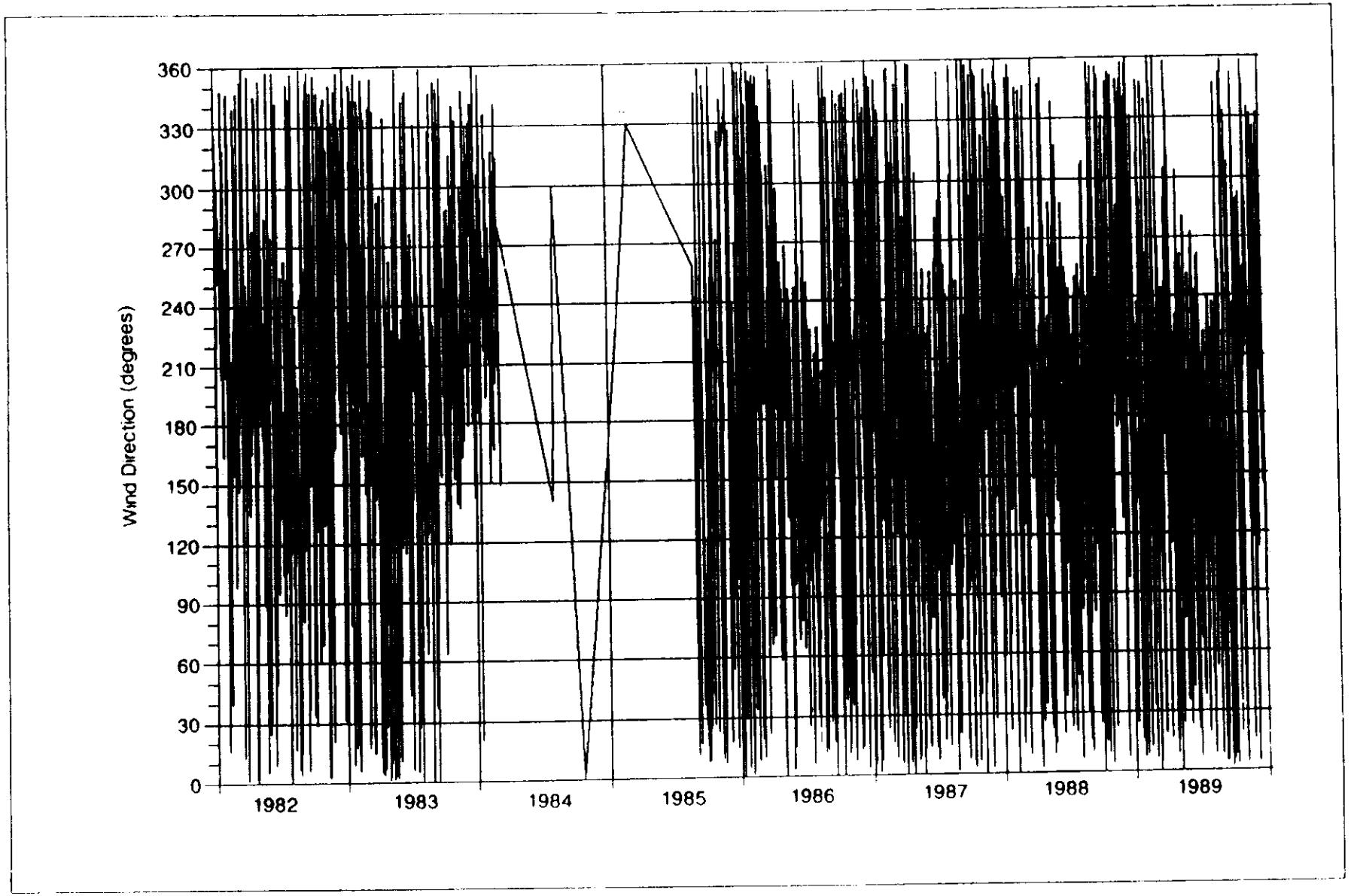

Figure D-1. Daily Average Wind Direction, 300 Area, 1982-1989.

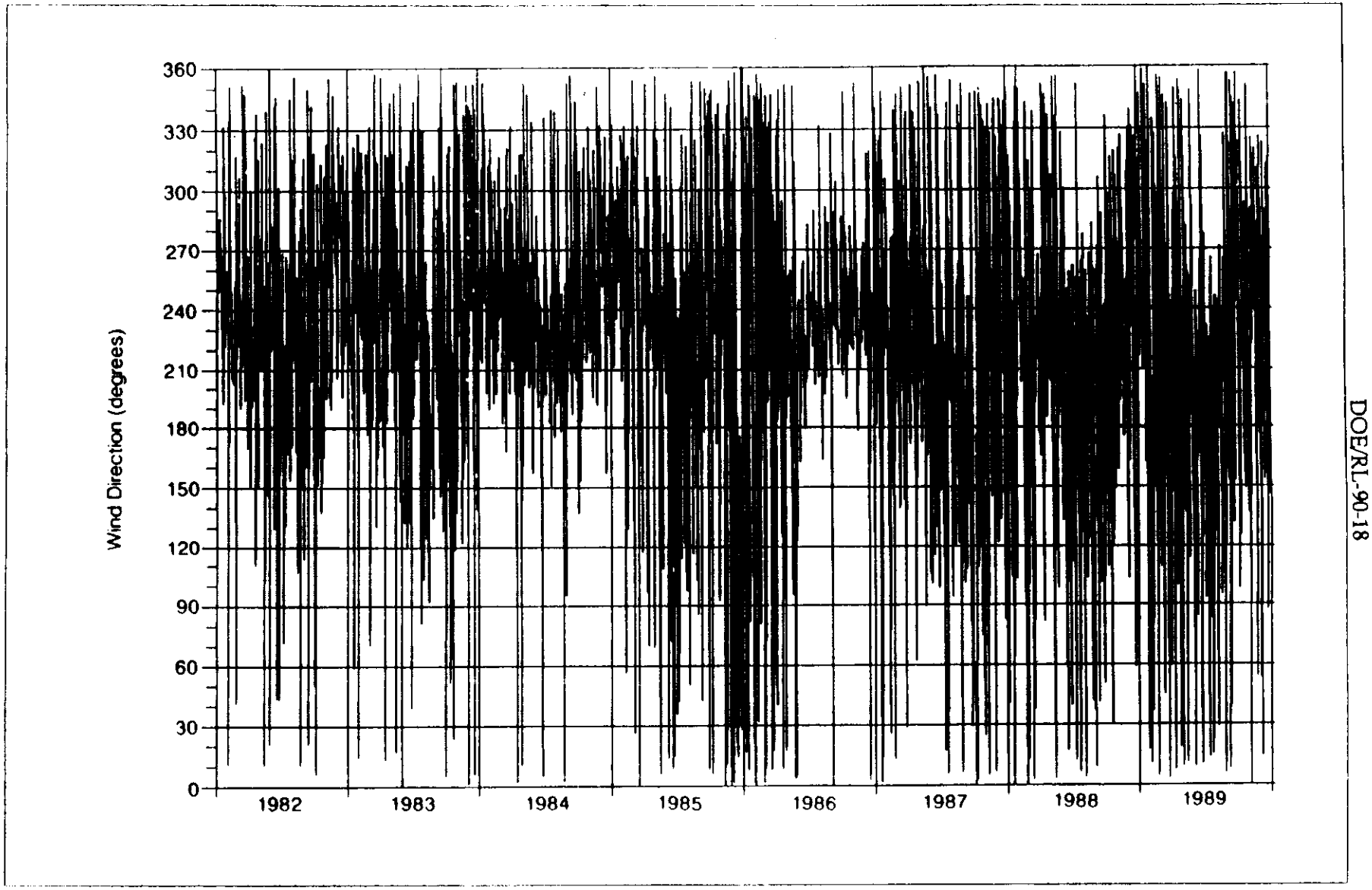

Figure D-2. Daily Average Wind Direction, Richland Airport, 1982-1989.

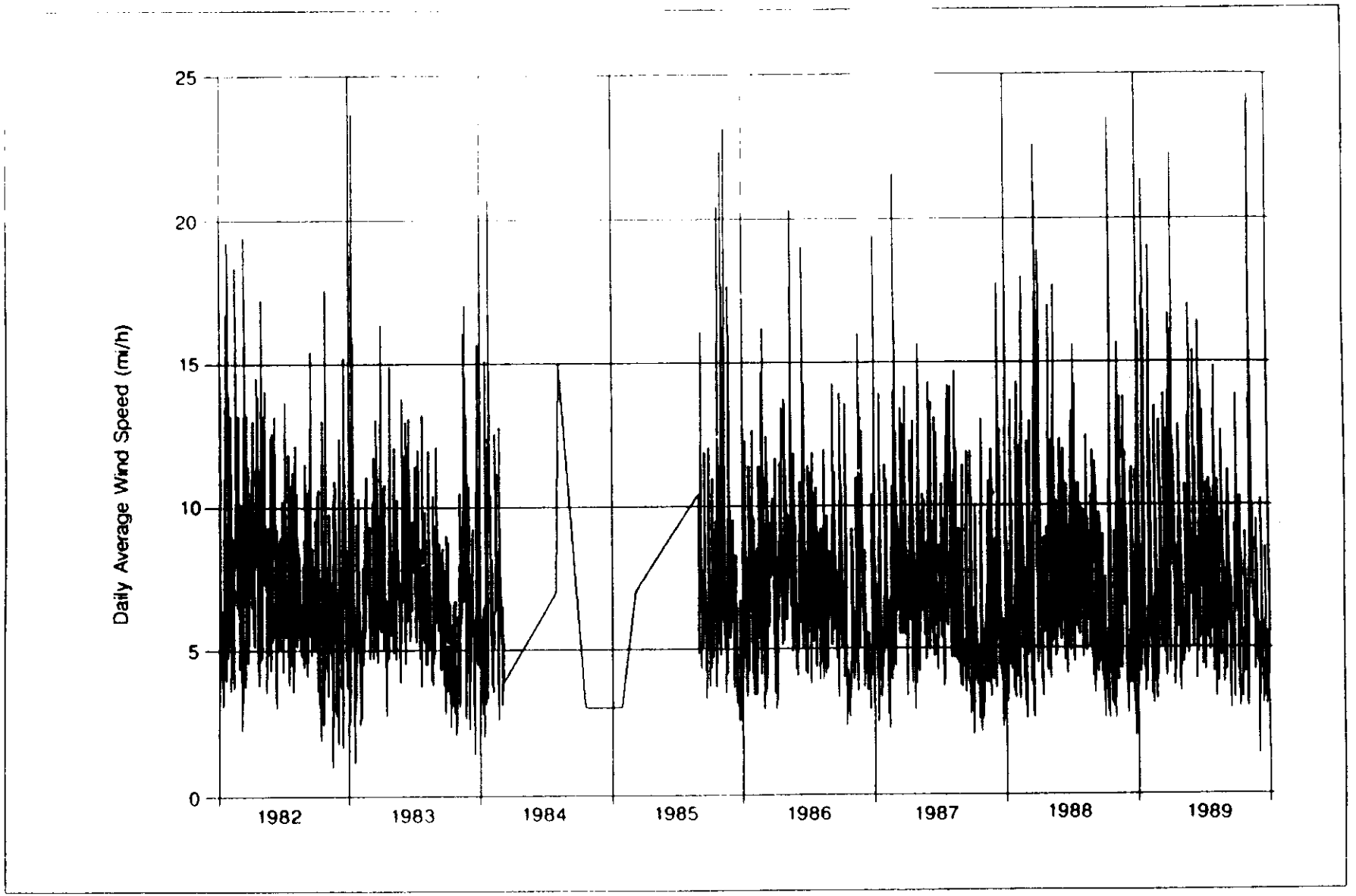

Figure D-3. Daily Average Wind Speed, 300 Area, 1982-1989.

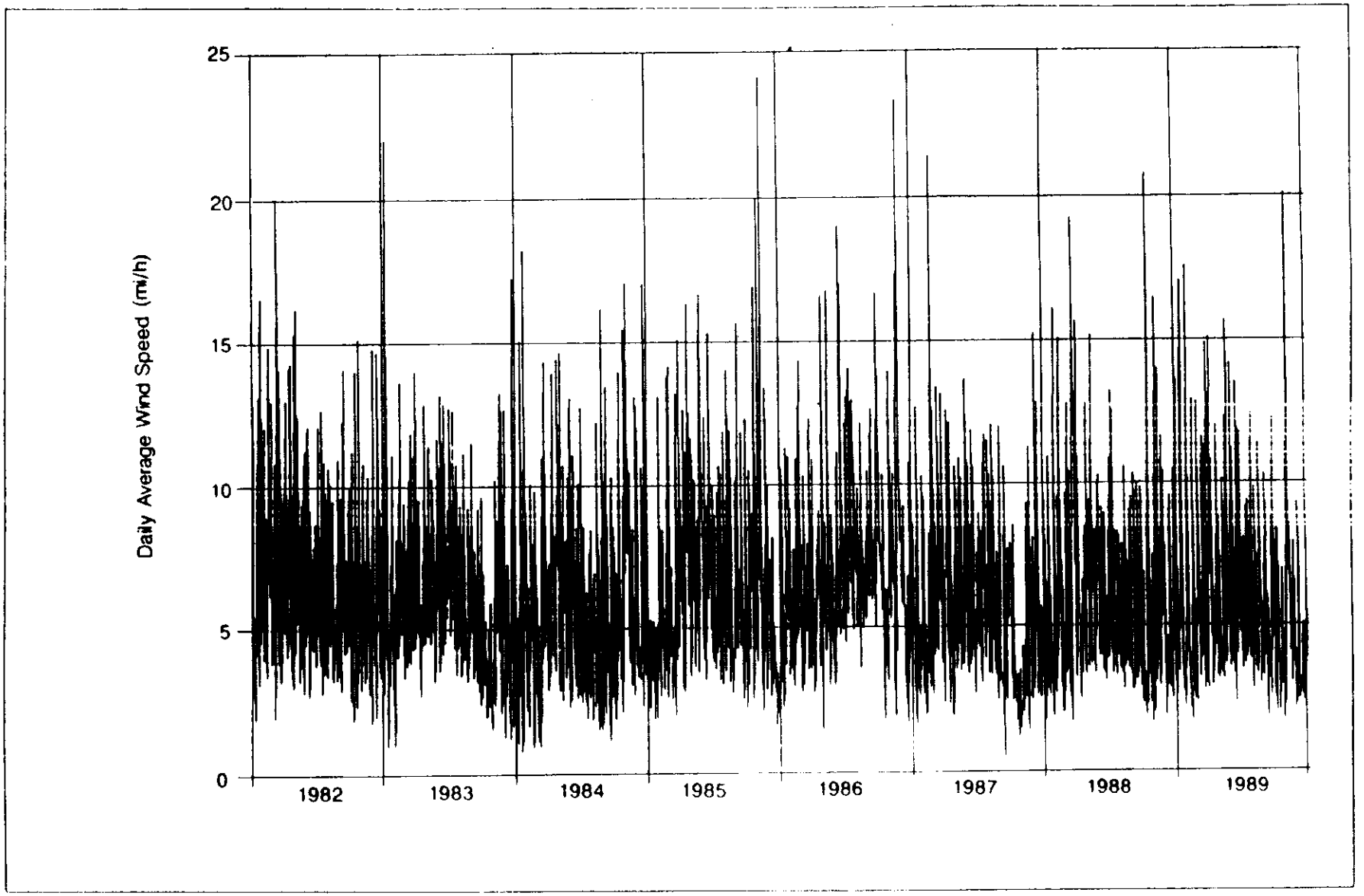

Figure D-4. Daily Average Wind Speed, Richland Airport, 1982-1989.

APPENDIX E
AIR QUALITY MONITORING RESULTS

Air quality monitoring results are reproduced from Glantz and Laws 1990. Semivolatile organic results from 1100-1, are not provided in Subappendix E-4 because these results were omitted from Glantz and Laws 1990. Corrections to data as originally reported have been noted where appropriate.

Glantz, C.S. and G.L. Laws, 1990, *Air Quality Monitoring for the 1100-EM-1 Remedial Investigation: Phase 1 Sampling*, Pacific Northwest Laboratory, Richland, Washington.

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Appendix E Contents

	Description	Page
Subappendix E-1	Meteorological Data for First Round Ambient Air Monitoring Events	E1-1
Subappendix E-2	Sampling Parameters	E2-1
Subappendix E-3	Laboratory Analyses of Carbon Molecular Sieve Samples (Volatile Results)	E3-1
Subappendix E-4	Laboratory Analyses of Polyurethane Foam Samples (Semivolatile Results)	E4-1
Subappendix E-5	Laboratory Analyses of Filter Samples Particulates (Particulate Element Results)	E5-1
Subappendix E-6	Laboratory Analyses of Filter Samples For Asbestos	E6-1

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SUBAPPENDIX E-1
METEOROLOGICAL DATA FOR PHASE I MONITORING EVENTS

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METEOROLOGICAL DATA FOR PHASE I MONITORING EVENTS

Meteorological data for Phase I monitoring events are presented in this appendix. The data were collected from Hanford meteorological monitoring stations located near the waste sites (the 300 Area and Richland stations) or from a portable meteorological tower that was deployed near the waste site just before most monitoring events. The 300 Area meteorological monitoring station is located near Highway 4S (Stevens Drive), under 1 mi (1.6 km) north-northeast of the Horn Rapids Landfill. The Richland meteorological monitoring station is located on the roof of the Richland Airport control tower. This station is about 2 mi (3 km) south-southwest of the 1100-2 and 1100-3 Disposal Pits.

The portable meteorological monitoring tower was scheduled to measure meteorological conditions during most monitoring events. Data from the 300 Area or Richland Airport stations were used when supplementary data were not collected.

Meteorological Data Collected During Monitoring Event "B" Monitoring at the 1100-2 and 1100-3 Disposal Pits

Date: April 3, 1989

Data were collected using the supplementary monitoring tower. The portable tower was located 200 ft (60 m) southwest of the 1100-3 Disposal Pit 3.

Temperature at start of monitoring event: 62°F (17°C)
Temperature at end of monitoring event: 63°F (17°C)

The wind direction presented below is the mean direction the wind was blowing from during each 15 min averaging period. Winds are rounded to the nearest 5° and are measured clockwise from true North. Add or subtract 180° to obtain the mean transport direction (the direction the wind was blowing toward).

Time (PDT)	Time (PST)	Wind Direction (from N)	Wind Speed (mph)
13:00	12:00	220°	8.3
13:15	12:15	250°	9.1
13:30	12:30	240°	9.4
13:45	12:45	280°	7.3
14:00	13:00	295°	6.3
14:15	13:15	250°	7.9
14:30	13:30	295°	6.0
14:45	13:45	255°	8.4
15:00	14:00	240°	7.9
15:15	14:15	260°	7.3
15:30	14:30	265°	7.5
15:45	14:45	260°	11.0

Meteorological Data Collected During Monitoring Event "C" Standard Monitoring at the Horn Rapids Landfill

Date: May 2, 1989

The datalogger for the supplementary monitoring tower failed during this monitoring event. Representative data are available from the 300 Area and Richland Airport meteorology monitoring stations.

Temperature during the monitoring event: ≈ 69°F (21°C)

The wind direction presented below is the mean direction the wind was blowing from during each one hour averaging period. Winds are rounded to the nearest 5° and are measured clockwise from true North. Add or subtract 180° to obtain the mean transport direction (the direction the wind was blowing toward).

300 Area Meteorology Monitoring Station

Time (PDT)	Time (PST)	Wind Direction (from N)	Wind Speed (mph)
11:00	10:00	230°	7
12:00	11:00	240°	4
13:00	12:00	160°	4

Richland Meteorology Monitoring Station

Time (PDT)	Time (PST)	Wind Direction (from N)	Wind Speed (mph)
11:00	10:00	260°	6
12:00	11:00	250°	8
13:00	12:00	210°	4

Meteorological Data Collected During Monitoring Event "D" Asbestos Monitoring at the Horn Rapids Landfill

Date: May 24, 1989

Supplementary meteorological monitoring was not required during this monitoring event. Meteorological observations at the 300 Area and Richland Airport meteorology monitoring stations were representative of the conditions present at the landfill on this day(2).

Temperature during the monitoring event: ≈ 67°F (19°C)

The wind direction presented below is the mean direction the wind was blowing from during each one hour averaging period. Winds are rounded to the nearest 5° and are measured clockwise from true North. Add or subtract 180° to obtain the mean transport direction (the direction the wind was blowing toward).

300 Area Meteorology Monitoring Station

Time (PDT)	Time (PST)	Wind Direction (from N)	Wind Speed (mph)
12:00	11:00	240°	19
13:00	12:00	240°	18
14:00	13:00	250°	17
15:00	14:00	250°	18
16:00	15:00	240°	18

Richland Meteorology Monitoring Station

Time (PDT)	Time (PST)	Wind Direction (from N)	Wind Speed (mph)
12:00	11:00	230°	19
13:00	12:00	230°	16
14:00	13:00	240°	16
15:00	14:00	260°	15
16:00	15:00	270°	15

(2) The strong atmospheric pressure gradient that was present on this day produced uniform meteorological conditions over a wide area that included the southern portion of the Hanford Site and north Richland.

Meteorological Data Collected During Monitoring Event "E"
Standard Monitoring at the Battery Acid Pit

Date: May 25, 1989

The datalogger for the supplementary monitoring tower was still inoperable for this monitoring event. Representative data are available from the 300 Area and Richland Airport meteorology monitoring stations.

Temperature during the monitoring event: ≈ 70°F (21°C)

The wind direction presented below is the mean direction the wind was blowing from during each one hour averaging period. Winds are rounded to the nearest 5° and are measured clockwise from true North. Add or subtract 180° to obtain the mean transport direction (the direction the wind was blowing toward).

300 Area Meteorology Monitoring Station

Time (PDT)	Time (PST)	Wind Direction (from N)	Wind Speed (mph)
12:00	11:00	240°	12
13:00	12:00	210°	11
14:00	13:00	210°	10
15:00	14:00	240°	8
16:00	15:00	270°	6

Richland Meteorology Monitoring Station

Time (PDT)	Time (PST)	Wind Direction (from N)	Wind Speed (mph)
12:00	11:00	210°	11
13:00	12:00	200°	9
14:00	13:00	210°	7
15:00	14:00	260°	5
16:00	15:00	240°	7

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SUBAPPENDIX E-2
SAMPLING PARAMETERS

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Phase I Sampling Parameters

Sample ID[a]	Date Sampled	Sampling Started (PDT)	Sampling Ended (PDT)	Sampling Duration (min)	Flow Rate (l/min)	Volume Sampled (m^3)
B2F-U	4/03/89	12:50	15:40	170	147	25.0
B2P-U	4/03/89	12:50	15:40	170	147	25.0
B2C-U	4/03/89	12:50	15:29	159	0.29	0.046
B1F-DW	4/03/89	12:50	15:40	170	155	26.4
B1P-DW	4/03/89	12:50	15:40	170	155	26.4
B4C-DW	4/03/89	12:50	15:12	142	0.27	0.038
B3F-DE	4/03/89	12:52	15:41	169	169	~~26.8~~ 26.6
B3P-DE	4/03/89	12:52	15:41	169	169	~~26.8~~ 26.6
B3C-DE	4/03/89	12:52	pump fail.	-	-	-
B0F	4/03/89	-	-	-	-	-
B0P	4/03/89	-	-	-	-	-
B0C	4/03/89	-	-	-	-	-
C1F-U	5/02/89	9:55	10:59	64	156	~~9.97~~ 9.98
C1P-U	5/02/89	9:55	10:59	64	156	~~9.97~~ 9.98
C2C-U	5/02/89	9:55	10:59	64	0.30	0.019
C2F-DW	5/02/89	9:56	11:00	64	147	~~9.42~~ 9.41
C2P-DW	5/02/89	9:56	11:00	64	147	~~9.42~~ 9.41
C1C-DW	5/02/89	9:56	11:00	64	0.23	~~0.019~~ 0.015
C3F-DE	5/02/89	9:54	10:58	64	147	~~8.67~~ 9.41
C3P-DE	5/02/89	9:54	10:58	64	147	~~8.67~~ 9.41
C3C-DE	5/02/89	9:54	10:58	64	0.23	0.015
C0F	5/02/89	-	-	-	-	-
C0P	5/02/89	-	-	-	-	-
C0C	5/02/89	-	-	-	-	-
D1A	5/24/89	12:55	15:56	181	0.50	0.09
D2A	5/24/89	12:55	15:56	181	0.54	0.10
D0A	5/24/89	-	-	-	-	-
E3F-U	5/25/89	12:40	13:40	60	144	~~8.66~~ 8.64
E3P-U	5/25/89	12:40	13:40	60	144	~~8.66~~ 8.64
E3C-U	5/25/89	12:40	13:40	60	0.075	0.0045
E1F-D	5/25/89	12:41	13:41	60	147	~~26.4~~ 8.82
E1P-D	5/25/89	12:41	13:41	60	147	~~26.4~~ 8.82
E1C-D	5/25/89	12:41	13:41	60	0.096	0.006
E0F	5/25/89	-	-	-	-	-
E0P	5/25/89	-	-	-	-	-
E0C	5/25/89	-	-	-	-	-

(a) The sampler ID and site code consists of the three-character sample ID, followed by a location code. In this code U = upwind, D = downwind, DW = the more westerly downwind monitoring location (when there are two downwind monitoring sites), and DE = the more easterly downwind monitoring location (when there are two downwind monitoring sites).

SAMPLING PARAMETERS

Information on sampling parameters is presented in this appendix. The information presented for each monitoring event includes the date of sampling, on- and off-times for each sampling instrument, and calculated flow rates through the samplers. The tables containing this information are photocopied from the laboratory record book. All flow rates are in l/min.

SUBAPPENDIX E-3
LABORATORY ANALYSES OF CARBON MOLECULAR SIEVE SAMPLES

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LABORATORY ANALYSES OF CARBON MOLECULAR SIEVE SAMPLES

Laboratory analyses of carbon molecular sieve (CMS) samples are presented in this appendix. CMS samples were collected during monitoring events "B", "C", and "E" and were analyzed for volatile organic compounds (VOCs). In each table of laboratory results, the CMS samples are identified by their three-character identification code and a brief sample description that indicates where sampling was conducted in relation to the waste site ("blank" represents an unexposed sample analyzed for quality control purposes).

Monitoring Event "E" - Phase 1 monitoring at the Battery Acid Pit

Sample Description	Mass (nanograms) of Pollutant Contained in Sample						
	PCE	1,1,1-TCA	CCl_4	TCE	Benzene	Toluene	Octane
EOC - blank	0.2	1.4	0.9	0.4	*	*	*
E1C - downwind	0.2 J	4.6 J	2.6 J	2.1	<2.5 J	<1.0 J	4.5 J
E2C - upwind	0.7 J	4.1 J	2.1 J	2.2	<7.5 J	<7.5 J	75 J 28 J 4

* = experienced overload conditions at these retention times

Monitoring Event "B" - Phase 1 monitoring at the 1100-3 Disposal Pit

Sample Description	Mass (nanograms) of Pollutant Contained in Sample						
	PCE	1,1,1-TCA	CCl_4	TCE	Benzene	Toluene	Octane
B0C - blank	+	+	+	+	+	+	+
B4C - downwind	<1.5 U	+	+	<1.5 U	<15 U	+	5.0 U
B2C - upwind	8.0	<7.5 U	≥ 11(a)	>50	8.5	<12 U	25 U

BWJ, GAI 4/11/90

(a) Possible detector overload indicating values could be higher.

Monitoring Event "C" - Phase 1 monitoring at the Horn Rapids Landfill

Sample Description	Mass (nanograms) of Pollutant Contained in Sample						
	PCE	1,1,1-TCA	CCl_4	TCE	Benzene	Toluene	Octane
C0C - blank	0.05	2.8	<0.05 U	<0.15 U	<8.0 U	<2.5 U	32
C1C - downwind W	≥ 36(a)	104(b)	27(b)	39	<3.5 U	<1.5 U	22 U
C2C - upwind	≥ 8.5(a)	160(b)	41(b)	64	<6.0 U	<1.0 U	2.5 U
C3C - downwind E	42	98(b)	26(b)	32	<22 U	<2.5 U	300

BWJ, GAI 4/11/90

(a) Possible detector overload indicating values could be higher.

(b) Observed detector overload conditions at this retention time initially caused from impurities in Carbotraps.

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SUBAPPENDIX E-4
LABORATORY ANALYSES OF POLYURETHANE FOAM SAMPLES

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LABORATORY ANALYSES OF POLYURETHANE FOAM SAMPLES

Laboratory analyses of polyurethane foam (PUF) samples are presented in this appendix. PUF samples were collected during monitoring events "B", "C", and "E" and were analyzed for semivolatile organic compounds (including pesticides and PCBs). The data in this appendix are presented using photocopies of the analysis laboratory's reporting sheets. The laboratory report for each sample is two pages long. The identification code of the sample is provided near the top of the first page on each of the sets of reporting sheets.

UNITED STATES TESTING COMPANY, INC. RICHLAND DIVISION (UST-RD)

SEMI-VOLATILE ORGANIC ANALYSIS (ABN) All values are reported as total amounts in µg.

ANALYSIS CODE: 733

UST-RD I.D.: 19035 DATE EXTRACTED: 4-5-89

CUST I.D.: BOP DATE ANALYZED: DA 5/16/89 D1 D2

ANALYST: ECS/ZC EXTRACT DILUTION: DA D1 D2

SPLE WT(g)/VOL(mL) EXTRD.: — TOTAL DILUTION: DA D1 D2

INJECTION VOL(uL): 1 ul MATRIX: FOAM

COMPOUND	CODE	MDL SOIL	MDL WATER	FOUND	REPORTED
CRESOL	B51	< 1.0 ug/g	< 10 ppb	ND	<10
1,2-DICHLOROBENZENE	B61	< 1.0 ug/g	< 10 ppb		
1,3-DICHLOROBENZENE	B62	< 1.0 ug/g	< 10 ppb		
p-DICHLOROBENZENE	B63	< 1.0 ug/g	< 10 ppb		
HEXACHLOROBENZENE	B89	< 1.0 ug/g	< 10 ppb		
PENTACHLOROBENZENE	C26	< 1.0 ug/g	< 10 ppb		
PENTACHLOROPHENOL	C28	< 5.0 ug/g	< 50 ppb		<50
1,2,4,5-TETRACHLOROBENZENE	C37	< 1.0 ug/g	< 10 ppb		<10
1,2,4-TRICHLOROBENZENE	C43	< 1.0 ug/g	< 10 ppb		
HEXACHLOROPHENE	C54	< 1.0 ug/g	< 10 ppb		
NAPHTHALENE	C55	< 1.0 ug/g	< 10 ppb		
1,2,3-TRICHLOROBENZENE	C56	< 1.0 ug/g	< 10 ppb		
PHENOL	C57	< 1.0 ug/g	< 10 ppb	8 ug/l	8
1,3,5-TRICHLOROBENZENE	C58	< 1.0 ug/g	< 10 ppb		<10
1,2,3,4-TETRACHLOROBENZENE	C59	< 1.0 ug/g	< 10 ppb		
1,2,3,5-TETRACHLOROBENZENE	C60	< 1.0 ug/g	< 10 ppb		
KEROSENE	C79	< 1000 ug/g	< 10 ppm		
STRYCHNINE	C91	< 5.0 ug/g	< 50 ppb		<50
MALEIC HYDRAZIDE	C92	< 50.0 ug/g	< 500 ppb		<500

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NICOTINIC ACID	C93	< 10.0 ug/g	< 100 ppb	ND	<100
TRIBUTYLPHOSPHATE	I21	< 1.0 ug/g	< 10 ppb		<10
CHLOROBENZENE	L64	< 1.0 ug/g	< 10 ppb		<10

LBW, GAI 4/11/90

TENTATIVELY IDENTIFIED COMPOUNDS (>25% OF NEAREST I.D.)

COMPOUND	CODE	EST. CONC.
T1: Diethylphthalate	B62	2
T2: Di-n-butylphthalate	B60	10
T3: Butylbenzylphthalate	B42	0.5
T4: Bis(2-Ethylhexyl)phthalate	B40	79
T5: Unknown siloxane	L83	14
T6: Unknown polycyclic aromatic hydrocarbon	L68	23
T7: Unknown	I99	19
T8: Unknown fatty acid	L05	55
T9: Unknown fatty acid ester	L50	12
T10: Unknown polycyclic aromatic hydrocarbon	L68	9
T11: Unknown phthalate	L16	33
T12: Unknown	I99	31
T13: Unknown fatty acid ester	L80	44
T14: Unknown sterol	L84	50
T15: Unknown aliphatic hydrocarbon	I98	17

UNITED STATES TESTING COMPANY, INC., RICHLAND DIVISION (UST-RD)

SEMI-VOLATILE ORGANIC ANALYSIS (ABN) All values are reported as total amounts in µg.

ANALYSIS CODE: 733

UST-RD I.D.: 19036 DATE EXTRACTED: 4-5-89

CUST I.D.: B1P DATE ANALYZED: DA 4/5/89 D1 D2

ANALYST: ECS/ZC/LKT EXTRACT DILUTION: DA D1 D2

SPLE WT(g)/VOL(mL) EXTRD.: — TOTAL DILUTION: DA D1 D2

INJECTION VOL(uL): 1ml MATRIX: FOAM

COMPOUND	CODE	MDL SOIL	MDL WATER	FOUND	REPORTED
CRESOL	B51	< 1.0 ug/g	< 10 ppb	ND	<10 µg
1,2-DICHLOROBENZENE	B61	< 1.0 ug/g	< 10 ppb		
1,3-DICHLOROBENZENE	B62	< 1.0 ug/g	< 10 ppb		
p-DICHLOROBENZENE	B63	< 1.0 ug/g	< 10 ppb		
HEXACHLOROBENZENE	B89	< 1.0 ug/g	< 10 ppb		
PENTACHLOROBENZENE	C26	< 1.0 ug/g	< 10 ppb		
PENTACHLOROPHENOL	C28	< 5.0 ug/g	< 50 ppb		<50 µg
1,2,4,5-TETRACHLOROBENZENE	C37	< 1.0 ug/g	< 10 ppb		<10 µg
1,2,4-TRICHLOROBENZENE	C43	< 1.0 ug/g	< 10 ppb		
HEXACHLOROPHENE	C54	< 1.0 ug/g	< 10 ppb		
NAPHTHALENE	C55	< 1.0 ug/g	< 10 ppb		
1,2,3-TRICHLOROBENZENE	C56	< 1.0 ug/g	< 10 ppb		
PHENOL	C57	< 1.0 ug/g	< 10 ppb		
1,3,5-TRICHLOROBENZENE	C58	< 1.0 ug/g	< 10 ppb		
1,2,3,4-TETRACHLOROBENZENE	C59	< 1.0 ug/g	< 10 ppb		
1,2,3,5-TETRACHLOROBENZENE	C60	< 1.0 ug/g	< 10 ppb		
KEROSENE	C79	< 1000 ug/g	< 10 ppm		
STRYCHNINE	C91	< 5.0 ug/g	< 50 ppb		<50 µg
MALEIC HYDRAZIDE	C92	< 50.0 ug/g	< 500 ppb		<500 µg

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NICOTINIC ACID	C93	< 10.0 ug/g	< 100 ppb	ND	<100 ug
TRIBUTYLPHOSPHATE	I21	< 1.0 ug/g	< 10 ppb	↓	<10 ug
CHLOROBENZENE	L64	< 1.0 ug/g	< 10 ppb	↓	↓

TENTATIVELY IDENTIFIED COMPOUNDS (>25% OF NEAREST I.D.)

	COMPOUND	CODE	EST. CONC.	
T1:	Unknown Silicone	L93	11 ug	B:U
T2:	Unknown Polynuclear Aromatic Hydrocarbon	L69	27 ug	B:U
T3:	Unknown	I99.1	31 ug	B:U
T4:	Unknown	I99.1	21 ug	
T5:	Unknown	I99.2	17 ug	
T6:	Unknown	I99.3	13 ug	
T7:	Unknown Polynuclear Aromatic Hydrocarbon	L69	15 ug	
T8:	Unknown	I99.4	16 ug	
T9:	Unknown Phthalate	L16	33 ug	B:U
T10:	Unknown Fatty Acid	L05	166 ug	B:U
T11:	D. butyl Phthalate	B60	26 ug	B:U
T12:	Unknown Hydrocarbon	I99.5	24 ug	
T13:	Unknown Fatty Acid & Ester	L90	50 ug	B:U
T14:	B.s(2-Ethylhexyl)phthalate	B40	49 ug	
T15:	Unknown Polynuclear Aromatic Hydrocarbon	L69	11 ug	
T16:	Unknown	I99.6	69 ug	
T17:	Unknown Polynuclear Aromatic Hydrocarbon	L69	13 ug	
T18:	Unknown Hydrocarbon	I99.11	63 ug	B:U
T19:	Unknown Hydrocarbon	I99.12	44 ug	
T20:	Unknown Hydrocarbon	I99.14	14 ug	
T21:	Unknown Hydrocarbon	I99	11 ug	
T22:	Unknown Polynuclear Aromatic Hydrocarbon	L69	19 ug	

SRW, GAI
4/11/90

UNITED STATES TESTING COMPANY, INC., RICHLAND DIVISION (UST-RD)

SEMI-VOLATILE ORGANIC ANALYSIS (ABN)

ANALYSIS CODE: 733

All values are reported as total amounts in ug

UST-RD I.D.: 19037 DATE EXTRACTED: 4-5-89

CUST I.D.: B2P DATE ANALYZED: DA 4/24/89 D1 D2

ANALYST: ECS/LKT/ZC EXTRACT DILUTION: DA D1 D2

SPLE WT(g)/VOL(mL) EXTRD.: — TOTAL DILUTION: DA D1 D2

INJECTION VOL(uL): 1ul MATRIX: FOAM

COMPOUND	CODE	MDL SOIL	MDL WATER	FOUND	REPORTED
CRESOL	B51	< 1.0 ug/g	< 10 ppb	ND	<10
1,2-DICHLOROBENZENE	B61	< 1.0 ug/g	< 10 ppb		
1,3-DICHLOROBENZENE	B62	< 1.0 ug/g	< 10 ppb		
p-DICHLOROBENZENE	B63	< 1.0 ug/g	< 10 ppb		
HEXACHLOROBENZENE	B89	< 1.0 ug/g	< 10 ppb		
PENTACHLOROBENZENE	C26	< 1.0 ug/g	< 10 ppb		
PENTACHLOROPHENOL	C28	< 5.0 ug/g	< 50 ppb		<50
1,2,4,5-TETRACHLOROBENZENE	C37	< 1.0 ug/g	< 10 ppb		<10
1,2,4-TRICHLOROBENZENE	C43	< 1.0 ug/g	< 10 ppb		
HEXACHLOROPHENE	C54	< 1.0 ug/g	< 10 ppb		
NAPHTHALENE	C55	< 1.0 ug/g	< 10 ppb		
1,2,3-TRICHLOROBENZENE	C56	< 1.0 ug/g	< 10 ppb		
PHENOL	C57	< 1.0 ug/g	< 10 ppb	2.5 ug	3 ug B
1,3,5-TRICHLOROBENZENE	C58	< 1.0 ug/g	< 10 ppb	ND	<10
1,2,3,4-TETRACHLOROBENZENE	C59	< 1.0 ug/g	< 10 ppb		
1,2,3,5-TETRACHLOROBENZENE	C60	< 1.0 ug/g	< 10 ppb		
KEROSENE	C79	< 1000 ug/g	< 10 ppm		
STRYCHNINE	C91	< 5.0 ug/g	< 50 ppb		<50
MALEIC HYDRAZIDE	C92	< 50.0 ug/g	< 500 ppb		<500

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NICOTINIC ACID	C93	< 10.0 ug/g	< 100 ppb	ND	<100
TRIBUTYLPHOSPHATE	I21	< 1.0 ug/g	< 10 ppb	↓	<10
CHLOROBENZENE	L64	< 1.0 ug/g	< 10 ppb	↓	↓

TENTATIVELY IDENTIFIED COMPOUNDS (>25% OF NEAREST I.D.)

COMPOUND	CODE	EST. CONC.	
T1: Unknown Siloxane	L97	20 ug	B:U
T2: Unknown Polynuclear Aromatic Hydrocarbon	L69	28 ug	B:U
T3: Unknown	I99-	34 ug	B:U
T4: Unknown	I99-	25 ug	B:U
T5: Unknown	I99-	84 ug	
T6: Unknown	I99-	10 ug	
T7: Unknown Aliphatic Substituted Benzene	L69	19 ug	
T8: Diethyl Phthalate	B67	3 ug	B:U
T9: Unknown	I99-	13 ug	
T10: Unknown Phthalate	L16	157 ug	B:U
T11: Unknown	I99-	35 ug	B:U
T12: Di-n-butyl phthalate	B60	37 ug	B:U
T13: Unknown Fatty Acid Ester	L90	196 ug	B:U
T14: Bis(2-ethylhexyl)phthalate	B70	66 ug	B:U
T15: Unknown Polynuclear Aromatic Hydrocarbon	L69	73 ug	B
T16: Unknown	I99-	17 ug	
T17: Unknown Polynuclear Aromatic Hydrocarbon	L69	10 ug	

BSW, BAH 4/11/90

UNITED STATES TESTING COMPANY, INC., RICHLAND DIVISION (UST-RD)

SEMI-VOLATILE ORGANIC ANALYSIS (ABN)

ANALYSIS CODE: 733

All values are reported as total amounts in mg

UST-RD I.D.: 19038 DATE EXTRACTED: 4-8-89

CUST I.D.: B3P DATE ANALYZED: D0 4/5/89 D1 D2

ANALYST: ECS/ZC/LKT EXTRACT DILUTION: D0 D1 D2

SPLE WT(g)/VOL(mL) EXTRD.: — TOTAL DILUTION: D0 D1 D2

INJECTION VOL(uL): 1µl MATRIX: FOAM

COMPOUND	CODE	MDL SOIL	MDL WATER	FOUND	REPORTED
CRESOL	B51	< 1.0 ug/g	< 10 ppb	ND	<10
1,2-DICHLOROBENZENE	B61	< 1.0 ug/g	< 10 ppb		
1,3-DICHLOROBENZENE	B62	< 1.0 ug/g	< 10 ppb		
p-DICHLOROBENZENE	B63	< 1.0 ug/g	< 10 ppb		
HEXACHLOROBENZENE	B89	< 1.0 ug/g	< 10 ppb		
PENTACHLOROBENZENE	C26	< 1.0 ug/g	< 10 ppb		
PENTACHLOROPHENOL	C28	< 5.0 ug/g	< 50 ppb		<50
1,2,4,5-TETRACHLOROBENZENE	C37	< 1.0 ug/g	< 10 ppb		<10
1,2,4-TRICHLOROBENZENE	C43	< 1.0 ug/g	< 10 ppb		
HEXACHLOROPHENE	C54	< 1.0 ug/g	< 10 ppb		
NAPHTHALENE	C55	< 1.0 ug/g	< 10 ppb		
1,2,3-TRICHLOROBENZENE	C56	< 1.0 ug/g	< 10 ppb	3.0 ug/L	3.0J
PHENOL	C57	< 1.0 ug/g	< 10 ppb	ND	<10
1,3,5-TRICHLOROBENZENE	C58	< 1.0 ug/g	< 10 ppb		
1,2,3,4-TETRACHLOROBENZENE	C59	< 1.0 ug/g	< 10 ppb		
1,2,3,5-TETRACHLOROBENZENE	C60	< 1.0 ug/g	< 10 ppb		
KEROSENE	C79	< 1000 ug/g	< 10 ppm		
STRYCHNINE	C91	< 5.0 ug/g	< 50 ppb		<50
MALEIC HYDRAZIDE	C92	< 50.0 ug/g	< 500 ppb		<500

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RECEIVED MAY 0 5 1989

NICOTINIC ACID	C93	< 10.0 ug/g	< 100 ppb	ND	<100
TRIBUTYLPHOSPHATE	I21	< 1.0 ug/g	< 10 ppb	↓	<10
CHLOROBENZENE	L64	< 1.0 ug/g	< 10 ppb	↓	↓

TENTATIVELY IDENTIFIED COMPOUNDS (>25% OF NEAREST I.D.)

COMPOUND	CODE	EST. CONC.
T1: Unknown	I99-	27 B:U
T2: Unknown Fatty Acid	L05	49 B:U
T3: Unknown	I99-1	10
T4: Unknown Polynuclear Aromatic Hydrocarbon	L68	10 B:U
T5: Unknown Polynuclear Aromatic Hydrocarbon	L68-1	15
T6: Diethyl Phthalate	B67	3 B:U
T7: Unknown	I99-2	17
T8: Unknown Phthalate	L16	55 B:U
T9: Unknown Fatty Acid Ester	L80-	25 B:U
T10: Di-n-butyl phthalate	B60	17 B:U
T11: Unknown Hydrocarbon	I99-1	9
T12: Unknown Fatty Acid Ester	L80-	38 B:U
T13: Bis(2-ethylhexyl)phthalate	B80	66 B:U
T14: Unknown Polynuclear Aromatic Hydrocarbon	L68-	52
T15: Unknown Hydrocarbon	I99-2	39 B:U
T16: Unknown Hydrocarbon	I99-	17
T17: Unknown Polynuclear Aromatic Hydrocarbon	L68-3	11

WEW, GRI
4/11/90

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UNITED STATES TESTING COMPANY, INC., RICHLAND DIVISION (UST-RD)

SEMI-VOLATILE ORGANIC ANALYSIS (ABN) Reported as total amounts in ug.

ANALYSIS CODE: 733

UST-RD I.D.: 18747 DATE EXTRACTED: 5/8/89

CUST I.D.: CØP DATE ANALYZED: DA 5/13/89 D1 D2

ANALYST: ES/2c/LKT EXTRACT DILUTION: DA D1 D2

SPLE WT(g)/VOL(mL) EXTRD.: — TOTAL DILUTION: DA D1 D2

INJECTION VOL(uL): 1 MATRIX: Foam

COMPOUND	CODE	MDL SOIL	MDL WATER	FOUND	REPORTED
CRESOL	B51	< 1.0 ug/g	< 10 ppb	ND	<10
1,2-DICHLOROBENZENE	B61	< 1.0 ug/g	< 10 ppb		
1,3-DICHLOROBENZENE	B62	< 1.0 ug/g	< 10 ppb		
p-DICHLOROBENZENE	B63	< 1.0 ug/g	< 10 ppb		
HEXACHLOROBENZENE	B89	< 1.0 ug/g	< 10 ppb		
PENTACHLOROBENZENE	C26	< 1.0 ug/g	< 10 ppb		
PENTACHLOROPHENOL	C28	< 5.0 ug/g	< 50 ppb		<50
1,2,4,5-TETRACHLOROBENZENE	C37	< 1.0 ug/g	< 10 ppb		<10
1,2,4-TRICHLOROBENZENE	C43	< 1.0 ug/g	< 10 ppb		
HEXACHLOROPHENE	C54	< 1.0 ug/g	< 10 ppb		
NAPHTHALENE	C55	< 1.0 ug/g	< 10 ppb		
1,2,3-TRICHLOROBENZENE	C56	< 1.0 ug/g	< 10 ppb		
PHENOL	C57	< 1.0 ug/g	< 10 ppb		
1,3,5-TRICHLOROBENZENE	C58	< 1.0 ug/g	< 10 ppb		
1,2,3,4-TETRACHLOROBENZENE	C59	< 1.0 ug/g	< 10 ppb		
1,2,3,5-TETRACHLOROBENZENE	C60	< 1.0 ug/g	< 10 ppb		
KEROSENE	C79	< 1000 ug/g	< 10 ppm		
STRYCHNINE	C91	< 5.0 ug/g	< 50 ppb		<50
MALEIC HYDRAZIDE	C92	< 50.0 ug/g	< 500 ppb		<500

ST76[82]PAGE 1 OF 2 733, 1989 GCMS REPORT REV 1, 1/9/89

RECEIVED MAY 18 1989

NICOTINIC ACID	C93	< 10.0 ug/g	< 100 ppb	ND	<100
TRIBUTYLPHOSPHATE	I21	< 1.0 ug/g	< 10 ppb	↓	<10
CHLOROBENZENE	L64	< 1.0 ug/g	< 10 ppb	↓	↓

TENTATIVELY IDENTIFIED COMPOUNDS (>25% OF NEAREST I.D.)

	COMPOUND	CODE	EST. CONC. ~~ug/g (ppb)~~	
T1:	Bis(2-Ethylhexyl)phthalate Bto		~~50~~ 70	
T2:	Unknown Polycyclic Aromatic Hydrocarbon		L68	12
T3:	Unknown Phenol		L84	51
T4:				
T5:				

UNITED STATES TESTING COMPANY, INC., RICHLAND DIVISION (UST-RD)

SEMI-VOLATILE ORGANIC ANALYSIS (ABN) Reported as total amounts in g

ANALYSIS CODE: 733

UST-RD I.D.: 18749 DATE EXTRACTED: 5-8-89

CUST I.D.: CIP DATE ANALYZED: DA 5/15/89 D1 D2

ANALYST: ZC/ES/LKT EXTRACT DILUTION: DA D1 D2

SPLE WT(g)/VOL(mL) EXTRD.: — TOTAL DILUTION: DA D1 D2

INJECTION VOL(uL): 1 MATRIX: Foam

COMPOUND	CODE	MDL SOIL	MDL WATER	FOUND	REPORTED
CRESOL	B51	< 1.0 ug/g	< 10 ppb	ND	<10
1,2-DICHLOROBENZENE	B61	< 1.0 ug/g	< 10 ppb		
1,3-DICHLOROBENZENE	B62	< 1.0 ug/g	< 10 ppb		
p-DICHLOROBENZENE	B63	< 1.0 ug/g	< 10 ppb		
HEXACHLOROBENZENE	B89	< 1.0 ug/g	< 10 ppb		
PENTACHLOROBENZENE	C26	< 1.0 ug/g	< 10 ppb		
PENTACHLOROPHENOL	C28	< 5.0 ug/g	< 50 ppb		<50
1,2,4,5-TETRACHLOROBENZENE	C37	< 1.0 ug/g	< 10 ppb		<10
1,2,4-TRICHLOROBENZENE	C43	< 1.0 ug/g	< 10 ppb		
HEXACHLOROPHENE	C54	< 1.0 ug/g	< 10 ppb		
NAPHTHALENE	C55	< 1.0 ug/g	< 10 ppb		
1,2,3-TRICHLOROBENZENE	C56	< 1.0 ug/g	< 10 ppb		
PHENOL	C57	< 1.0 ug/g	< 10 ppb		
1,3,5-TRICHLOROBENZENE	C58	< 1.0 ug/g	< 10 ppb		
1,2,3,4-TETRACHLOROBENZENE	C59	< 1.0 ug/g	< 10 ppb		
1,2,3,5-TETRACHLOROBENZENE	C60	< 1.0 ug/g	< 10 ppb		
KEROSENE	C79	< 1000 ug/g	< 10 ppm		
STRYCHNINE	C91	< 5.0 ug/g	< 50 ppb		<50
MALEIC HYDRAZIDE	C92	< 50.0 ug/g	< 500 ppb		<500

SY76(82) PAGE 1 OF 2 733, 1989 GCMS REPORT REV 1, 1/9/89

NICOTINIC ACID	C93	< 10.0 ug/g	< 100 ppb	ND	<100
TRIBUTYLPHOSPHATE	I21	< 1.0 ug/g	< 10 ppb	↓	<10
CHLOROBENZENE	L64	< 1.0 ug/g	< 10 ppb	↓	↓

TENTATIVELY IDENTIFIED COMPOUNDS (>25% OF NEAREST I.D.)

	COMPOUND	CODE	EST. CONC.	
T1:	Bis(2-Ethylhexyl)phthalate	B40	50	B:U
T2:	Unknown Polycyclic Aromatic hydrocarbon	L68	14	B:U
T3:	Unknown Fatty Acid ~~Ester~~	L05 ~~L00~~	57	B:U
T4:	Unknown	I99	15	B:U
T5:	Unknown Polycyclic Aromatic hydrocarbon	L68	13	B:U
~~T6:~~	~~2,6-Bis(1,1-dimethylethyl)-4-methylphenol~~	~~I63~~	~~16~~	DO NOT USE
T7:	Unknown Phenol	L84	35	B:U

T6: 2,6-Bis(1,1-Dimethylethyl)-4-methyl Phenol (BHT) I63 16

WEW, GAI 4/11/90

UNITED STATES TESTING COMPANY, INC., RICHLAND DIVISION (UST-RD)

SEMI-VOLATILE ORGANIC ANALYSIS (ABN) Reported as

ANALYSIS CODE: 733 total amounts in ug

UST-RD I.D.: 18749 DATE EXTRACTED: 5-8-89

CUST I.D.: C2P DATE ANALYZED: 5/14/89 DA D1 D2

ANALYST: ES/2C/LKT EXTRACT DILUTION: DA D1 D2

SPLE WT(g)/VOL(mL) EXTRD.: — TOTAL DILUTION: DA D1 D2

INJECTION VOL(uL): 1 MATRIX: Foam

COMPOUND	CODE	MDL SOIL	MDL WATER	FOUND	REPORTED
CRESOL	B51	< 1.0 ug/g	< 10 ppb	ND	<10
1,2-DICHLOROBENZENE	B61	< 1.0 ug/g	< 10 ppb		
1,3-DICHLOROBENZENE	B62	< 1.0 ug/g	< 10 ppb		
p-DICHLOROBENZENE	B63	< 1.0 ug/g	< 10 ppb		
HEXACHLOROBENZENE	B89	< 1.0 ug/g	< 10 ppb		
PENTACHLOROBENZENE	C26	< 1.0 ug/g	< 10 ppb		
PENTACHLOROPHENOL	C28	< 5.0 ug/g	< 50 ppb		<50
1,2,4,5-TETRACHLOROBENZENE	C37	< 1.0 ug/g	< 10 ppb		<10
1,2,4-TRICHLOROBENZENE	C43	< 1.0 ug/g	< 10 ppb		
HEXACHLOROPHENE	C54	< 1.0 ug/g	< 10 ppb		
NAPHTHALENE	C55	< 1.0 ug/g	< 10 ppb		
1,2,3-TRICHLOROBENZENE	C56	< 1.0 ug/g	< 10 ppb		
PHENOL	C57	< 1.0 ug/g	< 10 ppb		
1,3,5-TRICHLOROBENZENE	C58	< 1.0 ug/g	< 10 ppb		
1,2,3,4-TETRACHLOROBENZENE	C59	< 1.0 ug/g	< 10 ppb		
1,2,3,5-TETRACHLOROBENZENE	C60	< 1.0 ug/g	< 10 ppb		
KEROSENE	C79	< 1000 ug/g	< 10 ppm		
STRYCHNINE	C91	< 5.0 ug/g	< 50 ppb		<50
MALEIC HYDRAZIDE	C92	< 50.0 ug/g	< 500 ppb		<500

SY76[82]PAGE 1 OF 2 733, 1989 GCMS REPORT REV 1, 1/9/89

NICOTINIC ACID	C93	< 10.0 ug/g	< 100 ppb	ND	<100
TRIBUTYLPHOSPHATE	I21	< 1.0 ug/g	< 10 ppb		<10
CHLOROBENZENE	L64	< 1.0 ug/g	< 10 ppb		

LBW, GAI 4/11/90

TENTATIVELY IDENTIFIED COMPOUNDS (>25% OF NEAREST I.D.)

	COMPOUND	CODE	EST. CONC.	
T1:	Benzoic acid	J78		103
T2:	Bis(2-Ethylhexyl)phthalate	B40		25 B:U
T3:	Unknown polycyclic aromatic Hydrocarbon	L68		11 B:U
T4:	Unknown Fatty Acid ~~Ester~~	L05 ~~L60~~		40 B:U
T5:	~~BHT 2,6-bis(1,1-Dimethylethyl)-4-methyl phenol~~	~~L8~~ I63		~~7~~
T6	Unknown Phenol	L84		14 B:U
T7	Unknown Phenol	L84		37 B:U

LBW, GAI 4/11/90

T5: 2,6-bis(1,1-Dimethylethyl)-4-methyl Phenol (BHT) I63 17

UNITED STATES TESTING COMPANY, INC., RICHLAND DIVISION (UST-RD)

SEMI-VOLATILE ORGANIC ANALYSIS (ABN) Reported as total amounts only

ANALYSIS CODE: 733

UST-RD I.D.: 18750 DATE EXTRACTED: 5-8-89

CUST I.D.: C3P DATE ANALYZED: 5/14/89 DA D1 D2

ANALYST: ES/ZC/LKT EXTRACT DILUTION: DA D1 D2

SPLE WT(g)/VOL(mL) EXTRD.: — TOTAL DILUTION: DA D1 D2

INJECTION VOL(uL): 1 MATRIX: Foam

COMPOUND	CODE	MDL SOIL	MDL WATER	FOUND	REPORTED
CRESOL	B51	< 1.0 ug/g	< 10 ppb	ND	<10
1,2-DICHLOROBENZENE	B61	< 1.0 ug/g	< 10 ppb		
1,3-DICHLOROBENZENE	B62	< 1.0 ug/g	< 10 ppb		
p-DICHLOROBENZENE	B63	< 1.0 ug/g	< 10 ppb		
HEXACHLOROBENZENE	B89	< 1.0 ug/g	< 10 ppb		
PENTACHLOROBENZENE	C26	< 1.0 ug/g	< 10 ppb		
PENTACHLOROPHENOL	C28	< 5.0 ug/g	< 50 ppb	ND	<50
1,2,4,5-TETRACHLOROBENZENE	C37	< 1.0 ug/g	< 10 ppb		<10
1,2,4-TRICHLOROBENZENE	C43	< 1.0 ug/g	< 10 ppb		
HEXACHLOROPHENE	C54	< 1.0 ug/g	< 10 ppb		
NAPHTHALENE	C55	< 1.0 ug/g	< 10 ppb		
1,2,3-TRICHLOROBENZENE	C56	< 1.0 ug/g	< 10 ppb		
PHENOL	C57	< 1.0 ug/g	< 10 ppb		
1,3,5-TRICHLOROBENZENE	C58	< 1.0 ug/g	< 10 ppb		
1,2,3,4-TETRACHLOROBENZENE	C59	< 1.0 ug/g	< 10 ppb		
1,2,3,5-TETRACHLOROBENZENE	C60	< 1.0 ug/g	< 10 ppb		
KEROSENE	C79	< 1000 ug/g	< 10 ppm		
STRYCHNINE	C91	< 5.0 ug/g	< 50 ppb	<50	<50
MALEIC HYDRAZIDE	C92	< 50.0 ug/g	< 500 ppb	<500	<100

SY76(82)PAGE 1 OF 2 733, 1989 GCMS REPORT REV 1, 1/9/89

LKT 5.17.89

NICOTINIC ACID	C93	< 10.0 ug/g	< 100 ppb	ND	<100
TRIBUTYLPHOSPHATE	I21	< 1.0 ug/g	< 10 ppb	↓	<10
CHLOROBENZENE	L64	< 1.0 ug/g	< 10 ppb	↓	<10

LEW, BKI 4/11/90

TENTATIVELY IDENTIFIED COMPOUNDS (>25% OF NEAREST I.D.)

	COMPOUND	CODE	EST. CONC.	
T1:	Bis(2-Ethylhexyl)phthalate	B40	50	B:U
T2:	Unknown Polycyclic Aromatic Hydrocarbon	L68	15	B:U
T3:	Unknown Fatty Acid	L05	20	B:U
T4:	~~BHT 2,6-Bis(1,1-Dimethylethyl)-4-Methyl Phenol~~	~~L65~~	~~15~~	
T5:	Unknown Polycyclic Aromatic Hydrocarbon	L68	11	B:U
T6:	Unknown Phenol	L84	40	B:U
T4:	2,6-Bis(1,1-Dimethyl)-4-Methyl Phenol (BHT)	I63	15	

LEW, BKI 4/11/90

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SUBAPPENDIX E-5
LABORATORY ANALYSES OF FILTER SAMPLES PARTICULATES (HEAVY METALS)

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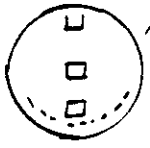
X-RAY FLUORESCENCE ANALYSIS

PERFORMED: GAIL LAW
DATE OF WORK: 6-20-89
WORK ORDER NUMBER: M07998
TYPE OF MATERIAL: FILTERS

SERIES NAMES ASSOCIATED WITH THIS SAMPLE SET:
12GL01
23GL01
AGL001
GGL001

DESCRIPTION OF XRFA TECHNIQUES USED

The filters were counted Bottom, middle, and Top. Because there was a visiable patient to the deposit the sample proved to be difficult to quantize because of the 1st backing generated absorption correction that was too large. The paper was stripped off one of the samples and processed again, and the correction generated was applied to all samples.



6-10-89

ANALYST: RON SANDERS
PHONE: 6 3877

Bottom, middle, and top values averaged and compared to sample blank values (see p. 7). ~ 50 cm² filter area assumed (see p. 7).
WEH, GAI
4/11/90

LABORATORY ANALYSES OF FILTER SAMPLES FOR PARTICULATES (HEAVY METALS)

Laboratory analyses of particulates collected on filter samples are presented in this appendix. Filter samples were collected during monitoring events "B" and "C". The data in this appendix are presented using photocopies of the analysis laboratory's reporting sheets. At the top of each column of data is a sample identification code. Several sections of each filter were analyzed independently. Separate results are reported for the bottom, middle, and top section of each filter sample.

µg/cm² LSW, GAI 4/11/90

AS UNITS	EL	FE SZUG./CM2 T-FILM	+/-	CIF BOTTOM		+/-	CIF MIDDLE		+/-	CIF TOP		+/-
TI												
PPM	AL	0.320	0.076	AL	0.516	0.093	AL	0.342	0.087	AL	0.330	0.091
PPM	SI	0.414	0.045	SI	0.541	0.054	SI	0.412	0.048	SI	0.417	0.050
PPM	P	0.050	0.021	P	< 0.053		P	< 0.050		P	< 0.053	
PPM	S	0.491	0.037	S	0.090	0.030	S	0.129	0.029	S	0.136	0.030
PPM	CL	0.117	0.010	CL	< 0.041		CL	< 0.030		CL	< 0.040	
PPM	K	0.150	0.011	K	0.040	0.007	K	0.030	0.006	K	0.033	0.006
PPM	CA	0.003	0.007	CA	0.117	0.009	CA	0.110	0.008	CA	0.114	0.009
PPM	FE	52.5	2.6	FE	0.260	0.019	FE	0.137	0.012	FE	0.140	0.012
ZR			+/-			+/-			+/-			+/-
PPM	SI	< 0.77		SI	< 1.2		SI	< 1.1		SI	< 1.2	
PPM	P	< 0.53		P	< 0.06		P	< 0.74		P	< 0.87	
PPM	S	0.66	0.21	S	< 0.72		S	< 0.68		S	< 0.71	
PPM	CL	0.23	0.10	CL	< 0.33		CL	< 0.30		CL	< 0.33	
PPM	K	0.152	0.035	K	< 0.076		K	< 0.074		K	< 0.077	
PPM	CA	0.061	0.026	CA	0.207	0.036	CA	0.139	0.033	CA	0.137	0.034
PPM	TI	< 0.062		TI	< 0.037		TI	0.035	0.017	TI	0.046	0.010
PPM	V	0.036	0.014	V	< 0.020		V	< 0.026		V	< 0.020	
PPM	CR	< 0.020		CR	< 0.021		CR	< 0.019		CR	0.020	0.010
PPM	MN	< 0.025		MN	< 0.016		MN	< 0.015		MN	< 0.017	
PPM	FE	52.5	2.6	FE	0.260	0.019	FE	0.137	0.012	FE	0.140	0.012
PPM	CO	< 0.094		CO	< 0.013		CO	< 0.011		CO	< 0.012	
PPM	NI	0.062	0.009	NI	< 0.007		NI	< 0.007		NI	< 0.007	
PPM	CU	0.009	0.003	CU	0.051	0.006	CU	0.119	0.009	CU	0.050	0.006
PPM	ZN	0.007	0.002	ZN	0.025	0.004	ZN	0.065	0.006	ZN	0.016	0.004
PPM	GA	< 0.003		GA	< 0.006		GA	< 0.006		GA	< 0.006	
PPM	HG	< 0.011		HG	< 0.021		HG	0.020	0.009	HG	< 0.020	
PPM	SE	< 0.003		SE	< 0.006		SE	< 0.005		SE	< 0.006	
PPM	PB	< 0.011		PB	< 0.021		PB	< 0.020		PB	< 0.021	
PPM	AS	0.000	0.002	AS	< 0.000		AS	< 0.007		AS	< 0.000	
PPM	BR	0.005	0.006	BR	< 0.005		BR	< 0.005		BR	< 0.005	
PPM	RB	< 0.005		RB	< 0.000		RB	< 0.000		RB	< 0.000	
AG			+/-			+/-			+/-			+/-
PPM	U	< 0.015		U	< 0.041		U	< 0.042		U	< 0.042	
PPM	SR	< 0.007		SR	< 0.015		SR	0.019	0.007	SR	< 0.015	
PPM	Y	0.007	0.003	Y	< 0.016		Y	< 0.015		Y	< 0.016	
PPM	ZR	< 0.007		ZR	< 0.015		ZR	< 0.015		ZR	< 0.016	
PPM	NB	< 0.007		NB	< 0.015		NB	< 0.015		NB	< 0.016	
PPM	MO	< 0.007		MO	< 0.016		MO	< 0.015		MO	< 0.016	
AM			+/-			+/-			+/-			+/-
PPM	RU	< 0.15		RU	< 0.22		RU	< 0.23		RU	< 0.24	
PPM	RH	< 0.14		RH	< 0.23		RH	< 0.24		RH	0.20	0.12
PPM	PD	< 0.15		PD	< 0.24		PD	< 0.23		PD	< 0.23	
PPM	AG	< 0.16		AG	< 0.25		AG	< 0.25		AG	< 0.26	
PPM	CD	< 0.16		CD	< 0.27		CD	< 0.26		CD	< 0.27	
PPM	IN	< 0.16		IN	< 0.26		IN	< 0.25		IN	< 0.28	
PPM	SN	< 0.17		SN	< 0.29		SN	< 0.28		SN	< 0.29	
PPM	SB	< 0.18		SB	< 0.31		SB	< 0.29		SB	< 0.32	
PPM	TE	< 0.19		TE	< 0.33		TE	< 0.32		TE	< 0.33	
PPM	I	< 0.22		I	< 0.33		I	< 0.34		I	< 0.38	
PPM	CS	< 0.25		CS	< 0.38		CS	< 0.37		CS	< 0.40	
PPM	BA	< 0.27		BA	< 0.44		BA	< 0.44		BA	< 0.44	
PPM	LA	< 0.31		LA	< 0.47		LA	< 0.46		LA	< 0.48	
PPM	CE	< 0.34		CE	< 0.51		CE	< 0.56		CE	< 0.59	

mg/cm² 2/11/90

SS	UNITS	EL	C2F	+/-		C2F MIDDLE	+/-		C2F TOP	+/-
TI										
	PPM	AL	0.340	0.096	AL	0.365	0.092	AL	0.387	0.089
	PPM	SI	0.480	0.053	SI	0.483	0.051	SI	0.306	0.049
	PPM	P	< 0.055		P	< 0.085		P	< 0.054	
	PPM	S	0.006	0.031	S	0.139	0.031	S	0.120	0.030
	PPM	CL	< 0.042		CL	< 0.044		CL	< 0.041	
	PPM	K	0.062	0.007	K	0.050	0.007	K	0.043	0.007
	PPM	CA	0.136	0.010	CA	0.116	0.009	CA	0.131	0.009
	PPM	FE	0.313	0.021	FE	0.212	0.016	FE	0.227	0.017
ZR				+/-			+/-			+/-
	PPM	SI	< 1.3		SI	< 1.2		SI	< 1.2	
	PPM	P	< 0.90		P	< 0.00		P	< 0.96	
	PPM	S	< 0.76		S	< 0.73		S	< 0.73	
	PPM	CL	< 0.34		CL	< 0.33		CL	< 0.33	
	PPM	K	0.127	0.043	K	< 0.079		K	< 0.079	
	PPM	CA	0.197	0.039	CA	0.172	0.035	CA	0.163	0.037
	PPM	TI	0.601	0.040	TI	1.332	0.000	TI	0.194	0.025
	PPM	V	< 0.033		V	< 0.040		V	< 0.030	
	PPM	CR	< 0.023		CR	< 0.020		CR	< 0.021	
	PPM	MN	< 0.017		MN	< 0.016		MN	< 0.016	
	PPM	FE	0.313	0.021	FE	0.212	0.016	FE	0.227	0.017
	PPM	CO	< 0.013		CO	< 0.012		CO	< 0.012	
	PPM	NI	< 0.007		NI	< 0.007		NI	< 0.007	
	PPM	CU	0.035	0.005	CU	0.026	0.005	CU	0.029	0.005
	PPM	ZN	0.050	0.005	ZN	0.050	0.006	ZN	0.017	0.004
	PPM	GA	< 0.006		GA	< 0.006		GA	< 0.006	
	PPM	HG	< 0.021		HG	< 0.020		HG	< 0.021	
	PPM	SE	< 0.006		SE	< 0.006		SE	< 0.006	
	PPM	PB	0.035	0.012	PB	< 0.022		PB	< 0.022	
	PPM	AS	< 0.008		AS	< 0.008		AS	< 0.008	
	PPM	BR	< 0.006		BR	< 0.006		BR	< 0.006	
	PPM	RB	< 0.009		RB	< 0.008		RB	< 0.009	
AG				+/-			+/-			+/-
	PPM	U	< 0.044		U	< 0.042		U	< 0.047	
	PPM	SR	< 0.016		SR	< 0.016		SR	< 0.017	
	PPM	Y	< 0.017		Y	< 0.017		Y	< 0.018	
	PPM	ZR	< 0.017		ZR	< 0.016		ZR	< 0.018	
	PPM	NB	< 0.016		NB	< 0.016		NB	< 0.017	
	PPM	MO	< 0.017		MO	< 0.016		MO	< 0.018	
RH				+/-			+/-			+/-
	PPM	RU	< 0.25		RU	0.25	0.11	RU	< 0.23	
	PPM	RH	< 0.25		RH	< 0.25		RH	< 0.24	
	PPM	PD	< 0.25		PD	< 0.24		PD	< 0.25	
	PPM	AG	< 0.26		AG	< 0.27		AG	< 0.27	
	PPM	CD	< 0.29		CD	< 0.27		CD	< 0.28	
	PPM	IN	< 0.28		IN	< 0.28		IN	< 0.28	
	PPM	SN	< 0.31		SN	< 0.31		SN	< 0.31	
	PPM	SB	< 0.33		SB	< 0.32		SB	< 0.33	
	PPM	TE	< 0.33		TE	< 0.33		TE	< 0.34	
	PPM	I	< 0.38		I	< 0.38		I	< 0.38	
	PPM	CS	< 0.43		CS	< 0.40		CS	< 0.41	
	PPM	BA	< 0.44		BA	< 0.46		BA	< 0.47	
	PPM	LA	< 0.49		LA	< 0.43		LA	< 0.50	
	PPM	CE	< 0.58		CE	< 0.55		CE	< 0.61	

µg/cm² LEW BKL 4/17/90

SS UNITS	EL	CSF MIDDLE	+/-	CSF TOP	+/-	CSF BOTTOM	+/-	CSF (BLANK)	+/-
TI									
PPM	AL	0.276	0.004	AL 0.307	0.005	AL 0.350	0.007	AL < 0.15	
PPM	SI	0.265	0.043	SI 0.300	0.045	SI 0.484	0.052	SI 0.005	0.034
PPM	P	< 0.052		P < 0.050		P < 0.051		P < 0.051	
PPM	S	0.076	0.029	S 0.004	0.020	S 0.009	0.029	S < 0.057	
PPM	CL	< 0.040		CL < 0.038		CL < 0.040		CL < 0.040	
PPM	K	0.020	0.006	K 0.026	0.006	K 0.041	0.006	K < 0.010	
PPM	CA	0.005	0.007	CA 0.091	0.000	CA 0.122	0.009	CA 0.040	0.006
PPM	FE	0.200	0.019	FE 0.164	0.013	FE 0.692	0.040	FE 0.915	0.051
ZR									
PPM	SI	< 1.2		SI < 1.2		SI 1.40	0.59	SI < 1.1	
PPM	P	< 0.05		P < 0.03		P < 0.03		P < 0.61	
PPM	S	< 0.70		S < 0.60		S < 0.70		S < 0.32	
PPM	CL	< 0.32		CL < 0.31		CL < 0.32		CL < 0.20	
PPM	K	< 0.000		K < 0.075		K < 0.070		K < 0.073	
PPM	CA	0.162	0.036	CA 0.093	0.033	CA 0.303	0.042	CA < 0.059	
PPM	TI	0.041	0.010	TI 0.030	0.010	TI 0.121	0.021	TI < 0.035	
PPM	V	< 0.027		V < 0.026		V < 0.027		V < 0.027	
PPM	CR	< 0.020		CR 0.021	0.010	CR < 0.021		CR < 0.021	
PPM	MN	< 0.017		MN < 0.016		MN < 0.016		MN < 0.016	
PPM	FE	0.200	0.019	FE 0.164	0.013	FE 0.692	0.040	FE 0.035	0.000
PPM	CO	< 0.012		CO < 0.012		CO < 0.015		CO < 0.011	
PPM	NI	< 0.007		NI < 0.007		NI 0.009	0.003	NI < 0.006	
PPM	CU	0.040	0.006	CU 0.029	0.005	CU 0.036	0.005	CU 0.024	0.005
PPM	ZN	0.031	0.004	ZN 0.010	0.003	ZN 0.019	0.004	ZN 0.014	0.003
PPM	GA	< 0.006		GA < 0.006		GA < 0.006		GA < 0.006	
PPM	HG	< 0.019		HG < 0.020		HG < 0.019		HG < 0.020	
PPM	SE	< 0.006		SE < 0.006		SE < 0.005		SE < 0.006	
PPM	PB	< 0.021		PB < 0.020		PB 0.030	0.011	PB < 0.021	
PPM	AS	< 0.000		AS < 0.007		AS < 0.000		AS < 0.005	
PPM	BR	< 0.005		BR < 0.005		BR < 0.005		BR < 0.006	
PPM	RB	< 0.000		RB < 0.000		RB < 0.000		RB < 0.000	
AG									
PPM	U	< 0.043		U < 0.020		U < 0.031		U < 0.044	
PPM	SR	< 0.016		SR < 0.015		SR < 0.016		SR < 0.016	
PPM	Y	< 0.017		Y < 0.015		Y < 0.016		Y < 0.017	
PPM	ZR	< 0.017		ZR < 0.015		ZR 0.040	0.009	ZR < 0.017	
PPM	NB	< 0.016		NB 0.017	0.000	NB < 0.016		NB < 0.017	
PPM	MO	< 0.016		MO < 0.015		MO < 0.017		MO < 0.017	
RH									
PPM	RU	< 0.24		RU		RU < 0.22		RU	
PPM	RH	< 0.24		RH		RH < 0.23		RH	
PPM	PD	< 0.24		PD		PD < 0.22		PD	
PPM	AG	< 0.27		AG		AG < 0.24		AG	
PPM	CD	< 0.27		CD		CD < 0.25		CD	
PPM	IN	< 0.27		IN		IN < 0.25		IN	
PPM	SN	< 0.29		SN		SN < 0.28		SN	
PPM	SB	< 0.30		SB		SB < 0.29		SB	
PPM	TE	< 0.32		TE		TE < 0.33		TE	
PPM	I	< 0.35		I		I < 0.33		I	
PPM	CS	< 0.42		CS		CS < 0.38		CS	
PPM	BA	< 0.43		BA		BA < 0.42		BA	
PPM	LA	< 0.48		LA		LA < 0.45		LA	
PPM	CE	< 0.59		CE		CE < 0.55		CE	

SS UNITS	EL	S2UG/CM2 FE		BIF(4389)D WIND(BOT)		BIF MID		BIF TOP	
TI									
			+/-		+/-		+/-		+/-
UG/CM2	AL	0.49	0.12	AL 0.46	0.12	AL 0.71	0.13	AL 0.69	0.13
UG/CM2	SI	0.357	0.068	SI 0.084	0.083	SI 1.115	0.089	SI 1.296	0.097
UG/CM2	P	0.101	0.030	P < 0.057		P < 0.072		P 0.072	0.035
UG/CM2	S	0.563	0.053	S 0.314	0.031	S 0.292	0.045	S 0.379	0.045
UG/CM2	CL	< 0.063		CL 0.065	0.020	CL 0.090	0.033	CL 0.123	0.033
UG/CM2	K	0.156	0.013	K 0.133	0.012	K 0.113	0.011	K 0.161	0.013
UG/CM2	CA	0.145	0.011	CA 0.197	0.013	CA 0.205	0.014	CA 0.263	0.016
UG/CM2	FE	52.0	2.6	FE 0.316	0.023	FE 0.300	0.022	FE 0.365	0.025
ZR									
			+/-		+/-		+/-		+/-
UG/CM2	SI	< 1.6		SI < 1.5		SI < 1.6		SI < 1.5	
UG/CM2	P	< 1.1		P < 0.86		P < 1.1		P < 1.1	
UG/CM2	S	< 0.99		S < 0.46		S < 0.95		S < 0.91	
UG/CM2	CL	< 0.44		CL < 0.27		CL < 0.44		CL < 0.41	
UG/CM2	K	< 0.11		K < 0.11		K 0.137	0.051	K < 0.10	
UG/CM2	CA	0.160	0.047	CA 0.209	0.045	CA 0.254	0.047	CA 0.207	0.047
UG/CM2	TI	< 0.004		TI 0.057	0.024	TI < 0.047		TI < 0.045	
UG/CM2	V	0.053	0.021	V < 0.035		V < 0.034		V < 0.033	
UG/CM2	CR	< 0.041		CR < 0.026		CR < 0.027		CR < 0.020	
UG/CM2	MN	< 0.036		MN < 0.021		MN < 0.022		MN < 0.022	
UG/CM2	FE	52.9	2.6	FE 0.319	0.023	FE 0.311	0.022	FE 0.360	0.025
UG/CM2	CO	0.211	0.059	CO < 0.016		CO < 0.016		CO < 0.016	
UG/CM2	NI	0.060	0.011	NI < 0.009		NI < 0.009		NI < 0.009	
UG/CM2	CU	0.021	0.007	CU 0.150	0.012	CU 0.096	0.009	CU 0.052	0.007
UG/CM2	ZN	0.016	0.004	ZN 0.000	0.000	ZN 0.050	0.006	ZN 0.027	0.005
UG/CM2	GA	< 0.007		GA < 0.008		GA < 0.007		GA < 0.007	
UG/CM2	HG	< 0.028		HG < 0.027		HG < 0.026		HG < 0.026	
UG/CM2	SE	< 0.008		SE < 0.007		SE < 0.007		SE < 0.007	
UG/CM2	PB	< 0.029		PB < 0.028		PB 0.035	0.014	PB < 0.027	
UG/CM2	AS	0.012	0.005	AS < 0.007		AS < 0.010		AS < 0.010	
UG/CM2	BR	0.076	0.006	BR < 0.007		BR < 0.007		BR < 0.007	
UG/CM2	RB	< 0.011		RB < 0.010		RB < 0.010		RB < 0.010	
RG									
			+/-		+/-		+/-		+/-
UG/CM2	U	< 0.035		U < 0.046		U < 0.045		U < 0.040	
UG/CM2	SR	< 0.017		SR < 0.017		SR < 0.017		SR < 0.017	
UG/CM2	Y	< 0.010		Y < 0.010		Y < 0.010		Y < 0.010	
UG/CM2	ZR	< 0.021		ZR < 0.020		ZR < 0.019		ZR < 0.019	
UG/CM2	NB	< 0.019		NB < 0.010		NB < 0.010		NB < 0.017	
UG/CM2	MO	< 0.020		MO < 0.019		MO < 0.019		MO < 0.018	
RH									
			+/-		+/-		+/-		+/-
UG/CM2	RU	< 0.22		RU < 0.20		RU < 0.21		RU < 0.20	
UG/CM2	RH	< 0.20		RH < 0.20		RH < 0.18		RH < 0.19	
UG/CM2	PD	< 0.22		PD < 0.22		PD < 0.22		PD < 0.21	
UG/CM2	AG	< 0.24		AG < 0.23		AG < 0.23		AG < 0.23	
UG/CM2	CD	< 0.24		CD < 0.24		CD < 0.23		CD < 0.23	
UG/CM2	IN	< 0.27		IN < 0.25		IN < 0.25		IN < 0.25	
UG/CM2	SN	< 0.20		SN < 0.26		SN < 0.26		SN < 0.25	
UG/CM2	SB	< 0.31		SB < 0.38		SB < 0.38		SB < 0.30	
UG/CM2	TE	< 0.31		TE < 0.30		TE < 0.32		TE < 0.28	
UG/CM2	I	< 0.30		I < 0.32		I < 0.34		I < 0.31	
UG/CM2	CS	< 0.40		CS < 0.36		CS < 0.37		CS < 0.36	
UG/CM2	BA	< 0.41		BA < 0.30		BA < 0.41		BA < 0.41	
UG/CM2	LA	< 0.41		LA 0.62	0.20	LA < 0.41		LA < 0.40	
UG/CM2	CE	< 0.51		CE < 0.49		CE < 0.50		CE < 0.52	

SS	UNITS	EL	B2F(4309)A'B (BOT)		B2F MID		B2F TOP	
TI								
				+/-		+/-		+/-
	UG/CM2	AL	0.50	0.13	AL 0.64	0.12	AL 0.50	0.11
	UG/CM2	SI	1.079	0.009	SI 0.960	0.002	SI 0.014	0.074
	UG/CM2	P	0.059	0.020	P < 0.060		P 0.057	0.026
	UG/CM2	S	0.313	0.031	S 0.294	0.043	S 0.292	0.029
	UG/CM2	CL	0.067	0.020	CL < 0.061		CL 0.060	0.026
	UG/CM2	K	0.134	0.012	K 0.107	0.011	K 0.091	0.010
	UG/CM2	CA	0.209	0.014	CA 0.101	0.013	CA 0.102	0.013
	UG/CM2	FE	0.351	0.025	FE 0.370	0.025	FE 0.512	0.032
ZR								
				+/-		+/-		+/-
	UG/CM2	SI	< 1.5		SI < 1.5		SI < 1.5	
	UG/CM2	P	< 0.83		P < 1.1		P < 0.81	
	UG/CM2	S	< 0.45		S < 0.91		S < 0.46	
	UG/CM2	CL	< 0.26		CL < 0.41		CL < 0.26	
	UG/CM2	K	< 0.11		K < 0.10		K < 0.10	
	UG/CM2	CA	0.204	0.045	CA 0.220	0.046	CA 0.222	0.045
	UG/CM2	TI	0.077	0.023	TI 0.095	0.024	TI 0.057	0.023
	UG/CM2	V	< 0.032		V < 0.031		V < 0.033	
	UG/CM2	CR	0.029	0.014	CR < 0.027		CR < 0.027	
	UG/CM2	MN	< 0.021		MN 0.021	0.010	MN 0.026	0.011
	UG/CM2	FE	0.354	0.025	FE 0.374	0.026	FE 0.518	0.032
	UG/CM2	CO	< 0.016		CO < 0.017		CO < 0.017	
	UG/CM2	NI	< 0.009		NI < 0.008		NI < 0.009	
	UG/CM2	CU	0.256	0.017	CU 0.100	0.009	CU 0.125	0.010
	UG/CM2	ZN	0.131	0.018	ZN 0.086	0.006	ZN 0.063	0.007
	UG/CM2	GA	< 0.007		GA < 0.008		GA < 0.007	
	UG/CM2	HG	0.020	0.013	HG < 0.025		HG < 0.025	
	UG/CM2	SE	< 0.007		SE < 0.007		SE < 0.007	
	UG/CM2	PB	< 0.020		PB < 0.027		PB < 0.027	
	UG/CM2	AS	< 0.007		AS < 0.010		AS < 0.007	
	UG/CM2	BR	< 0.007		BR < 0.007		BR < 0.007	
	UG/CM2	RB	< 0.010		RB < 0.010		RB < 0.010	
AG								
				+/-		+/-		+/-
	UG/CM2	U	< 0.033		U < 0.040		U < 0.046	
	UG/CM2	SR	< 0.017		SR < 0.017		SR < 0.017	
	UG/CM2	Y	< 0.017		Y < 0.017		Y < 0.018	
	UG/CM2	ZR	< 0.020		ZR < 0.019		ZR < 0.018	
	UG/CM2	NB	< 0.018		NB < 0.018		NB < 0.018	
	UG/CM2	MO	< 0.018		MO < 0.019		MO < 0.018	
AM								
				+/-		+/-		+/-
	UG/CM2	RU	< 0.21		RU < 0.21		RU < 0.20	
	UG/CM2	RH	< 0.19		RH < 0.19		RH < 0.19	
	UG/CM2	PD	< 0.22		PD < 0.21		PD 0.25	0.10
	UG/CM2	AG	< 0.23		AG < 0.23		AG < 0.23	
	UG/CM2	CD	< 0.24		CD < 0.24		CD < 0.23	
	UG/CM2	IN	< 0.25		IN < 0.25		IN < 0.25	
	UG/CM2	SN	< 0.27		SN < 0.27		SN < 0.26	
	UG/CM2	SB	< 0.31		SB < 0.29		SB < 0.29	
	UG/CM2	TE	< 0.29		TE < 0.20		TE < 0.28	
	UG/CM2	I	< 0.32		I < 0.32		I < 0.34	
	UG/CM2	CS	< 0.37		CS < 0.37		CS < 0.37	
	UG/CM2	BA	< 0.37		BA < 0.38		BA 0.50	0.18
	UG/CM2	LA	< 0.41		LA < 0.40		LA < 0.39	
	UG/CM2	CE	< 0.55		CE < 0.52		CE < 0.49	

SS	UNITS	EL	BF3 MID	+/-	EL	BF3 TOP	+/-	EL	BOF(4389) B WIND(BOT)	+/-
TI										
	UG/CM2	AL	0.43	0.12	AL	0.39	0.12	AL	0.62	0.12
	UG/CM2	SI	0.045	0.079	SI	0.014	0.078	SI	0.939	0.084
	UG/CM2	P	< 0.060		P	< 0.071		P	< 0.060	
	UG/CM2	S	0.221	0.042	S	0.190	0.043	S	0.300	0.043
	UG/CM2	CL	0.062	0.031	CL	< 0.062		CL	0.080	0.031
	UG/CM2	K	0.081	0.010	K	0.097	0.010	K	0.120	0.011
	UG/CM2	CA	0.181	0.013	CA	0.174	0.013	CA	0.210	0.014
	UG/CM2	FE	0.446	0.029	FE	0.401	0.027	FE	0.407	0.031
ZR										
	UG/CM2	SI	< 1.6		SI	< 1.6		SI	< 1.5	
	UG/CM2	P	< 1.1		P	< 1.2		P	< 1.1	
	UG/CM2	S	< 0.92		S	< 0.97		S	< 0.91	
	UG/CM2	CL	< 0.43		CL	< 0.44		CL	< 0.41	
	UG/CM2	K	0.107	0.052	K	< 0.11		K	< 0.10	
	UG/CM2	CA	0.256	0.040	CA	0.251	0.040	CA	0.321	0.049
	UG/CM2	TI	< 0.046		TI	0.007	0.025	TI	0.003	0.024
	UG/CM2	V	< 0.031		V	< 0.035		V	< 0.034	
	UG/CM2	CR	< 0.026		CR	< 0.027		CR	< 0.027	
	UG/CM2	MN	< 0.021		MN	< 0.023		MN	< 0.022	
	UG/CM2	FE	0.450	0.029	FE	0.405	0.027	FE	0.492	0.032
	UG/CM2	CO	< 0.017		CO	< 0.017		CO	< 0.016	
	UG/CM2	NI	0.012	0.005	NI	< 0.009		NI	0.037	0.006
	UG/CM2	CU	0.042	0.007	CU	0.070	0.008	CU	0.074	0.008
	UG/CM2	ZN	0.016	0.005	ZN	0.037	0.006	ZN	0.031	0.005
	UG/CM2	GA	< 0.007		GA	< 0.008		GA	< 0.008	
	UG/CM2	HG	< 0.026		HG	< 0.028		HG	< 0.026	
	UG/CM2	SE	< 0.007		SE	< 0.007		SE	< 0.007	
	UG/CM2	PB	< 0.027		PB	< 0.029		PB	< 0.027	
	UG/CM2	AS	< 0.010		AS	< 0.010		AS	< 0.010	
	UG/CM2	BR	< 0.007		BR	< 0.007		BR	< 0.007	
	UG/CM2	RB	< 0.010		RB	< 0.011		RB	< 0.010	
AG										
	UG/CM2	U	< 0.044		U	< 0.033		U	< 0.045	
	UG/CM2	SR	< 0.017		SR	< 0.017		SR	< 0.017	
	UG/CM2	Y	< 0.010		Y	< 0.017		Y	< 0.010	
	UG/CM2	ZR	< 0.019		ZR	< 0.019		ZR	< 0.010	
	UG/CM2	NB	< 0.017		NB	< 0.017		NB	< 0.010	
	UG/CM2	MO	< 0.010		MO	< 0.019		MO	< 0.010	
AM										
	UG/CM2	RU	< 0.19		RU	< 0.20		RU	< 0.20	
	UG/CM2	RH	< 0.10		RH	< 0.19		RH	< 0.19	
	UG/CM2	PD	< 0.21		PD	< 0.22		PD	< 0.22	
	UG/CM2	AG	< 0.23		AG	< 0.24		AG	< 0.23	
	UG/CM2	CD	< 0.23		CD	< 0.24		CD	< 0.23	
	UG/CM2	IN	< 0.24		IN	< 0.25		IN	< 0.24	
	UG/CM2	SN	< 0.24		SN	< 0.27		SN	0.30	0.12
	UG/CM2	SB	< 0.20		SB	< 0.30		SB	< 0.29	
	UG/CM2	TE	< 0.29		TE	< 0.31		TE	< 0.31	
	UG/CM2	I	< 0.34		I	< 0.35		I	< 0.33	
	UG/CM2	CS	< 0.37		CS	< 0.30		CS	< 0.30	
	UG/CM2	BA	< 0.41		BA	< 0.42		BA	< 0.42	
	UG/CM2	LA	< 0.38		LA	< 0.41		LA	< 0.41	
	UG/CM2	CE	< 0.46		CE	< 0.53		CE	< 0.48	

	DBF (BLANK)	+/-		SS UG/CM2 MN	+/-
AL	0.26	0.10	AL	0.29	0.11
SI	0.410	0.075	SI	0.249	0.053
P	< 0.047		P	< 0.072	
S	< 0.038		S	0.232	0.044
CL	< 0.040		CL	0.060	0.061
K	< 0.014		K	< 0.014	
CA	0.057	0.007	CA	0.002	0.009
FE	0.142	0.015	FE	< 0.14	
		+/-			+/-
SI	< 1.5		SI	< 1.6	
P	< 0.05		P	< 1.2	
S	< 0.46		S	< 1.00	
CL	< 0.27		CL	1.10	0.25
K	< 0.099		K	< 0.11	
CA	0.095	0.042	CA	< 0.094	
TI	< 0.045		TI	< 0.053	
V	< 0.036		V	< 0.040	
CR	< 0.029		CR	< 0.046	
MN	< 0.022		MN	60.0	3.0
FE	0.144	0.015	FE	< 0.14	
CO	< 0.015		CO	< 0.016	
NI	< 0.010		NI	< 0.010	
CU	0.026	0.006	CU	0.079	0.008
ZN	0.015	0.004	ZN	0.064	0.007
GA	< 0.008		GA	< 0.008	
HG	< 0.027		HG	< 0.029	
SE	< 0.007		SE	< 0.008	
PB	< 0.029		PB	< 0.029	
AS	< 0.007		AS	< 0.011	
BR	< 0.007		BR	0.009	0.004
RB	< 0.010		RB	< 0.011	
		+/-			+/-
U	< 0.045		U	< 0.040	
SR	< 0.017		SR	< 0.018	
Y	< 0.018		Y	< 0.019	
ZR	< 0.020		ZR	< 0.020	
NB	< 0.018		NB	< 0.019	
MO	< 0.018		MO	< 0.019	
		+/-			+/-
RU	< 0.21		RU	< 0.21	
RH	< 0.20		RH	< 0.20	
PD	< 0.22		PD	< 0.22	
AG	< 0.24		AG	< 0.24	
CD	< 0.24		CD	< 0.24	
IN	< 0.25		IN	< 0.26	
SN	0.30	0.13	SN	< 0.20	
SB	< 0.30		SB	< 0.30	
TE	< 0.31		TE	< 0.32	
I	< 0.34		I	< 0.33	
CS	< 0.36		CS	< 0.38	
BA	< 0.39		BA	< 0.43	
LA	< 0.41		LA	< 0.42	
CE	< 0.51		CE	< 0.50	

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SUBAPPENDIX E-6
LABORATORY ANALYSES OF FILTER SAMPLES FOR ASBESTOS

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HANFORD ENVIRONMENTAL
HEALTH FOUNDATION

May 31, 1989 CO 14035

Pacific Northwest Laboratory
MSIN K6-08

Attn: Gail L. Laws

ANALYSIS OF FIBER CONTENT AS AN INDICATION OF ASBESTOS EXPOSURE - WP# M69058

The three samples received May 25, 1989, reportedly from the Horn Rapids Landfill, have been analyzed for fiber content using the approved NIOSH Analytical Method 7400. It should be noted that the method does not distinguish between asbestos and nonasbestos fibers but rather uses 400 power phase contrast microscopy to count all particles with an overall length exceeding 5 microns (μ) and a length-to-width ratio of 3:1 or greater. Results are as follows:

Sample #	Sampling Data	Date 1989	Air Vol. (L)	Fibers /Field	Fibers >5 μ/cc
D1A	Cassette #A263-A	2-23	89.1	<0.03	<0.02
D2A	Cassette #A550-A	2-23	96.6	<0.03	<0.02
DA	Cassette #N680-A (Blank)	2-23	--	<0.03	--

If there are questions concerning this report, please contact us.

K. A. Lavaty
Environmental Health Sciences

jt

P. O. BOX 100, RICHLAND, WASHINGTON 99352

LABORATORY ANALYSES OF FILTER SAMPLES FOR ASBESTOS

Laboratory analyses for asbestos fibers are presented in this appendix. Sampling for asbestos fibers was conducted during monitoring event "D". The results of the laboratory analysis of the three filter cartridges used during this monitoring event are reported in a letter from the analysis laboratory. Each filter sample is identified by a sample number and sampling data description.

APPENDIX F
BOREHOLE LOGS

A total of 22 vadose zone borings and 16 ground-water monitoring wells were installed during the 1100-EM-1 Phase I RI. The summary logs presented in this appendix were prepared from field logs, which are available in the DOE-RL 1100-EM-1 Administrative Record. The DOE-RL 1100-EM-1 Administrative Record is managed by Westinghouse Hanford's Department of Engineering Environmental Information Management Center, located at the following address:

U.S. Department of Energy - Richland Operations Office
Administrative Record Center
395 Hills Street
Richland, Washington 99352

This appendix is organized by background borings (Figures F-1 through F-3), vadose zone borings by suboperable unit (Figures F-4 through F-22), and operable unit monitoring wells (Figures F-23 through F-38).

Preceding these logs are tables that summarize stratigraphic data as interpreted from the vadose zone and monitoring well borings. The tables are organized by operable subunit as follows: 1100-1 and 1100-4 (Table F-1), 1100-2 (Table F-2), 1100-3 (Table F-3), Horn Rapids Landfill vadose zone borings (Table F-4), and Horn Rapids Landfill ground-water monitoring wells (Table F-5).

The last portion of this appendix contains copies of published well logs for existing wells in the vicinity of the operable unit that were used to construct the geologic cross sections in Section 3.4.3, Local Geology. The wells include: 699-S40-E14 (Figure F-39), 699-S43-E12 (Figure F-40), 699-S37-E14 (Figure F-41), 699-S30-E15C (Figure F-42), 10/28-10G1 (Figure F-43), 3000-B (Figure F-44), and 699-S32-E13A (Figure F-45). The sources of these logs are noted on the logs.

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TABLE F-1. STRATIGRAPHIC DATA FROM BOREHOLE LOGS BATTERY ACID PIT (1100-1) AND ANTIFREEZE TANK (1100-4)

BORING	TOTAL DEPTH m (ft)	BORING ELEV. m (ft)	FILL THICK. m (ft)	EOLIAN SAND THICK. m (ft)	PASCO GRAVEL THICK. m (ft)	DEPTH TO TOP OF RINGOLD m (ft)	TOP OF RINGOLD ELEV. m (ft)	DEPTH TO TOP OF SILT m (ft)	TOP OF SILT ELEV. m (ft)
Vadose Backgro BAP-2	13.88 (45.55)	121.21 (397.66)	NA	0.30 (1.0)	Base of eolian sand to EOH	ND	ND	ND	ND
Vadose Zone Boring									
BAP-1	6.10 (20.0)	122.66 (402.42)	1.83 (6.0)	none	Base of Fill to EOH	ND	ND	ND	ND
ATS-1C	6.71 (22.0)	Not Available	3.75 (12.3)	none	Base of Fill to EOH	ND	ND	ND	ND
Monitoring Wells									
MW-1	28.65 (94.0)	121.44 (398.43)	NA	0.58 (1.9)	16.03 (52.6)	16.61 (54.5)	104.83 (343.9)	26.97 (88.5)	94.47 (309.9)
MW-2	15.54 (51.0)	115.63 (379.36)	NA	0.40 (1.3)	9.05 (29.7)	9.45 (31.0)	106.18 (348.4)	14.17 (46.5)	101.46 (332.9)
MW-3	25.52 (83.74)	122.53 (402)	NA	none	18.33 (6	18.44 (60.5)	104.09 (341.5)	23.96 (78.6)	98.57 (323.4)
MW-17	38.10 (125.0)	124.24 (407.62)	NA	none	17.07 (56.0)	17.07 (56.0)	107.17 (351.6)	27.58 (90.5)	96.66 (317.1)

EOH = End of Hole
NA = Not Applicable
ND = No Data Because of Shallow Depth of Boring
* = 0.11m (0.35 ft) of Blacktop Asphalt At Surface

TABLE F-2. STRATIGRAPHIC DATA FROM BOREHOLE LOGS DISPOSAL PIT 1100-2

BORING	TOTAL DEPTH m (ft)	BORING ELEV. m (ft)	FILL THICK. m (ft)	EOLIAN SAND THICK. m (ft)	PASCO GRAVEL THICK. m (ft)	DEPTH TO TOP OF RINGOLD m (ft)	TOP OF RINGOLD ELEV. m (ft)	DEPTH TO TOP OF SILT m (ft)	TOP OF SILT ELEV. m (ft)
Vadose Background DP-7	12.50 (41.0)	119.65 (392.54)	NA	0.46 (1.5)	Base of eolian sand to EOH	ND	ND	ND	ND
Vadose Zone Borings									
DP-4	6.10 (20.0)	120.15 (394.19)	2.16 (7.1)	none	Base of Fill to EOH	ND	ND	ND	ND
DP-5	6.10 (20.0)	120.22 (394.43)	4.88 (16.0)	none	Base of Fill to EOH	ND	ND	ND	ND
DP-6	6.10 (20.0)	120.31 (394.71)	not identified	none	To EOH	ND	ND	ND	ND
DP-9	12.13 (39.8)	119.68 (392.65)	1.22 (4.0)	none	10.82 35.5	12.04 (39.5)	107.64 (353.15)	ND	ND
Monitoring Wells									
MW-4	20.51 (67.29)	122.35 (401.40)	NA	1.07 (3.5)	15.09 (49.5)	16.15 (53.0)	106.19 (348.4)	ND	ND
MW-5	27.02 (88.65)	122.40 (401.57)	NA	0.91 (3.0)	14.94 (49.0)	15.85 (52.0)	106.55 (349.6)	26.49 (86.9)	95.91 (314.7)
MW-6	27.74 (91.0)	120.70 (396.00)	NA	0.55 (1.8)	16.98 (55.7)	17.53 (57.5)	103.17 (338.5)	25.9 (85.0)	94.79 (311.0)

EOH = End of Hole
NA = Not Applicable
ND = No Data Because of Shallow Depth of Boring

TABLE F-3. STRATIGRAPHIC DATA FROM BOREHOLE LOGS DISPOSAL PIT 1100-3

BORING	TOTAL DEPTH m (ft)	BORING ELEV. m (ft)	FILL THICK. m (ft)	EOLIAN SAND THICK. m (ft)	PASCO GRAVEL THICK. m (ft)	DEPTH TO TOP OF RINGOLD m (ft)	TOP OF RINGOLD ELEV. m (ft)	DEPTH TO TOP OF SILT m (ft)	TOP OF SILT ELEV. m (ft)
Vadose Background DP-7	12.50 (41.0)	119.65 (392.54)	NA	0.46 (1.5)	Base of eolian sand to EOH	ND	ND	ND	ND
Vadose Zone Borings									
DP-1	6.10 (20.0)	117.57 (385.74)	not identified	none	To EOH	ND	ND	ND	ND
DP-2	6.10 (20.0)	116.99 (383.84)	1.6 (5.3)	none	Base of fill to EOH	ND	ND	ND	ND
DP-3	6.10 (20.0)	118.13 (387.58)	not identified	none	To EOH	ND	ND	ND	ND
DP-8	10.36 (34.0)	117.81 (386.51)	not identified	none	To EOH	ND	ND	ND	ND
Monitoring Well MW-7	27.22 (89.3)	120.46 (395.20)	NA	1.14 (3.75)	13.91 (45.7)	15.06 (49.4)	105.40 (345.8)	26.06 (85.5)	94.40 (309.7)

EOH = End of Hole
NA = Not Applicable
ND = No Data Because of Shallow Depth of Boring

TABLE F-4. STRATIGRAPHIC DATA FROM VADOSE ZONE BOREHOLE LOGS HORN RAPIDS LANDFILL

BORING	TOTAL DEPTH m (ft)	BORING ELEV. m (ft)	FILL THICK. m (ft)	EOLIAN SAND THICK. m (ft)	PASCO GRAVEL THICK. m (ft)	DEPTH TO TOP OF RINGOLD m (ft)	TOP OF RINGOLD ELEV. m (ft)	DEPTH TO TOP OF SILT m (ft)	TOP OF SILT ELEV. m (ft)
Vadose Background									
HRL-1	5.67 (18.6)	112.71 (369.78)	NA	0.30 (1.0)	Base of eolian sand to EOH	ND	ND	ND	ND
Vadose Zone Borings									
HRL-2	7.71 (25.3)	114.34 (375.13)	none	0.91 (3.0)	6.10 (20.0)	7.01 (23.0)	107.33 (352.1)	ND	ND
HRL-3	7.80 (25.6)	114.63 (376.07)	none	0.61 (2.0)	Base of eolian sand to EOH	ND	ND	ND	ND
HRL-4	7.77 (25.5)	114.48 (375.58)	not identified	none	To EOH	ND	ND	ND	ND
HRL-5	7.80 (25.6)	114.40 (375.33)	not identified	none	To EOH	ND	ND	ND	ND
HRL-6	8.47 (27.8)	114.95 (377.12)	not identified	none	To EOH	ND	ND	ND	ND
HRL-7	7.92 (26.0)	114.31 (375.04)	not identified	none	6.92 (22.7)	6.92 (22.7)	107.39 (352.3)	ND	ND
HRL-8	8.63 (28.3)	114.73 (376.40)	trace red brick frags. 6.31 to 6.95 (20.7 to 22.8)	none	Base of fill to EOH	ND	ND	ND	ND
HRL-9	8.23 (27.0)	114.16 (374.54)	not identified	none	3.32 (10.9)	3.32 (10.9)	110.84 (363.6)	ND	ND
HRL-10	10.5 (34.5)	116.24 (381.37)	discoloration @ 5.82 (19.1)	none	Base of fill to EOH 32.4	ND	ND	ND	ND

EOH = End of Hole
NA = Not Applicable
ND = No Data Because of Shallow Depth of Boring

TABLE F-5. STRATIGRAPHIC DATA FROM GROUND-WATER MONITORING WELL LOGS HORN RAPIDS LANDFILL

BORING	TOTAL DEPTH m (ft)	BORING ELEV. m (ft)	FILL THICK. m (ft)	EOLIAN SAND THICK. m (ft)	PASCO GRAVEL THICK. m (ft)	DEPTH TO TOP OF RINGOLD m (ft)	TOP OF RINGOLD ELEV. m (ft)	DEPTH TO TOP OF SILT m (ft)	TOP OF SILT ELEV. m (ft)
Monitoring Well									
MW-8	10.39 (34.08)	113.27 (371.62)	NA	1.07 (3.5)	6.86 (22.5)	7.92 (26.0)	105.34 (345.6)	ND	ND
MW-9	24.8 (81.4)	113.34 (371.86)	NA	1.07 (3.5)	7.59 (24.9)	8.66 (28.4)	104.69 (343.5)	10.73 (35.2)	102.61 (336.7)
MW-10	20.57 (67.5)	118.59 (389.09)	NA	0.61 (2.0)	10.06 (33.0)	10.67 (35.0)	107.93 (354.1)	19.51 (64.0)	99.09 (325.1)
MW-11	17.83 (58.5)	118.47 (388.69)	NA	0.82 (2.7)	12.28 (40.3)	13.11 (43.0)	105.37 (345.7)	ND	ND
MW-12	18.04 (59.17)	116.17 (381.14)	NA	1.22 (4.0)	6.40 (21.0)	7.62 (25.0)	108.55 (356.1)	17.37 (57.0) (ash)	98.80 (324.1)
MW-13	13.41 (44.0)	115.78 (379.85)	NA	none	7.62 (25.0)	7.62 (25.0)	108.16 (354.9)	ND	ND
MW-14	18.44 (60.5)	115.83 (380.01)	NA	0.15 (0.5)	6.55 (21.5)	6.71 (22.0)	109.12 (358.0)	16.34 (53.6) (ash)	99.49 (326.4)
MW-15	16.60 (54.47)	115.04 (377.43)	NA	0.30 (1.0)	6.40 (21)	6.71 (22.0)*	108.34 (355.4)	15.82 (51.9) (ash)	99.22 (325.5)

EOH = End of Hole
NA = Not Applicable
ND = No Data Because of Shallow Depth of Boring
* Ringold contact based on visual examination of physical samples in WHC sample library.

Vadose Zone Borehole No. BAP-2

Lambert Coordinates (NAD '83(ft)) N 363,927.5, E 1,946,528.0

Date Total Depth Reached 6-23-89

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
8" Dia. Temporary Casing Set @ 4'; 6" Dia. Temporary Casing Set @ 44.3'.		10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130		0'-1.0' Slightly Silty Sand, Brown; vf-f Sand, Dry 1.0'-7.0' Sandy Gravel, Lt Brownish Gray, vf-vc Sand; Dry 7.0'-16.0' Silty Sandy Gravel, Grayish Brown, vf-vc sand, Dry 16.0'-42.0 Sandy Gravel, Grayish Brown-Gray; Increasing Gravel, Decreasing Sand Near 17', Becomes Slightly Moist Near 34' 42.0'-43.5' Slightly Gravelly Sand, Gray, f-vc Sand, Moist Static Water Level @ 43.9' 43.5'-45.6' Sandy Gravel, Very Dark Gray; Wet Total Depth @ 45.6'
Drive Shoe - 6" [illegible] 3.8" O.D., Weld-on T.D. on 6-23-89				

893-1407\ bap-2

Figure F-1. Background Boring BAP-2.

Vadose Zone Borehole No. DP-7

Lambert Coordinates (NAD '83(ft)) N 367,868.43, E 1,945,449.15

Date Total Depth Reached 6-14-89

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
8" Dia. Temporary Casing Set @ 4'; 6" Dia. Temporary Casing Set @ 39.6'. All Casing Removed and Hole Grouted (Abandoned).		10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130		1'-1.5' Slightly Silty Sand, Brown, Dry. 1.5'-11.0' Gravelly Sand, Gray; 5% Silt; Slightly damp. 11.0'-16.0' Sandy Gravel, Gray, 8% Silt; Dry - Slightly Damp. 16.0'-41.0' Gravelly Sand, Dark Olive; 2-3% Silt; Damp to Moist; Moist - Very Moist Near 38'; Becomes Wet Near 39.5'
Drive Shoe - 6" O.D. - 3.6" O.D., Wedge-on				Static Water Level Measured @ 39.35', 6-15-89. Total Depth @ 41.0'
T.D. on 6-14-89				

893-1407\ dp-7

Figure F-2. Background Boring DP-7.

Vadose Zone Borehole No. HRL-1

Lambert Coordinates (NAD '83(ft)) N 373,997.6, E 1,943,059.74

Date Total Depth Reached 6-30-89

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
Temporary 8" Diameter Casing Set @ 4'; Temporary 6" Casing Set @ 17.2'. Drive Shoe – 6" I.D., 7 3/8" O.D., Weld-on. T.D. on 6-30-89		10 20 30 40 50 60 70 80 90 100 110 120 130		0'–1.0' Slightly Silty Sand, Pale Brown; no Reaction with HCL. 1.0'–11.7' Silty Sandy Gravel, Gray, Strong Reaction with HCL, Less Carbonate Cement Below 5'. 11.7'–17.31' Slightly Gravelly Sand, Light Brownish Gray, 1% Silt, Slight Reaction with HCL. Becomes Saturated Near 17'. Static Water Level @ 16.8'. Total Depth @ 17.3'

893-1407\ hrl-1

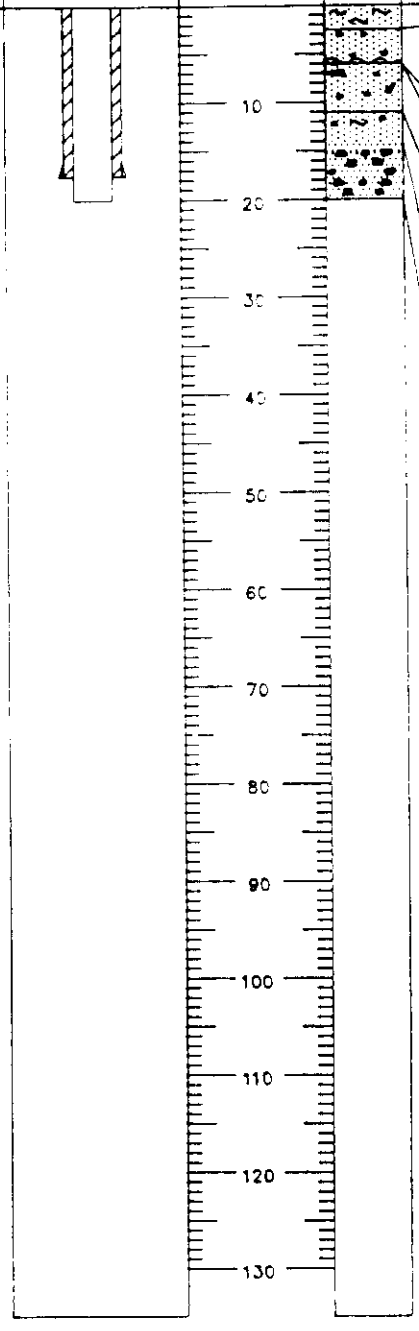
Figure F-3. Background Boring HRL-1.

Vadose Zone Borehole No. BAP-1

Lambert Coordinates (NAD '83(ft)) N 363,940, E 1,946,763.5

Date Total Depth Reached 8-9-89

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
6" Dia. Temporary Carbon Steel Casing Set @ 17.4'; Casing Removed After Reaching Total Depth (20'); Borehole Back-filled to Grade With Granular Bentonite. Weld-on Drive Shoe; 6" I.D., 7 3/8" O.D. Splitspoon Driven to 20' T.D. at 20', 8/9/89.				0'-2.6' Silty Sandy Gravel; Brown; Dry 2.6'-6.0' Slightly Gravelly Sand; Olive; Scattered Asphalt Debris; Soil Discoloration; Slightly Damp. Probable Base of Backfill. 6.0'-11.0' Sandy Gravel; Olive; Damp; Soil Discoloration(red, orange and Yellow) 11.0'-14.3' Slightly Silty Slightly Gravelly Sand; Light Brownish Gray Slightly Damp; Soil Discoloration Common above 16'. 14.8'-20.0' Sandy Gravel, Olive Brown; Trace Silt; Damp-to Slightly Moist; Slight Soil Discoloration Observed Below 18' Total Depth @ 20.0'

893-1407\ bap-1

Figure F-4. Suboperable Unit 1100-1 Boring BAP-1.

Vadose Zone Borehole No. DP-4

Lambert Coordinates (NAD '83(ft)) N 367,745.8, E 1,947,388.0

Date Total Depth Reached 7-14-89

Well Construction Summary

Construction Data		Depth in Feet	Graphic Log	Lithologic Description
Description	Diagram			
8" Dia. Temporary Casing (not Stainless) Set to 4'; 6" Dia. Casing Set to 18' All Casing Removed and Hole Backfilled wiht Dry Bentonite Grout. Drive Shoe, 6" I.D., 7 3/8" O.D., Weld-on. Removed With Casing T.D. on 7-14-89		10 20 30 40 50 60 70 80 90 100 110 120 130		0'-1.9' Sandy Silty Gravel Backfill, Dry; Yellow-Brown; 5% Silt. 1.9'-8.6' Gravelly Silty Sand Backfill, Moist, Dark Yellow-Brown, Chunks of Asphalt. Bottom of Fill at ~7' ± 1' 8.6'-12.4' Sandy Gravel, Dark Yellowish Brown. 12.4'-20.0' Gravelly Sand, Moist, Dark Yellow-Brown, Bed (Small Layer) or Chunk of Clay Encountered in interval 12.5'-14.5' Total Depth @ 20.0'

893-1407\ dp-4

Figure F-5. Suboperable Unit 1100-2 Boring DP-4.

Vadose Zone Borehole No. DP-5

Lambert Coordinates (NAD '83(ft)) N 367,643.6, E 1,947,387.5

Date Total Depth Reached 7-19-89

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
8" Dia. Temporary Carbon Steel Casing Set @ 4'; 6" Dia. Temporary Carbon Steel Casing Set @ 18'. Casing Pulled and Hole Backfilled with Dry Bentonite Grout. Drive Shoe 6" I.D., 7 3/8" O.D., Weld-on. 5" Dia. Split Spoon Driven from 18'-20'. T.D. on 7/19/89		10 20 30 40 50 60 70 80 90 100 110 120 130		0'-6.5' Slightly Silty Gravelly Sand, Grayish Brown; Moist Near 5.5'; Asphalt-Like Debris to 4' Below Grade to 16'. 6.5'-16.0' Gravelly Sand, Black (moist), Grayish Brown (dry), 1-3% Silt; Common Asphalt Tar-Like Debris From 7.5'-11', 13.2'-13.9', and 14.2'- Near 16'. Base of Landfill. 16.0'-20.0' Slightly Gravelly Sand, Black (Moist); Gray (dry); 1% Silt, Moist; Salt and Pepper Appearance; Unconsolidated with no Landfill Debris. Total Depth @ 20.0'

893-1407, dp-5

Figure F-6. Suboperable Unit 1100-2 Boring DP-5.

Vadose Zone Borehole No. DP-6

Lambert Coordinates (NAD '83(ft.)) N 367,557.7, E 1,947,283.4

Date Total Depth Reached 7-25-89

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
8" Dia. Temporary Casing Set @ 4'; 6" Dia. Temporary Casing Set Driven to 18' While Drilling. All Casing Removed Following Well Completion and Well Bore Backfilled w/ Dry Grout. Drive Shoe - 6" O.D. 7.3, 8" O.D., Weld-on, Removed With Casing After Borehole Completion. Completed 7/25/89		10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130		0'-2.5' Sandy Gravel to Gravelly Sand, Pale Brown, Dry. 2.5'-4.7' Silty Sandy Gravel, Pale Brown, Dry to Damp. 4.7'-6.9' Sand, Very Moist, Dark Grayish Brown. 6.9'-15.4' Gravelly Sand, Dark Grayish Brown, Lower Contact Gradational to Sand Below. 15.4'-20.0' Sand, Grading to Gravelly Sand, Silty on Top and Non-silty and Gravelly at Bottom Moist, Dark Grayish Brown to Dark Gray. Total Depth @ 20.0'

893-1407\ dp-6

Figure F-7. Suboperable Unit 1100-2 Boring DP-6.

Vadose Zone Borehole No. DP-9

Lambert Coordinates (NAD '83(ft)) N 367,585.95, E 1,947,258.28

Date Total Depth Reached 9-20-89

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
6" Dia. Temporary Steel Casing Set @ 38'; Casing Removed After Reaching Total Depth; Borehole Back-filled to Grade with Granular Bentonite.		10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130		0'-4.0' Gravelly Sand, Yellowish Brown, ~2% Silt; Asphalt Debris Common; Dry Base of Landfill. 4.0'-7.7' Silty Sandy Gravel, Yellowish Brown; ~5% Silt; Slightly Damp. 7.7'-9.7' Sandy Gravel, Dark Gray; Trace Silt; Slightly Moist. 9.6'-11.4' Gravelly Sand, Dark Gray; Moist. 11.4'-14.6' Sand, Yellowish Brown, Damp to Moist, 5% Gravel 14.6'-17.0' Slightly Gravelly Sand, Very Dark Grayish Brown. 17.0'-23.0' Gravelly Sand, Very Dark Gray; Moist. 23.0'-39.5' Sandy Gravel, Dark Grayish Brown. Static Water Level @ 37.9' Total Depth @ 39.5'
Welded-on Drive Shoe 6" I.D., 7 3/8" O.D. T.D. on 9-20-89				

893-1407\ dp-9

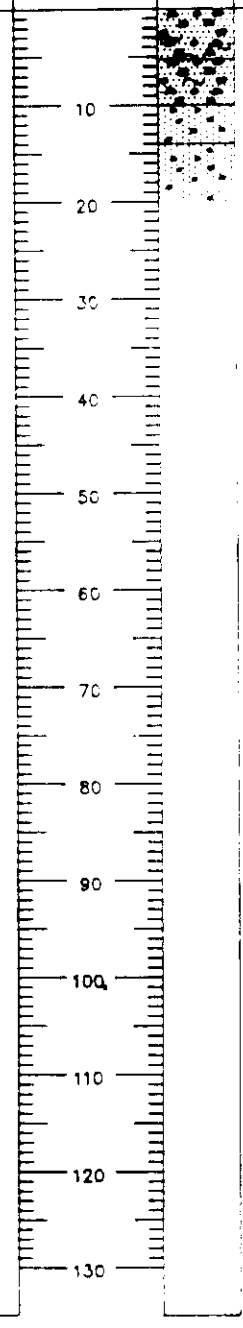
Figure F-8. Suboperable Unit 1100-2 Boring DP-9.

Vadose Zone Borehole No. DP-1

Lambert Coordinates (NAD '83(ft)) N 367,807.2, E 1,946,323.2

Date Total Depth Reached 8-3-89

Well Construction Summary

Construction Data		Depth In Feet	Graphic Log	Lithologic Description
Description	Diagram			
Borehole Drilled Using Cable Tool Rig with Either Core Barrel or Split Spoon Sampler. Drilling Started 8/1/89. Temporary 6" I.D. Schedule 40 Carbon Steel Casing Used to Hold the Borehole Open. Casing Pulled and Backfilled with Dry Bentonite Grout. Casing Driven to 18' then 5" Diameter Split Spoon Taken to 20'. T.D. on 8/3/89.				0'-2' Sandy Gravel 2' Indistinct Change to Silty Sandy Gravel 5.5' Distinct Change to Sandy Gravel 7.0' Indistinct Change to Silty Sandy Gravel 8.0' Indistinct Change to Sandy Gravel 10.0' Sharp Contact to Sand 12.0' Gradual Increase of Gravel Content to Slightly Gravelly Sand 14.0'-20.0' Sand With Only Trace Gravel Total Depth @ 20.0

893-1407\ dp-1

Figure F-9. Suboperable Unit 1100-3 Boring DP-1.

Vadose Zone Borehole No. DP-2

Lambert Coordinates (NAD '83(ft)) N 367,846.15, E 1,946,401.2

Date Total Depth Reached 8-1-89

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
6" Dia. Temporary Carbon Steel Casing Set @ 18'; Casing Removed After Drilling to Total Depth (20 ft). Borehole Backfilled to Grade with Granular Bentonite. Drive Shoe, 6" I.D., 7 3/8" O.D. Weld-on. 5" Dia. Split Spoon Driven From 18'-20' T.D. on 8/1/89.		10 20 30 40 50 60 70 80 90 100 110 120 130		0'-0.5' Gravel, Brown; Wood Fragments Common; Dry. 0.5'-5.1' Sandy Gravel, Gray; Trace Silt; Landfill Debris Common; Dry. Base Landfill @ 5.3' Below Grade. 5.1'-11.0' Slightly Gravelly Sand, Very Dark Gray; Trace Silt; Damp, Becomes Slightly Moist Near 10'. 11.0'-15.5' Sand, Very Dark Gray; ~4% Gravel; Trace Silt; Moist. 15.5'-19.4' Sandy Gravel, Very Dark Grayish-Brown; 5% Silt; Moist; Sand Lense Occurs Between 17.4'-17.8'. 19.4'-20.0' Sand, Very Dark Gray; ~2% Gravel, Trace Silt; Moist. Total Depth @ 20.0'

893-1407\ bop-1

Figure F-10. Suboperable Unit 1100-3 Boring DP-2.

Vadose Zone Borehole No. DP-3

Lambert Coordinates (NAD '63(ft)) N 367,967.4, E 1,946,481.3

Date Total Depth Reached 7-28-89

Well Construction Summary

Construction Data		Depth in Feet	Graphic Log	Lithologic Description
Description	Diagram			
6" Dia. Temporary Carbon Steel Casing Set @ 18'; All Casing was Removed After Borehole Completion to Total Depth of 20'. Borehole Backfilled with Granular Bentonite to Grade. Drive Shoe, 6" I.D., 7 3/8" O.D., Weld-on. 5" Dia. Split Spoon Driver from 18'-20'. T.D. on 7/28/89		10 20 30 40 50 60 70 80 90 100 110 120 130		0'-5.4' Silty Sandy Gravel, Pale Brown; Root Hair and Plant Debris Common, Dry. 5.4'-9.6' Sandy Gravel, Gray; Slightly Moist near 9.5'; This May be the Base of the Landfill. 9.6'-20.0' Sand, Very Dark Gray (Moist); Moist Near 16'; Sand has Salt and Pepper Appearance. Total Depth @ 20.0'

893-1407\ dp-3

Figure F-11. Suboperable Unit 1100-3 Boring DP-3.

Vadose Zone Borehole No. DP-8

Lambert Coordinates (NAD '83(ft)) N 367,865.15, E 1,946,481.3

Date Total Depth Reached 9-28-89

Well Construction Summary

Construction Data		Depth in Feet	Graphic Log	Lithologic Description
Description	Diagram			
6" Dia. Temporary Casing Set @ 32.5'; Casing Pulled and Borehole Backfilled to Grade from 34' (Total Depth) to Grade. Weld on Drive Shoe; 6" I.D., 7 3/8" O.D. TD on 9-28-89		10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130		0'-5.3' Sandy Gravel, Pale Brown; 5% Silt; Dry; Plant and Root Debris Common; Slight Reaction to HCL; Probable Landfill Material. 5.3'-11.0' Silty Sandy Gravel, Dark Gray; Damp; Strong Reaction w/HCL. 11.0'-13.5' Slightly Gravelly Sand, Very Dark Gray. 13.5'-15.0' Sand, Very Dark Gray; Damp; no Reaction with HCL. 15.0'-17.3' Sandy Gravel, Dark Gray, ~2% Silt; Damp. 17.3'-26.5' Gravelly Sand, Very Dark Gray; Damp, Becomes Moist Near 24'; Slight Reaction with HCL. 26.5'-27.6' Silty Sandy Gravel, Grayish Brown; Damp. 27.6'-29.0' Gravelly Sand, Very Dark Gray; Damp-Moist. 29.0'-31.5' Silty Sandy Gravel, Gray, With Sandy Interbeds (<3" Thick); Moist-Damp. 31.5'-32.1' Sandy Gravel, Very Dark Gray; ~2% Silt; Becomes Wet at Base 32.6'. Static Water Level @ 32.1' 32.1'-34.0' Gravelly Sand, Black; Slight Reaction with HCL, Wet. Total Depth @ 34 ft.

893-1407\ dp-8

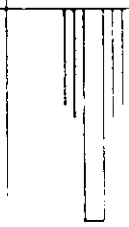
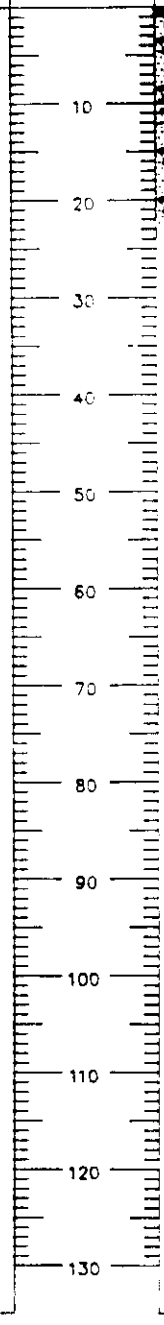
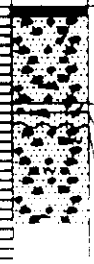
Figure F-12. Suboperable Unit 1100-3 Boring DP-8.

Vadose Zone Borehole No. ATS-1C

Lambert Coordinates (NAD '83(H))

Date Total Depth Reached 11-10-89

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
Drilled With 7" O.D. Hollow Stem Auger to 10'; Diamond Core to 11.3'; Used 76mm Drill Pipe and 2" O.D. Split Spoon Through Augers to T.D. 7" O.D. Hollow Stem Auger 76mm Drill Pipe Interval Penetrated with 2" O.D. Split Spoon. T.D. on 11-10-89				0'-10.0' Sandy Gravel, Dark Brown; Common Concrete Debris and Other Fill Material, Especially Near 8'-10' Below Grade; Damp. 10.0'-11.3' Concrete Debris; Used Diamond Core Bit to Penetrate. 11.3'-12.3' Slightly Gravelly Sand, Very Dark Grayish Brown, Bedding Sand Base of Landfill. 12.3'-22.0' Sandy Gravel, Very Dark Gray; 1% Silt; Strong Reaction with HCl; Strong HNu Response to 150 ppm from 13.9' to Near 20'. Total Depth @ 22.0'

893-1407\ats-1c

Figure F-13. Suboperable Unit 1100-4 Boring ATS-1C.

Vadose Zone Borehole No. HRL-2

Lambert Coordinates (NAD '83(ft)) N 373,962.9, E 1,943,877.9

Date Total Depth Reached 1-19-90

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
Sample A1802 Chemical-5" Split Spoon * Casing-Black Iron Entire Borehole. Sample A1803 Physical-Drive Barrel. Sample A1804 & A1805 Chemical & Replicate 5" Split Spoon. Sample A1806 Physical-Drive Barrel Sample A1807 & A1808 Chemical & Lab Split, 5" Split Spoon Sample A1809 Physical-Drive Barrel Sample A1810 Chemical-Split Spoon Sample A1811 Physical-Drive Barrel Sample A1812 Chemical- 5" Split Spoon Sample A1813 Physical-Drive Barrel Sample A1814 Chemical-5" Split Spoon Sample A1815 Water Sample (2" SS Bailer) Temporary Casing Removed and Hole Backfilled with Bentonite Granules. *SS w/SS Liners T.D. on 1-19-90	6" I.D. Casing Casing Shoe	10 20 30 40 50 60 70 80 90 100 110 120 130		0'-2.5' Sandy Silt 3.4'-4.8' Gravelly Sandy Silt 5.1'-7.9' Silty Gravel 8.0'-8.9' Gravelly Sandy Silt 9.8'-12.3' Gravelly Silty Sand 12.5'-13.5' Silty Sandy Gravel 13.9'-16.2' Silty Sandy Gravel 16.5'-17.6' Silty Sandy Gravel 17.7'-19.9' Silty Sandy Gravel 20.5'-21.7' Silty Gravel Static Water Level @ 22.0' 23.0'-24.0' Gravelly Silty Sand 24.0'-25.3' Sand Total Depth @ 25.3'

893-1407\ hr-2

Figure F-14. Horn Rapids Landfill Suboperable Unit Boring HRL-2

Vadose Zone Borehole No HRL-3

Lambert Coordinates (NAD '83(ft)) N 373,571.38, E 1,943,876.9

Date Total Depth Reached 1-24-90

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
Sample A2002 Chemical-5" Split Spoon Casing-Blank Iron Entire Hole. Sample A2003 Physical-Drive Barrel Sample A2004 & A2005 Chemical & Replicate-5" Split Spoon Sample A2006 Physical-Drive Barrel Sample A2007 Chemical-5" Split Spoon Sample A2008 Physical-Drive Barrel Sample A2009 & A2010 Chemical & Split-5" Split Spoon Sample A2011 Physical-Drive Barrel Sample A2012 Chemical-5" Split Spoon Sample A2013 Physical-Drive Barrel Sample A2014 Chemical-5" Split Spoon Sample A2015 Water Sample (2" SS Bailer) Temporary Carbon Steel Casing Pulled From Hole and Hole Backfilled With Bentonite Granules T.D. on 1-24-90		10 20 30 40 50 60 70 80 90 100 110 120 130		0'-2.5' Silty Sand 2.5'-10.8' Silty Sandy Gravel 10.8'-13.0' Gravelly Silty Sand 13.0'-20.7' Silty Sandy Gravel 20.7'-21.9' Slightly Silty Gravelly Sand 21.9'-23.2' Silty Sandy Gravel 23.2'-25.1' Gravel Static Water Level ● 23.0' Total Depth ● 25.6'

893-1407\ hr-1

Figure F-15. Horn Rapids Landfill Suboperable Unit Boring HRL-3.

Vadose Zone Borehole No. HRL-4

Lambert Coordinates (NAD '83(ft)) N 373,664.95, E 1,944,230.59

Date Total Depth Reached 1-29-90

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
Sample A2202 Chemical-5" Split Spoon* Casing-Black Iron Entire Borehole. Sample A2203 Physical-Drive Barrel Sample A2204 & A2205 Chemical & Replicate 5" Split Spoon Sample A2206 Physical-Drive Barrel Sample A2207 & A2208 Chemical & Split - 5" Split Spoon Sample A2209 Physical-Drive Barrel Sample A2210 Chemical-5" Split Spoon Sample A2211 Physical-Drive Barrel Sample A2212 Chemical-5" Split Spoon Sample 2213 Physical-Drive Barrel Sample A2214 Chemical-5" Split Spoon Sample A2215 Water Sample (2" SS Bailer) Temporary Casing Removed and Hole Backfilled with Bentonite Granules. *w/SS Liners T.D. on 1-29-90	6" Casing Drive Shoe	10 20 30 40 50 60 70 80 90 100 110 120 130		0'-3.0' Gravelly Sand 3.0'-5.0' Gravelly Silty Sand 5.0'-10.0' Silty Gravel 10.0'-1.36' Silty Sandy Gravel 13.6'-14.5' Gravelly Silty Sand 14.5'-15.9' Silty Sandy Gravel 15.9'-17.2' Slightly Silty Gravelly Sand 17.2'-25.5' Silty Sandy Gravel Static Water Level ● 22.5' Total Depth ● 25.5'

893-1407\ hn-4

Figure F-16. Horn Rapids Landfill Suboperable Unit Boring HRL-4.

Vadose Zone Borehole No HRL-5

Lambert Coordinates (NAD '83(ft)) N 374,865.68, E 1,944,278.33

Date Total Depth Reached 1-10-90

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
6 5/8" Casing to 23.6' 7.5" Hole to 25.6' Temporary Casing Used and was Removed After Hole Completed. Hole Backfilled with Bentonite Granules. TD on 1-10-90		10 20 30 40 50 60 70 80 90 100 110 120 130		0'-2.6' Slightly Silty Gravelly Sand. 2.6'-12.9' Silty Sandy Gravel 12.9'-19.6' Silty Gravel 19.6'-25.6' Silty Sandy Gravel Static Water Level @ 23.7' Total Depth @ 25.6'

893-1407\ hrl-5

Figure F-17. Horn Rapids Landfill Suboperable Unit Boring HRL-5.

Vadose Zone Borehole No. HRL-6

Lambert Coordinates (NAD '83(ft)) N 374,515.82, E 1,944,577.4

Date Total Depth Reached 1-15-90

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
Used 11 1/8" O.D. Hollow Stem Auger. Drove 3" O.D. Split Spoon Sampler to 4.77' 5" O.D. Split Spoon Sampler was Used from 4.77' to End of Hole. After Sampler was Driven ~2' Auger was Advanced to New Depth.		10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130		0'-11.6' Silty Sandy Gravel 11.6'-13.9' Slightly Silty Gravelly Sand 13.9'-16.2' No Recovery 16.2'-21.5' Silty Sandy Gravel 21.5'-23.0' Gravelly Silty Sand 23.0'-24.2' Silty Sandy Gravel Strong Reaction to HCL 24.2'-25.8' Gravelly Sandy Silt Caliche? Static Water Level 25.8' 25.8'-27.8' Silty Sandy Gravel Total Depth @ 27.8
T.D. on 1-15-90				

893-1407\ hrl-6

Figure F-18. Horn Rapids Landfill Suboperable Unit Boring HRL-6

Vadose Zone Borehole No. HRL-7

Lambert Coordinates (NAD '83(ft)) N 373,903.56, E 1,944,577.76

Date Total Depth Reached 2-8-90

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
Sample A2301 Chemical-5" Split Spoon Casing: 6 5/8" O.D. Black Iron Entire Hole. Sample A2302 Physical-Drive Barrel Sample A2303 & A2304 Chemical & Replicate 5" Split Spoon Sample A2305 Physical-Drive Barrel Sample A2306 & A2307 Chemical & Lab Split 5" Split Spoon Sample A2309 Physical-Drive Barrel Sample A2310 Chemical-5" Split Spoon Sample A2311 Physical-Drive Barrel Sample A2312 Chemical-5" Split Spoon Sample A2313 Physical-Drive Barrel Sample A2314 Chemical-5" Split Spoon Sample A2315 Water Sample (2" SS Bailer) T.D. on 2-8-90	Casing Shoe	10 20 30 40 50 60 70 80 90 100 110 120 130		0'-2.5' Silty Sandy Gravel 2.7'-4.3' Silty Gravel 4.8'-25' Silty Sandy Gravel Static Water Level @ 22.85' 0835 Hrs, 2/22/90. Total Depth @ 26.0'

893-1407\ hr-7

Figure F-19. Horn Rapids Landfill Suboperable Unit Boring HRL-7.

Vadose Zone Borehole No. HRL-8

Lambert Coordinates (NAD '83(ft.)) N 374,354.7, E 1,944,981.07

Date Total Depth Reached 12-21-89

Well Construction Summary

Construction Data		Depth in Feet	Graphic Log	Lithologic Description
Description	Diagram			
6 5/8" O.D. Butt Weld 7.5" Hole				0'-7.5' Sandy Gravel 7.5'-8.2' Gravelly Sand 8.2'-22.8' Silty Sandy Gravel 22.8'-28.3' Gravelly Silty Sand
Casing to 26.9' End of Hole 28.3' Temporary Casing Used and Removed After Hole Complete. Hole Backfilled w/ Bentonite Granules and Abandoned T.D. on 12-21-89		10 20 30 40 50 60 70 80 90 100 110 120 130		Static Water Level @ 26.5' Total Depth @ 28.3'

B93-1407\ hrl-8

Figure F-20. Horn Rapids Landfill Suboperable Unit Boring HRL-8.

Vadose Zone Borehole No. HRL-9

Lambert Coordinates (NAD '83(ft)) N 374,062.15, E 1,945,069.0

Date Total Depth Reached 1-17-90

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
Cable Tool Drilling 5" O.D. Core Barrel 6 5/8" O.D. Casing (Pulled Out After Hole and Sampling Completed) 6" I.D. Casing 6 5/8" O.D. Steel Casing to 25.7'. 7 1/8" O.D. Casing Shoe. T.D. on 1-17-90		10 20 30 40 50 60 70 80 90 100 110 120 130		0'-3.7' Sandy Gravel 3.7'-6.8' Silty Sandy Gravel 6.8'-10.9' Silty Gravel 10.9'-16.7' Sandy Gravel 16.7'-19.6' Silty Sandy Gravel 19.6'-20.4' No Recovery 20.4'-24.3' Sandy Gravel 24.3'-27' Silty Sandy Gravel Static Water Level @ 24.8' Total Depth @ 27.0'

893-1407\ hr-9

Figure F-21. Horn Rapids Landfill Suboperable Unit Boring HRL-9.

Vadose Zone Borehole No. HRL-10

Lambert Coordinates (NAD '83(ft)) N 374,163.63, E 1,945,179.5

Date Total Depth Reached 1-25-90

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
No Casing Used in HRL-10. Borehole was Drilled with 6 5/8" I.D. Hollow Stem Auger. Bit Diameter 11 1/8" Length of Auger Flights 5" For More Information on Tools & Equipment Used Downhole See Field Activity Report #1 for HRL-6 1/5/90. HRL-10 Borehole Abandoned by Backfilling with Bentonite Pellets Filled to Surface Bit Auger 11 1/8", Auger Flights 5" in Length & 6 5/8" I.D. For Detailed Description of Auger Bit See Field Activity Report #1 for HRL-6, 1/5/90. T.D. on 1-25-90		10 20 30 40 50 60 70 80 90 100 110 120 130		0'-2.3' Silty Sandy Gravel 2.3'-6.3' Sandy Gravel 6.3'-6.8' Silty Sandy Gravel 6.8' 9.1' Sandy Gravel 9.1'-14.5' Silty Sandy Gravel 14.5'-16.5' Sandy Gravel 16.5'-19.1' Silty Sandy Gravel 19.1'-20.4' Gravelly Sand 20.4'-21.9' Sandy Gravel 21.9'-23.7' Silty Sandy Gravel 23.7'-32.4' Sandy Gravel Static Water Level ● 31.3' 32.4-34.5' Unknown Geology Borehole was Augered to 34.5 to Allow Ample Supply of Groundwater for Sampling. Auger Flights were Left in Place During Sampling Process All Flights, Bit, and Downhole Tools were Withdrawn After Groundwater Sample was Collected. Borehole was Back-filled with Bentonite Pellets as Flights were Being Extracted. Total Depth ● 34.5'

893-1407\hr-10

Figure F-22. Horn Rapids Landfill Suboperable Unit Boring HRL-10.

Temporary Well Number MW-1

Hanford Well Number 699-S41-E11

Lambert Coordinates (NAD 83 (H)) N 354,085.8, E 1,946,552.0

Date Well Completed 1-30-90

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
12" ID Casing to 18.18' 13.5" Hole (Removed all 12" Casing) 9" OD on drive Shoe		10 20		0'-1.9' Sand 1.9'-32.5' Silty Sandy Gravel
Surface Pad From 2' Portland Cement 18'-2'. Granular Bentonite From 30'-18' Bentonite Pellets from 30'-33.6' 20 - 40 Mesh Colorado Silica Sand From 60.1'-33.6' 8" ID Casing to 79.9' 79.9'-94' Open Hole 8" Hole (Removed all 8" Casing) Screen is 4" ID Johnson 304 Stainless Steel Continuous Wire Wrap 10 Slot Channel Pack with Screw on End Cap. (Two Lengths of Screen - Total Length 20.37 ft) 4" ID 304 Stainless Steel Riser to Surface. T.D. on 1-22-90		30 40 50 60 70 80 90 100 110 120 130		32.5'-39.6' Sandy Gravel 39.6'-41.8' Gravelly Sand 41.8'-47' Sandy Gravel Static Water Level @ - 43.8' (1-15-90) - 43.03' (1-16-90) 47'-47.4' Silty Sandy Gravel 47.4'-~54.5' Sandy Gravel 54.5'-88.5' Silty Sandy Gravel 88.5'-94.0' Silt Total Depth @ 94.0'

893-1407\mw-1

Figure F-23. 1100-EM-1 Monitoring Well, MW-1.

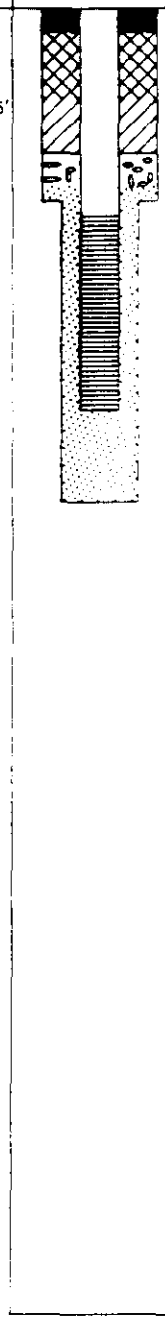
Temporary Well Number MW-2

Hanford Well Number 699-S34-E10

Lambert Coordinates (NAD 83 (ft)) N 370,878.5, E 1,945,364.8

Date Well Completed 2-2-90

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
Cement 2.5'-9.6' Bentonite Crumbles 9.6'-15' Bentonite Pellets 15'-18' Casing Material Sand 18'-45.5' Drilled 10 5/8" Hole to 18.6' (Without Shoe) 10" ID Casing to 18.6', Casing Removed During Completion 9.5" Hole 18.6'-51', 8" Casing Removal During Completion Centralizer 21' Riser 21.32'-5.18' Bentonite Pellets 45.5'-49.35' Screen 10 Slot 21.32'-41.65' Centralizer 41.3' T.D. on 1-30-90		10 20 30 40 50 60 70 80 90 100 110 120 130		0'-1.3' Sand 1.3'-46.5' Silty Sandy Gravel Static Water level 26.0' 46.5'-51' Silt Slough 49.35'-51' Total Depth @ 51.0'

893-1407\mw-2

Figure F-24. 1100-EM-1 Monitoring Well, MW-2.

Temporary Well Number MW-3

Hanford Well Number 699-S41-E12

Lambert Coordinates (NAD '83 (ft))

Date Well Completed 2-22-90

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
9 5/8" Hole (Shoe) 8" ID Buttweld Casing Centralizer (Bolt on) 13.6' Cement 20.92' - 2.3' 9 5/8" Hole to 83.74' 8" ID Casing to 81.24' Bentonite Crumbles 36' - 20.92' Bentonite Pellets 39.4' - 36' Sand 68.46' - 39.4' Centralizer (Bolt on) 43' 10 Slot Johnson Screen Centralizer Sand 68.46' - 39.4' Bentonite Pellets 83.26' - 68.46' 9 5/8" Hole to 83.74' 8" ID Casing to 81.24' T.D. on 2-16-90	4" Riser	10 20 30 40 50 60 70 80 90 100 110 120 130		0'-0.35' Blacktop - Asphalt 0.35'-2.0' Sandy Gravel 2.0'-2.8' Sand 2.8'-3.7' Silty Sand 3.7'-46' Silty Sandy Gravel 46'-49.5' Gravelly Sand 49.5'-52.5' Silty Sandy Gravel 52.5'-53.8' Sandy Gravel Static Water Level: - 50.21' on 2-14-90 - 52.41' on 2-15-90 - 56.0' on 2-16-90 53.8'-70' Silty Sandy Gravel 70'-78.6' Sandy Gravel 78.6'-83.7' Silt Total Depth @ 83.7'

893-1407\mw-3

Figure F-25. 1100-EM-1 Monitoring Well, MW-3.

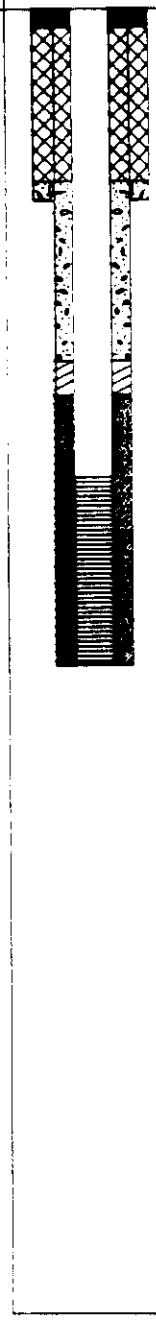
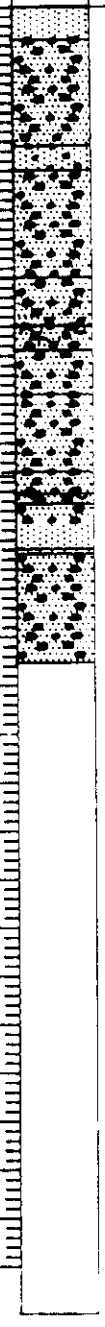
Temporary Well Number MW-4

Hanford Well Number 699-S38-E12A

Lambert Coordinates (NAD '83 (ft)) N 367,411.8, E 1,947,587.6

Date Well Completed 12-6-89

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
Concrete Tertiary Seal: Cement Type I-II, Acme w/Aluminum Powder Riser: Johnson Stainless Steel 4" Blank w/"O" Rings 12" Ø Temporary Casing 19.9' Steel Casing w/ Drive Shoe Secondary Seal: Bentonite Crumbles Primary Seal: 36.5' Volclay 3/8" Dia. 40' Screen: Johnson Stainless Steel Channel Pak, 4" .010 Slot w/"O" Rings Filter pak: Colorado Silica #20-40 T.D. on 11-20-89		10 20 30 40 50 60 70 80 90 100 110 120 130		0'-3.5' Sand - Grading Downward 3.5'-14.5' Sandy Gravel 14.5'-17.0' Gravelly Sand 17.0'-24.0' Sandy Gravel/ Gravelly Sand 24.0'-28.0' Gravelly Sand 28.0'-33.0' Sandy Gravel 33.0'-35.5' Silty Sandy Gravel 35.5'-50.3' Sandy Gravel Static Water Level 48.5' 50.3'-51.4' Silty Sandy Gravel 51.4'-56.0' Sandy Gravel 56.0'-56.5' Sand 56.5'-67.3' Sandy Gravel Total Depth @ 67.3

893-1407\mw-4

Figure F-26. 1100-EM-1 Monitoring Well, MW-4.

Temporary Well Number MW-5

Hanford Well Number 699-S38-E12B

Lambert Coordinates (NAD '83 (ft)) N 367,379.0, E 1,947,587.6

Date Well Completed 12-29-89

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
Concrete Tertiary Seal: Cement Type II, W/Aluminum Powder 12" ø Temporary Casing				0'-3.0' Sand, Trace Gravel
		10		3.0'-14.0' Silty Sandy Gravel 14.0'-18.5' Gravelly Sand
Secondary Seal: Bentonite Crumbles, American Colloid Riser: Johnson Stainless Steel 4" Blank W/"O" Rings 8" ø Temporary Casing		20		18.5'-28.0' Slightly Gravelly Sand
		30		28.0'-32.5' Gravelly Sand
				32.5'-50.0' Sandy Gravel
Primary Seal: Bentonite Pellets 3/8" Diameter, Volclay		40		Static Water Level 47.0'
		50		50.0'-52.0' Sandy Silty Gravel
				52.0'-57.5' Sand, Fine Micaceous
		60		
		70		57.5'-74.5' Sandy Gravel
Screen: Johnson Stainless Steel Channel Pak 4" .010 Slot Sand Pak: CSSI #20-40		80		74.5'-87.0' Silty Sandy Gravel 87.0'-88.6' Sandy Silt
T.D. on 12-18-89		90		Total Depth @ 88.6'
		100		
		110		
		120		
		130		

893-1407\mw-5

Figure F-27. 1100-EM-1 Monitoring Well, MW-5.

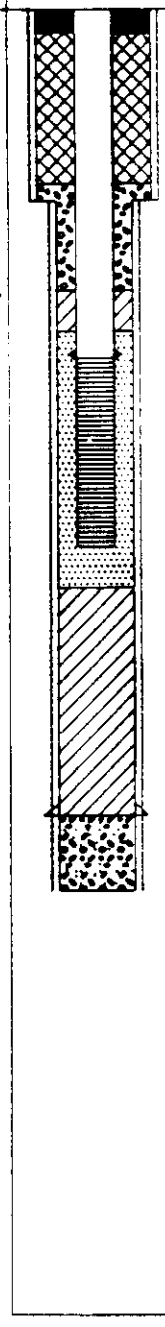
Temporary Well Number MW-6

Hanford Well Number 699-S37-E11

Lambert Coordinates (NAD '83 (ft)) N 358,019.0, E 1,546,646.3

Date Well Completed 12-1-89

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
13.5" Hole to 19.8' Cement 18'-2.3' 12" I.D. Casing to 20.15', Removed 12-1-89 Granular Bentonite 29.1'-18' Bentonite Pellets 33.2'-29.1' Centralizer Channel Pack Screen 9.5" Hole to 91' Bentonite Pellets 83'-59.8' 8" I.D. Casing to 83.3'; Removed 11-30-89 Slough 91'-83' T.D. on 11-20-89		10 20 30 40 50 60 70 80 90 100 110 120 130		0'-1.8' Sand 1.8'-12.2' Sandy Gravel 12.2'-14.5' Slightly Gravelly Sand 14.5'-26.2' Sandy Gravel 26.2'-29.2' Gravelly Sand 29.2'-30.6' Slightly Gravelly Sand 30.6'-37' Sand 37'-37.4' High Moisture, Silty Sandy Gravel 37.4'-42.8' Slightly Gravelly Sand Static Water Level 42.8' 42.8'-49.4' Sandy Gravel 49.4'-51.4' Silty Sandy Gravel 51.4'-57.5' Gravelly Sand 57.5'-85' Sandy Gravel 85'-88.7' Silty Sand 88.7'-89' Silt 89'-91' Silty Gravelly Sand Total Depth @ 91.0'

893-1407\mw-6

Figure F-28. 1100-EM-1 Monitoring Well, MW-6.

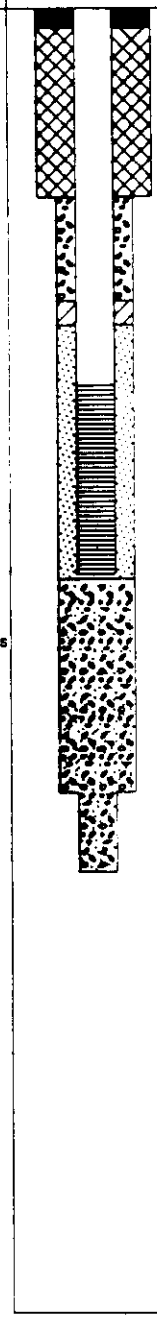
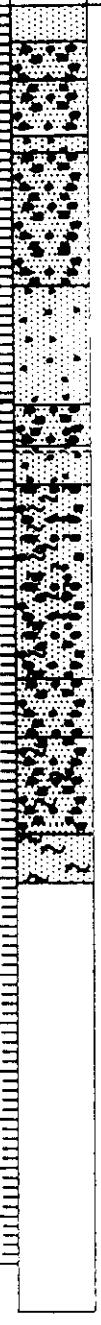
Temporary Well Number MW-7

Hanford Well Number 699-S38-E11

Lambert Coordinates (NAD '83 (ft)) N 367,097.7, E 1,946,037.4

Date Well Completed 12-13-89

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
19.4' of 12" Ø Nominal Carbon Steel Casing w/Shoe Added to Well 12/5/89. 36.4' of 8" Ø Nominal Carbon Steel Casing w/Shoe Added to Well 12/06/89. 29.1' of 8" Ø Nominal Carbon Steel Casing Added to Well 12/7/89. 10.5' of 8" Ø Nominal Carbon Steel Casing Added to Well 12/8/89. 6.3' of 8" Ø Nominal Carbon Steel Casing Added to Well 12/11/89. Backpulled all of Carbon Steel Casing After Installing 4" Ø Stainless Steel Casing and Screen. Total Stainless Steel Screen and Riser Installed in Well is 58.36' including 20.04' of Channel Pack Screen, all Installed 12/12/89. Portland Cement w/Aluminum Powder 19'-2' 8-20 Mesh Bentonite Crumbles 30.2'-19' Bentonite Pellets (3/8") 32.8'-30.2' 20-40 Colorado Silica Sand 59'-32.8' 5/8" Bentonite Pellets 89.3'-59' Screen is Channel Pack 316L Stainless Steel 10 Slot (.010") w/0.32' Bottom Cap Screwed on. Bottom of 12" Ø Casing @ 19.3'. Bottom of 8" / Casing @ 80.3' Splitspoon Sample w/Lexan Tube Driven From 87.3' to 89.3'. T.D. on 12-11-89		10 20 30 40 50 60 70 80 90 100 110 120 130		0'-3.75' Brown Sand 3.75'-4.5' Lt Brownish Gray Gravelly Sand 4.5'-7.8' Lt Brownish Gray Sandy Gravel 7.8'-13.5' Grayish Brown Sandy Gravel 13.5'-15.3' Grayish Brown Gravelly Sand 15.3'-29.1' Dark Gray Sandy Gravel 29.1'-41.3' Very Dark Grayish Brown, Slightly Gravelly Sand Static Water Level @ 40.8' 41.3'-45.4' Black Sandy Gravel 45.4'-49.4' Black, Slightly Gravelly Sand 49.4'-69.4' Very Dark Grayish Brown to Gray, Silty Sandy Gravel Silt Content Decreasing Gravel Content Increasing 69.4'-75.6' Sandy Gravel, Trace Silt 75.6'-85.5' Light Olive Brown, Silty Sandy Gravel 85.5'-89.3' Olive Brown Sandy Silt Total Depth @ 89.3'

893-1407\mw-7

Figure F-29. 1100-EM-1 Monitoring Well, MW-7.

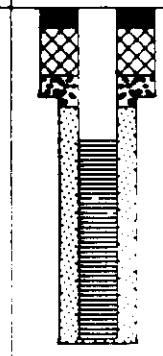
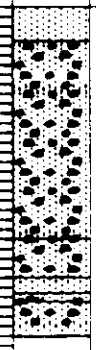
Temporary Well Number MW-8

Hanford Well Number 699-S31-E08

Lambert Coordinates (NAD '83(ft)) N 373,797.0, E 1,943,078.7

Date Well Completed 12-15-89

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
10" Schedule 40 Carbon Steel Casing w/Shoe Driven to 9.3 ft (Temporary). (10 5/8" O.D.). 8" Schedule 280 Wall Carbon Steel Casing w/Shoe Driven to 34.68' (Temporary) (8 5/8" O.D.) Top of Cement Grout 2' Depth. Top of Bentonite Granules 6.9' Top of Filter Pack 10.2' Bottom of Filter Pack 34.2' Bottom Of Screen * 34.2' Top of Screen ** 13.6' Screen = Johnson Continuous Wire Wrap .020 Slot Filter Pack 10-20 Colorado Silica Sand T.D. of 8" Casing 34.68 ft All Temporary Casings Removed from Well. *Includes End Cap of 0.37' **Includes 0.27' of Solid Stainless Steel Above Screen Openings T.D. on 10-31-89		10 20 30 40 50 60 70 80 90 100 110 120 130		0'-3.5' Sand 3.5'-24.0' Silty Sandy Gravel Static Water Level ● 18.3' 24.0'-28.0' Sandy Gravel 28.0'-29.6' Sand 29.6'-30.5' Silty Sandy Gravel 30.5'-34.1' Sandy Gravel Total Depth ● 34'

893-1407\mw-8

Figure F-30. 1100-EM-1 Monitoring Well, MW-8.

Temporary Well Number MW-9

Hanford Well Number 699-S32-E08

Lambert Coordinates (NAD '83(ft)) N 373,760.3, E 1,943,118.4

Date Well Completed 2-3-90

Well Construction Summary

Construction Data

Description

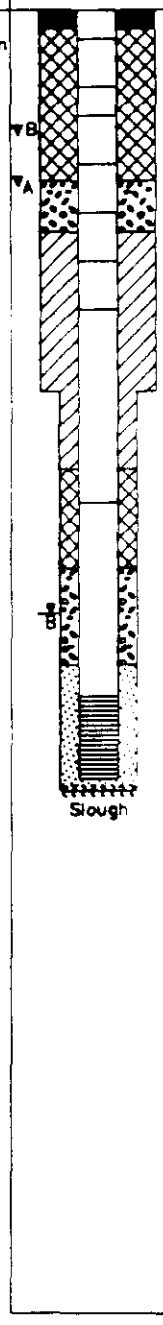
+0.5'-1.9' Concrete
1.9'-17.7' Cement w/Aluminum Powder
17.7'-23.0' 1/4" Bentonite Pellets
23.0'-47.4' Volclay Grout
47.4'-57.7' Cement w/ Aluminum Powder
57.7'-66.7' 1/4" Bentonite Pellets
66.7'-69.3' 20-40 Colorado Silica Sand
69.3'-80.7' 10-20 Colorado Silica Sand

Stainless Steel End Cap 79.6'-79.3'
Stainless Steel 10-Slot Channel Pack Screen 79.3'-69.3'
Stainless Steel Schedule 055 Riser 69.3'-+1.7'

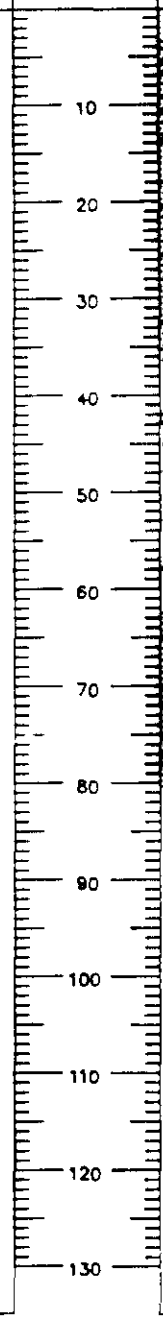
Well Constructed w/Open Hole as Problems Pulling 8" Ø Casing

(A) Unconfined Aquifer Encountered @ 18.2'
(B) Confined Aquifer Encountered @ 62.4', Stabilized @ 13'
T.D. on 1-19-90

Diagram



Depth in Feet



Graphic Log

Lithologic Description

0'-3.5' Sand
3.5'-4.3' Gravelly Sand

4.3'-13.9' Silty Sandy Gravel

13.9'-18.1' Sand and Slightly Silty Gravelly Sand

18.1'-35.2' Sandy Gravel

35.2'-42.0' Clayey Silt

42.0'-62.4' Silt

62.4'-63.6' Sandy Silt
63.6'-68.4' Silt

68.4'-81.4' Silty Gravel and Silty Sandy Gravel; Possible Sand Lenses.

Total Depth @ 81.4'

893-1407\mw-9

Figure F-31. 1100-EM-1 Monitoring Well, MW-9.

Temporary Well Number MW-10

Hanford Well Number 699-S30-E10A

Lambert Coordinates (NAD '83(ft)) N 375,260.6, E 1,945,079.3

Date Well Completed 11-17-89

Well Construction Summary

Construction Data

Description

21.7' of 8" Nominal Carbon Steel Casing (Sched. 40) With Shoe Added to Well 11/6/89.
10.46' of 8" Nominal Carbon Steel Casing (Sched. 40) Added 11/8/89.
9' of 8" Nominal Carbon Steel Casing (sched 40) Added 11/8/89.
10' of 8" Nominal Carbon Steel Casing (Sched. 40) Added 11/9/89.
10' of 8" Nominal Carbon Steel Casing (Sched 40) Added 11/10/89.

Backpulled all of Carbon Steel Casing After Installing 4" Stainless Steel Casing and Screen.

Total Stainless Steel Screen and Riser Installed in Well is 56.29' Including 20.32' Screen Section all Installed on 11/15/89.

Portland Cement 18.6'-2.0'
Granular Bentonite 27.4'-18.6'
Bentonite Pellets (1/4" Dia.) from 30.8'-27.4'

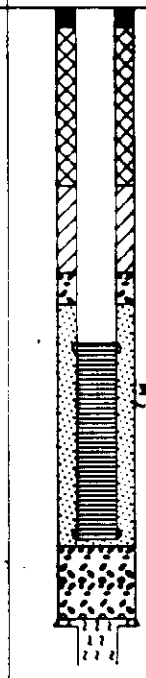
Colorado Silica Sand (20-40 Mesh) from 56.8'-30.8'

Screen is 20.32' Long Type 304 Stainless Steel Continuous Wire Wrap 10 Slot (0.010") Opening w/4" I.D. and Factory Welded Bottom Cap and Centralizer

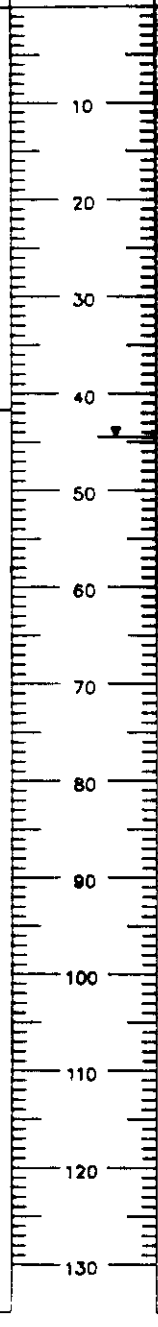
1/4" Dia. Bentonite Pellets from 63.2'-56.8'

Bottom of Casing at 64.5' at Well T.D.
Casing Driven to 64.9' then Backpulled
T.D. on 11-14-89

Diagram



Depth in Feet



Graphic Log

Lithologic Description

0'-2.0' Silty Sand, Brown

2.0'-9.0' Sandy Gravel

9.0'-15.0' Sand Grading Downward to Sandy Gravel and Silty Sandy Gravel

15.0'-44.0' Silty Sandy Gravel - Partly to Well Consolidated

Micaceous Starting at ~39.5'

Static Water Level @ 44.5

44.0'-56.0' Sandy Gravel: Very Little Silt, M-F Sand

Bottom of Screen at 55.0

56.0'-59.0' Sand

59.0'-62.0' Sandy Gravel

62.0'-64.0' Silty Sandy Gravel

64.0'-65.0' Silty Gravel

65.0'-67.5' Clayey Silt

Splitspoon Sample Driven to 65.5' to 67.5' (5" O.D.)

Total Depth @ 67.5'

893-1407\mw-10

Figure F-32. 1100-EM-1 Monitoring Well, MW-10.

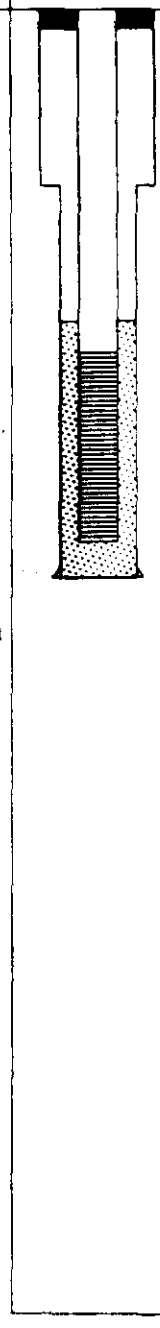
Temporary Well Number MW-11

Hanford Well Number 699-S30-E10B

Lambert Coordinates (NAD '83(ft)) N 374,949.1, E 1,945,105.1

Date Well Completed 12-27-89

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
18.75' of 12" Nominal Carbon Steel Casing with Casing Shoe (14 1/4" O.D.) Installed in Hole for Surface Support. Driven to 18.25' Depth on 12/18/89. 8" Nominal Carbon Steel Casing Run Into Hole After 12" Casing Running with 0.8' O.D. Drive Shoe. Total 8" Casing in Hole at T.D. of 58.8' with 0.9' Above Ground Surface thus Bottom of 8" Casing at 57.9' on 12/19/89. 20-40 Sand 57.8'-31.3' Screen is Channel Pack 4" I.D. Johnson 10 Slot Type 304 Stainless Steel Continuous Wire Wrap. Screen in 2 Sections: Bottom Cap Screwed on and Top Section is 10.0 ft Long. Total of Screened Section is 20.35 ft. Well was Overdrilled to 58.5 ft Then 20-40 Mesh Colorado Silica Sand Added. Screen Installed on Sand Then Sand Packed Around Screen and Temporary Casings Removed. T.D. on 12-19-89		10 20 30 40 50 60 70 80 90 100 110 120 130		0'-2.7' Silty Sand, Brown 2.7'-5.6' Gravelly Sand 5.6'-26.1' Sandy Gravel Gradual Increase in Silt. 26.1'-52.0' Silty Sandy Gravel Static Water Level @ 41.0' 52.0'-53.5' Sandy Gravel Bottom of Screen @ 54.7 ft Verified by Weightec Type at 57.8'. Total Depth @ 58.51'

893-1407\mw-11

Figure F-33. 1100-EM-1 Monitoring Well, MW-11.

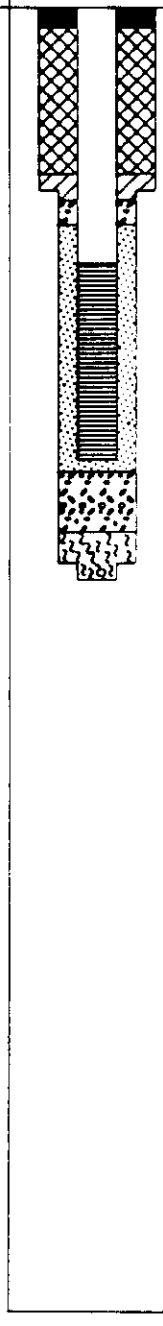
Temporary Well Number MW-12

Hanford Well Number 699-S31-E10A

Lambert Coordinates (NAD '83(ft)) N 374,720.6, E 1,945,415.6

Date Well Completed 1-17-90

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
Tertiary Seal: Cement Type I & II w/Aluminum Powder 18.25'-2' Riser: Johnson 4" ø Stainless Steel Secondary Seal: Bentonite Crumbles 20'-18.25' Primary Seal: Bentonite Pellets 3/8" 22.5'-20' Screen: Johnson 4" ø Stainless Steel Channel Pak - .010 Slot 46.85'-26.52' Sand Pak: Colorado Silica Sand #20-40 48'-22.5' Bottom Seal: Bentonite Pellets 3/8" 54.25'-48' Coving 59.17'-54.25' T.D. on 1-16-90		10 20 30 40 50 60 70 80 90 100 110 120 130		0'-1.5' Sand 1.5'-4.0' Silty Sand 4.0'-6.0' Sand 6.0'-9.5' Gravelly Sand 9.5'-15.5' Sandy Gravel 15.5'-31.0' Silty Sandy Gravel Static Water Level @ 32.5' 31.0'-57.0' Sandy Gravel 57.0'-59.2' Ash Vitric Tuff Total Depth @ 59.2'

893-1407\mw-12

Figure F-34. 1100-EM-1 Monitoring Well, MW-12.

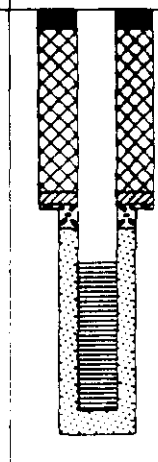
Temporary Well Number MW-13

Hanford Well Number 699-S31-E10B

Lambert Coordinates (NAD '83(ft)) N 374,504.6, E 1,945,399.9

Date Well Completed 1-12-90

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
Tertiary Seal: Cement Type I & II, w/Aluminum Powder ~19'-2' 12" Temporary Casing to 20.66' Riser: Johnson Stainless Steel 4" Ø T.D. 41.5' Secondary Seal: Bentonite Crumbles, Amer. Colloid 20.17'-~19' Primary Seal: Bentonite Pellets, 3/8" Dia., Volclay 22.82'-20.17' 8" Ø Temporary Casing T.D. 44 ft Screen: Johnson Stainless Steel 4" Ø .010 Slot Channel Pak. 41.5'-26.18' Sand Pak: Colorado Silica Sand #20-40, 44'-22.82' T.D. on 1-9-90		10 20 30 40 50 60 70 80 90 100 110 120 130		0'-6.5' Gravelly Sand 6.5'-9.0' Sand 9.0'-14.0' Gravelly Sand 14.0'-25.0' Silty Sandy Grave Static Water Level @ 30.8' 25.0'-44.0' Sandy Grave' Total Depth @ 44.0'

893-1407\mw-13

Figure F-35. 1100-EM-1 Monitoring Well, MW-13.

Temporary Well Number MW-14

Hanford Well Number 699-S31-E10C

Lambert Coordinates (NAD '83(ft)) N 374,522.8, E 1,945,423.9

Date Well Completed 1-7-90

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
Tertiary Seal: Cement Type I & II, w/Aluminum Powder 18.6'-2' 12" ø Temporary Casing		10		0'-0.5' Sand 0.5'-6.3' Gravelly Sand 6.3'-6.9' Sand 6.9'-9.6' Gravelly Sand 9.6'-10.8' Silty Sandy Gravel 10.8'-16.5' Sandy Gravel
Secondary Seal: Bentonite Crumbles, Amer. Colloid 28.04'-18.6' 8" ø Temporary Casing T.D. 58.5'		20		16.5'-32.5' Silty Sandy Gravel
Primary Seal: Bentonite Pellets, 3/8" Dia. Volclay 38.25'-28.04' Riser: Johnson Stainless Steel 4" ø Blank, T.D. 53.53' Screen: Johnson Stainless Steel Channel Pak, 4" ø 53.53'-43.51'		30		Static Water Level @ 30.4'
		40		32.5'-53.6' Sandy Gravel
Sand Pak: Colorado Silica Sand #20-40, 53.98'-38.25'		50		
Bottom Seal: Volclay Bentonite Pellets, 3/8" Dia. 60.5'-53.98' T.D. on 1-4-90		60		53.6'-60.5' Ash-Vitric Tuff. Total Depth @ 60.5'
		70		
		80		
		90		
		100		
		110		
		120		
		130		

893-1407\mw-14

Figure F-36. 1100-EM-1 Monitoring Well, MW-14.

Temporary Well Number MW-15

Hanford Well Number 699-S31-E10D

Lambert Coordinates (NAD '83(ft)) N 374,230.8, E 1,945,425.4

Date Well Completed 12-7-89

Well Construction Summary

Construction Data

Description

20.3' of 8" Ø Carbon Steel Casing w/Shoe Added to Well 11/21/89.
10' of 8" Ø Carbon Steel Casing Added w/0.1' of Casing Removed Due to Flaring of Steel Added 11/27/89.
20' of 8" Ø Carbon Steel Casing Added 11/28/89.
10' of 8" Ø Carbon Steel Casing Added 11/30/89.

Backpulled all of Carbon Steel Casing After Installing 4" Stainless Steel Casing and Screen.

Total Stainless Steel Screen and Riser Installed in Well is 40.30' Including 20.32' of Screen Section all Installed 12/04/89.

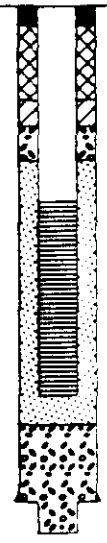
Portland Cement Type I & II from 1.9'-9.7'
Granular Bentonite Crumbles from 9.7'-12.5' (8-20 Mesh)
Bentonite Pellets (1/4"&3/8") from 12.5'-16'
Colorado 20-40 Silica Sand from 16'-43.3'
Bentonite Pellets (3/8") from 43.3'-54.5'

Screen is 20.32' Long, Type 304, Stainless Steel Continuous Wire Wrap 10 Slot (0.010") Opening w/4" Ø I.D. and Factory Welded Bottom Cap and Centralizer.

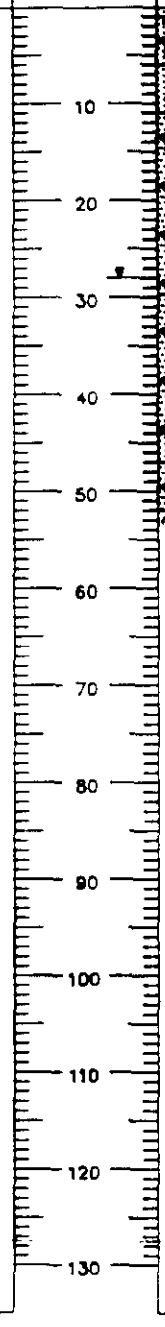
Bottom of Casing at 51.6' Then Backpulled.

Sample MW-15-12 Spoon Driven from 51.3'-54.5' on 12/01/89.
Sample MW-15-12 was 4" Ø and 2" Long.
T.D. on 12-1-89

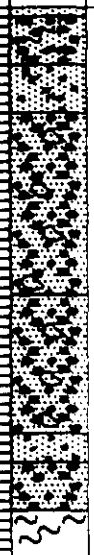
Diagram



Depth in Feet



Graphic Log



Lithologic Description

0'-1.0' Slightly Silty Sand
1.0'-6.0' Silty Sandy Gravel

6.0'-11.0' Silty Gravelly Sand, Trace Silt

11.0'-44.2' Sandy Gravel, Trace Cobble
Gradual Change in Color from Dark Gray to Olive Gray

Static Water Level ● 28.1'

Some Cobble
Some to Trace Cobble
Silt Content Increasing

44.2'-46.8' Gravelly Sand

46.8'-51.9' Sandy Gravel

51.9'-54.5' Silt (Ash Under Microscope)

Total Depth ● 54.5'

893-1407\mw-15

Figure F-37. 1100-EM-1 Monitoring Well, MW-15.

Temporary Well Number MW-17

Hanford Well Number 699-S41-E13C

Lambert Coordinates (NAD '83(ft)) N 354,291.1, E 1,948,387.6

Date Well Completed 1-26-90

Well Construction Summary

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Graphic Log	Lithologic Description
19.4' of 12" Carbon Steel Surface Casing w/o Drive Shoe (Bottom @ 19.1')				
94.92' of 10" Carbon Steel Casing w/Drive Shoe (Removed)(Bottom of Casing @ 94.4')		10		0'-19' Silty Sandy Gravel
		20		19'-23' Sandy Grave
				23'-30' Gravelly Sand
		30		30'-35' Slightly Silty Sand
Drive Barrel 0'-38' Hard Tool Bit 38'-85' Drive Barrel 85'-89' Split Spoon 89'-91' Hard Tool Bit 91'-95' Split Spoon 95'-97' Hard Tool Bit 97'-99.5' Split Spoon 99.5'-101.9' Drive Barrel 101.9'-103' Hard Tool Bit 103'-105' Split Spoon 105'-107' Hard Tool Bit 107'-110' Split Spoon 110'-112' Drive Barrel 112'-125'				35'-37' Slightly Silty Gravelly Sand
		40		
		50		37'-70' Silty Sandy Gravel Static Water Level @ 55.0'
		60		
		70		70'-79' Slightly Silty Gravelly Sand
		80		79'-84' Slightly Silty Slightly Gravelly Sand
126.29' of 8" Carbon Steel Casing w/Drive Shoe. (Removed) Bottom @ 123'.				84'-86' Silty Sand
		90		86'-90.5' Sandy Gravel 90.5'-95' Clay
				95'-99.5' Silty Sand 99.5'-108.5' Silty Clay
		100		
Bottom of 4" Stainless Steel Screen @ 121.45' (With End Cap). Used a 10 Slot Johnson Channel Pack Screen 10.30' Long. Centralizers @ 87',110'47'and 7'. T.D. on 1-20-90		110		108.5'-125' Sand
		120		Total Depth @ 125.0'
		130		☒ = Cement ◪ = Bentonite Crumbles ⊠ = Volclay Grout ⊡ = Sand ⊡ = Bentonite Pellets

893-1407\mw-17

Figure F-38. 1100-EM-1 Monitoring Well, MW-17.

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AS-BUILT DIAGRAM

Well Number 699-S40-E14 1100 AREA #2 Geologist GOODWIN, TEEL Page 1 of 1

Reviewed by J.L. McGhee Date 11-7-88

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Geologic/Hydrologic Data: Diagram Litho.	Geologic/Hydrologic Data: Lithologic Description
21' 3/4" OF 10" CARBON STEEL SURFACE CASING W/ DRIVE SHOE (REMOVED)		5		SILTY SANDY GRAVEL
		10		" " "
		15		" " "
		20		" " "
65' OF 5" CARBON STEEL CASING W/ DRIVE SHOE (REMOVED)		25		" " "
		30		" " "
		35		GRAVELLY SAND
		40		STATIC WATER @ 44.43'
35' OF 4" STAINLESS STEEL TYPE 304 CASING		45		SILTY SANDY GRAVEL
		50		SLIGHTLY SILTY GRAVELLY SAND
		55		SILTY SAND
25.05' OF 10 SLOT STAINLESS STEEL TYPE 304 (4" DIA)		60		" "
				RINGOLD CONTACT @ 52'
				DRILLED DEPTH: 62.44'
				COMPLETION DEPTH: 59.5'

CONNECTED SYMBOLS:
- CONCRETE PAD
- CEMENT GROUT
- BENTONITE GROUT
- BENTONITE PELLETS
- SAND PACK
- CASING JOINT
- CASING CENTRALIZER

A-1800-188 (3)

Figure F-39 Well 699-S40-E14 Source: Byrce and Goodwin (1989)

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AS-BUILT DIAGRAM

Well Number 699 - S43 - E12 100 AREA #4 Geologist TEEL, GOODWIN Page 1 of 1

Reviewed by [illegible] Date 11-8-88

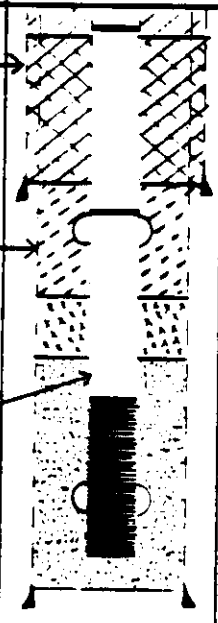
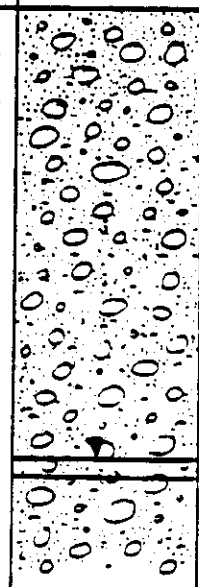
Construction Data		Depth in Feet	Geologic/Hydrologic Data	
Description	Diagram		Diagram Litho.	Lithologic Description
20' 5 1/2" to 10" CARBON STEEL SURFACE CASING w/ DRIVE SHOE (REMOVED)		5'		SANDY GRAVEL
		10'		" "
		15'		SILTY SANDY GRAVEL
		20'		" " "
60' 10" OR 8" CARBON STEEL CASING w/ DRIVE SHOE (REMOVED)		25'		" " "
		30'		" " "
		35'		" " "
		40'		" " "
45' OF 4" STAINLESS STEEL TYPE 304 CASING		45'		" " "
		50'		STATIC LEVEL @ 48.2' B.L.S.
		55'		RINGOLD CONTACT @ 53' B.L.S.
16' OF 20 SLOT STAINLESS STEEL TYPE 304 SCREEN (4" DIA.)		60'		" " "
				DRILLED DEPTH = 61.75'
				COMPLETION DEPTH = 53'
COMPLETION SYMBOLS:				
/// CONCRETE PAD				
CEMENT GROUT				
GRANULAR BENTONITE				
BENTONITE PELLETS				
SAND PACK				
CASING JOINT				
CASING CENTRALIZER				

Figure F-40 Well 699-S43-E12 Source: Bryce and Goodwin (1989)

A-1800-188 (3/87)

Battelle
Pacific Northwest Laboratories

AS-BUILT DIAGRAM

699-S37-E14

Well Number #5 Geologist TEEL, GOODWIN, CHAMNESS Page 1 of 1

Reviewed by [illegible] Date 11-8-88

Construction Data		Depth in Feet	Geologic/Hydrologic Data	
Description	Diagram		Diagram Litho.	Lithologic Description
20'8" of 10" carbon steel casing		5		SILTY SANDY GRAVEL
SURFACE CASING WITH		10		" " "
DRIVE SHOE (REMOVED)		15		" " "
		20		" " "
		25		" " "
50' of 4" STAINLESS		30		" " "
STEEL TYPE 304 CASING		35		" " "
		40		GRAVELLY SAND
		45		SILTY SANDY GRAVEL
62'4" of 8" carbon steel casing		50		" " ROUGHLY CONTACT @ 50' B.L.
WITH DRIVE SHOE (REMOVED)		55		" " STATIC H_2O @ 51.17' B.L.S.
		60		SANDY GRAVEL
IS 75' OF 20 SLOT STAIN-			TD = 62'6 1/2"	
LESS STEEL TYPE 304				DRILLED DEPTH = 62'6 1/2"
SCREEN (4" DIA.)				COMPLETION DEPTH = 63'
COMPLETION SYMBOLS:				
CONCRETE PAD				
CEMENT GROUT				
GRANULAR BENTONITE				
BENTONITE PELLETS				
SAND PACK				
CASING JOINT				
CASING CONTRACTION				

Figure F-41 Well 699-S37-E14 Source: Bryce and Goodwin (1989)

A-1800-188 (3/87)

699-S30-E15C (DDH-3)
Location: S30383, E15232 10/28-1463
Casing Elevation: 401.74
Cable tool (to 219 ft.) & diamond coring, drilled by Smith & Wilcox of Hagen Drilling Company for GE Company & Boyles Brothers Drilling Company for ARHCO, 1970, groundwater monitoring borehole & bedrock geology investigation borehole

Material (1, 17)	Thickness	Depth
Brown sand fine	2	2
Cemented gravel & 10 in. minus cobbles	1	2
Cemented gravel w/little sand, dark gray in color	3	5
Cemented gravel & cobbles w/ trace of sand	5	10
Cemented grout & cobbles w/ trace of sand	5	15
Cemented 2 in. minus gravel w/ coarse black sand, color dark gray to black	5	20
4 in. minus gravel w/some coarse black sand & a trace of brown sand	5	25
Lightly cemented 2 in. minus gravel w/sand, color gray	5	30
3 in. minus gravel w/coarse sand & some finer sand	5	35
2 1/2 in. minus gravel & coarse sand w/little fine sand	5	40
Coarse sand w/2 1/2 in. minus gravel, trace of fine sand	5	45
3 in. minus gravel w/little sand	5	50
2 1/2 in. minus gravel w/trace of sand	5	55
2 1/2 in. minus gravel w/trace of sand, color of material gray	5	60
2 in. minus gravel w/coarse & fine sand	5	65
3 in. minus gravel w/some sand, material has a light brown color	5	70
1 1/2 in. minus gravel w/ coarse & fine sand, water color light brown	5	75
1 1/2 in. minus gravel w/some coarse & fine sand, water color light brown	5	80
1 in. minus gravel w/some coarse & fine sand, trace of silt, water color brown	5	85
1 1/2 in. minus gravel tightly packed w/light brown & blue sand	5	90
2 in. minus gravel w/green sand & a little black clay, very tightly packed	5	95
3 in. minus gravel w/green sand & a little black clay, very tightly packed	5	100
2 1/2 in. minus gravel w/green sand very tightly packed	5	105
2 in. minus gravel w/green sand very tightly packed	5	110
3 in. minus gravel w/little light gray sand, very tightly packed	5	115
3 1/2 in. minus gravel & white & gray sand	5	120
Greenish blue clay w/some pebbles in it (silty)	5	125
Greenish blue clay w/small pebbles & a little silty	5	130
Fine green sand w/some hard lumps of sand	5	135
3 in. minus gravel w/green sand	5	140
2 in. minus gravel w/fine sand & coarse sand	5	145
1 in. minus gravel w/fine sand & some coarse sand	5	150
4 in. minus gravel w/some greenish blue sand	5	155
1 in. minus gravel w/greenish blue sand, very tightly packed	5	160
Clayey silt	5	165
Silt & clay, dark brown	5	170
Silt & clay w/stray 1 in. gravel dark brown	5	175
Silt & clay w/blue tint to it	20	195
2 in. minus pits of soft basalt w/coarse sand & blue clay	5	200
Basalt gravel & coarse sand w/ some clay	5	205
Basalt bedrock w/sand	5	210
Basalt bedrock	5	215
Basalt	69	284
Tuffaceous sandstone	39	323
Basalt	31	354
Altered rubble	8	362
Basalt	105	457
Tuffaceous sandstone	17	474
Black clay	1	475
Tuffaceous sandstone	8	487
Basalt	184	671
Sandstone	6	677
Highly altered rubble zone	23	700
Basalt	68	768
Clay	2	770
Altered tuff	72	842
Altered vesicular rubble zone	16	866
Basalt	253	1,119
Brown clay	17	1,136
Sandstone	8	1,144
Tuffaceous sandstone	14	1,158
Vesicular rubble zone	12	1,170
Basalt	124	1,294
Intermixed clay & sandstone, coal fragments	25	1,319
Basalt	125	1,544
Reddish oxidation zone	8	1,552
Basalt	8	1,560
Altered rubble zone	10	1,570
Basalt	1,970	3,540

Figure F-42 Well 699-S30-E15C Source: Fecht and Lillie (1982)

Logs of type wells on the Hanford Reservation

[Stratigraphic designations by R. C. Newcomb]

Materials	Thickness (feet)	Depth (feet)
10/28-10G1		
[Drilling, sampling, and stratigraphic designations of samples by U.S. Geol. Survey. Leveling and altitude data by Gen. Elec. Co.]		
Alluvium:		
Sand, silty; about 40 percent quartz and 60 percent basalt; angular to subangular; poorly sorted — mostly coarse to fine sand with some ¼- to ½-in. diameter gravel and a few boulders; some artificial fill in places	3	3
Glaciofluviatile and fluviatile deposits:		
Gravel, sandy and bouldery; contains a small amount of silt; basalt predominates in the gravel and coarse sand and makes up 80 percent of the finer sand; sand is angular to subangular, and gravel is subrounded to subrounded	12	15
Gravel, sandy and slightly silty; pebbles, averaging 1 to 3 in. in diameter, are subrounded to subangular, about 40 percent basalt and 60 percent exotic types; material is about 40 percent gravel, 55 percent medium to very fine sand, and 15 percent silt	6	21
Gravel, sandy; gravel forms 60 percent of sample, sand 25 percent, and silt 15 percent; ratio of basalt to exotic types in gravel is about 65 percent–35 percent; sand is about 55 percent basalt and 45 percent exotics and quartz; gravel is subangular to subrounded and has 3-in. maximum diameter and 1-in. average diameter	4	25
Gravel, coarse to fine, and coarse sand; maximum diameter of gravel 4 in., average diameter 2 in.; pebbles form about 80 percent of bed; basalt component of pebble gravel about 40 percent at 30-ft depth, decreasing gradually to 20 percent at 50-ft depth; basalt in coarse to medium sand decreases gradually from 30 percent at 30-ft depth to 5 percent at 50-ft depth; almost no silt present	25	50
Ringold Formation:		
Gravel; mostly exotic rock types; fine to coarse from ¼ to 6 in. in diameter, although mainly pebbles with occasional cobbles, in a medium clean micaceous, quartzose sand matrix; upper 10 ft of this gravel is highly calcareous and gives strong reaction to acid; sand content increases to 55 percent of sample in 57- to 60-ft zone, remainder being gravel	13	63
Gravel, exotic-type, subrounded to subangular; has thin silt and clay zones in bottom foot of bed	4	67
Clay, light-tan; contains a few ½-in. angular pebbles	5	72
Clay, light-tan, finely micaceous, slightly silty	9	81
Clay, light-tan, slightly silty; has a few 1/16- to ¼-in. diameter rounded to subrounded indurated claystone nodules	3	84
Gravel, granule and pebble, in a silty clay matrix; approximate percentages: granule gravel, 75; pebble gravel, 15; silty clay, 10; rock particles are about half exotic and half basalt, all rounded to subrounded	3	87

Figure F-43 Well 10/28-10G1

Source: Newcomb et al. (1972)

Logs of type wells on the Hanford Reservation — Continued

Materials	Thickness (feet)	Depth (feet)
Ringold Formation—Continued		
Siltstone, light-tan, clayey, very finely micaceous	4	91
Sand, quartzose and micaceous, medium to fine, well-sorted, over 90 percent siliceous, and gravel mainly of dark exotic types mostly about ½ to 1½ in. in diameter; gravel about 30 percent of sample in 91- to 96-ft zone increasing to 50 percent of sample in the 96- to 99-ft zone	8	99
Sand, silty and clayey, and gravel; gravel, maximum diameter 1 in., forms approximately 20 percent of sample; rude ⅛-in.-thick weathering rind on basalt pebbles	3	102
Sand, quartzose and micaceous, and gravel, as in 91- to 96-ft zone; good weathering rind on basalt	4	106
Gravel, sandy, as in 91- to 99-ft bed except that gravel component has increased to 80 percent of sample; gravel in lower 6 ft increases in size to maximum diameter of 4 in. and average diameter of 2½ in.; larger gravel is about 20 percent basalt having weathering rinds	10	116
Sand, quartzitic and micaceous, medium to fine, well-sorted; medium to heavy response to acid test	4	120
Siltstone, gravelly and slightly clayey; gravel of ¼-in. diameter forms 40 percent of bed in 120- to 123-ft zone, is absent in 123- to 126-ft zone and increases to 50 percent of sample in 126- to 130-ft zone, where the maximum diameter is 3 in.; gravel is mainly exotic types, and sand is siliceous	10	130
Sand, silty; contains about 3 percent subrounded granule gravel	6	136
Gravel, sandy and bouldery; gravel forms about 80 percent of bed, is 50 percent granules, and is composed mainly of dark exotic rocks; cemented sand coatings on pebbles and excellent ⅛-in.-thick rinds on basalts	5	141
Sand, fine to medium, micaceous; about 90 percent clear angular to subangular quartz, about 2 percent basalt, and estimated 1 percent calcareous grains; very reactive to acid test; a sand interbed in gravel of 136- to 165-ft unit	3	144
Gravel, pebble and boulder, in a clayey sand; subrounded gravel, mainly of exotic types, forms 50 percent of bed in 144- to 156-ft zone and increases to 80 percent in 156- to 165-ft zone	21	165
Gravel, boulder, cobble, and pebble; pebble gravel is mainly ½ to 1 in. in diameter	6	171
Ringold Formation—Continued		
Silt, clayey, gray-tan; contains about 5 percent angular granules — both exotics and basalt; fewer rock particles in lower half of bed than in upper half	6	177
Clay, silty, gray-tan; has thin laminae of fine gray-white volcanic ash near bottom of bed	13	190
Clay, blue-gray, has some greenish laminae	2	192
Sand, basaltic; sand is 80 percent coarse to fine black basalt, with 10 percent quartz and 10 percent calcareous cement; some basalt and cemented fragments are ¼ in. in diameter; pyrite occurs as rare vesicle filling in basalt pebbles; water-bearing	2	194
Basalt of the Columbia River Group:		
Basalt, black, dense to vesicular; contains about 30 percent khaki banded and botryoidal opaline vesicle fillings, together with some clear feldspar and rounded and frosted quartz vesicle fillings; secondary minerals abundant in upper part of basalt; basalt is weathered and clayey in upper part but fresh and hard below 200-ft depth	18	212

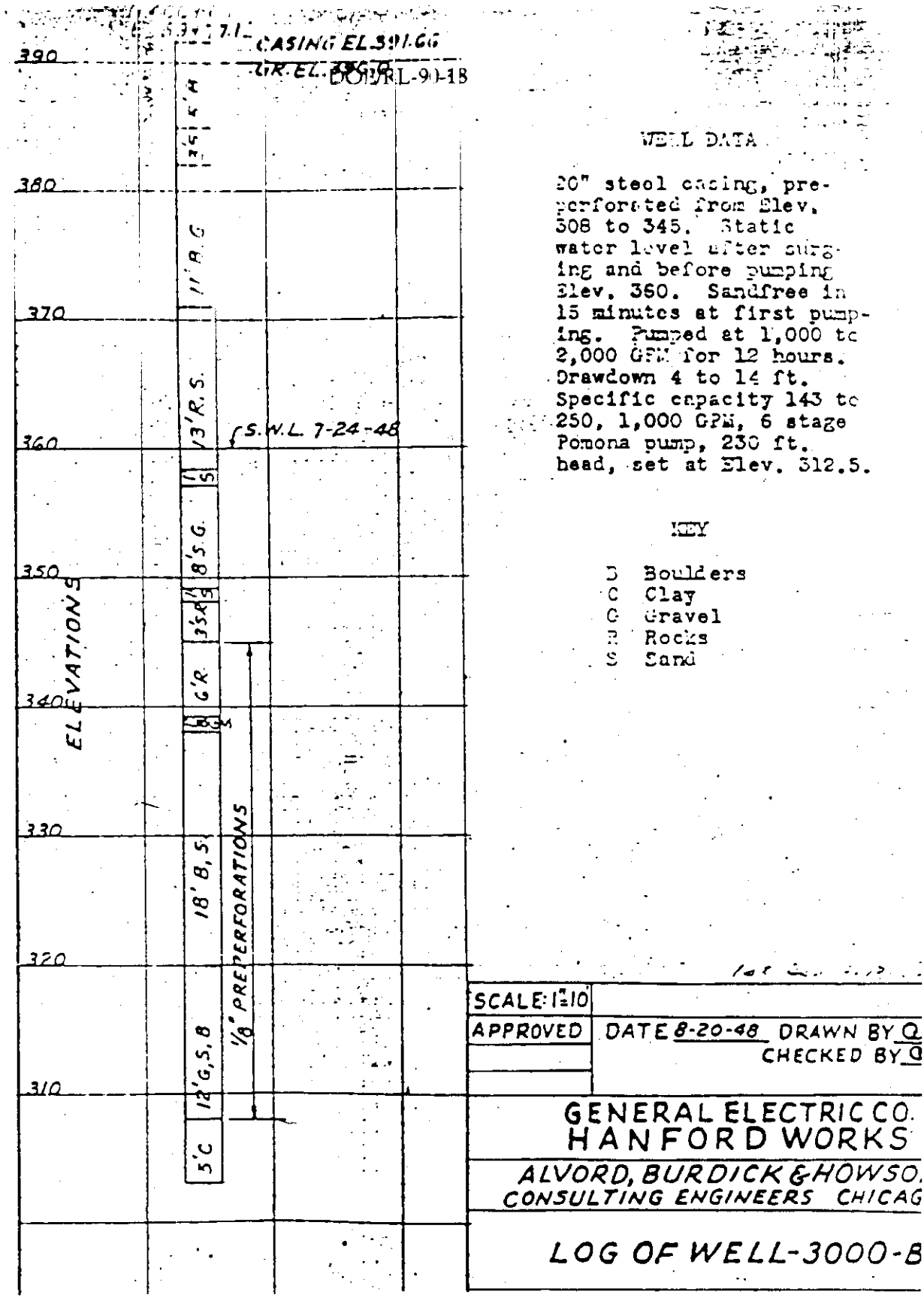


Figure 44 Well 3000-B

Source: CWC-HDR, Inc. (1988)

699-S32-E13A

DRILLING LOG

Casing @ = 390.46

RIG NUMBER	WELL NUMBER	DATE	PROJECT NUM
	1	9-21-79	
DRILLER	FOREMAN	SHIFT	DEPTH BEGINNING OF SHIFT: 0'
			DEPTH COMPLETION: 100'

DRILLING TIME	DRILLING DEPTH	CORING TIME	CORING DEPTH	TYPE SOIL	OTHER DELAYS TIME	OTHER DELAYS EXPLANATION
	0-4					Moja sand
	4-20					sand, tan + silty, med.
	20-52					cobbles to boulders and 3"-gravel fine black sand with gravel some cobbles + boulders
	52-75	20'	50 slot	50-70'		fine black + white sand
	75-76					brown clay with some sand
	76-80					blue clay with some gravel
	80-86					dark brown clay
	86-100					small gravel, cemented

REMARKS

Hit water table at about 50 ft.

Well completed 9-25-79; total depth 100 ft

Hanf. Coord

Figure F-45 Well 699-S32-E13A

Source: Lindberg, J., WHC (memo to S. Clark, WHC) May 11, 1990

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APPENDIX G
SUBSURFACE SOIL SAMPLING SCHEME SUMMARY

The purpose of this appendix is to suppliment Figures 2-11 through 2-18 in the text. The downhole distribution of samples collected from boreholes installed during Phase 1 of the 1100-EM-1 RI are presented in these tables organized by background, operable subunit and groundwater monitoring well physical samples.

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Background
Borehole: BAP-2

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM	Analysis CLP	SDG # CLP	Sample Duplicate	Sample Split	Field Blank	Matrix Spike	Matrix Spike Duplicate
A0201S	0.5-2.0	06/19/89		X	A0201S					
A0201S	0.5-2.0	06/20/89		X	A-0201		X		X	X
A0202S	5.5-6.5	06/20/89	X		-					
A0203S	8.3-9.6	06/20/89	X	X	A0201S				X	X
A0204S	11.5-13.0	06/20/89		X	A0201S					
A0205W	-	06/21/89		X	A0201S			X	X	X
A0206S	17.5-19.0	06/21/89		X	A0201S					
A0207S	17.5-19.0	06/21/89		X	A0201S	X				
A0208S	19.5-21.0	06/21/89	X	X	A0201S					
A0209S	25.20-26.65	06/21/89		X	A0201S					
A0210S	34.4-35.4	06/22/89	X	X	A0201S					
A0211S**	44.38-45.55	06/29/89	X	X	A0201S					

** - Sample was saturated

Background
Borehole: HRL-1

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM	Analysis CLP	SDG # CLP	Sample Duplicate	Sample Split	Field Blank	Matrix Spike	Matrix Spike Duplicate
A0301S	1.0-2.0	06/28/89		X	A0301S				X	X
A0302S	6.98-7.98	06/29/89	X	X	A0301S					
A0303S	6.98-7.98	06/29/89		X	A-0303		X		X	X
A0304W	-	06/29/89		X	A0301S			X	X	X
A0305W	-	06/29/89		X	A0301S			X	X	X
A0306S	11.66-13.66	06/29/89		X	A0301S				X	X
A0307S	15.0-16.0	06/29/89	X		-					

Background
Borehole: DP-7

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM	Analysis CLP	SDG # CLP	Sample Duplicate	Sample Split	Field Blank	Matrix Spike	Matrix Spike Duplicate
A0101S	0.7-2.0	06/07/89	X	X	A0101S				X	X
A0102S	3.0-4.0	06/09/89		X	*					
A0103S	5.2-6.5	06/12/89		X	*					
A0104S	12.2-13.5	06/12/89		X	A0103S					
A0104S	12.2-13.5	06/12/89		X	A-0104		X		X	X
A0105S	16.5-18.0	06/13/89	X	X	A0103S					
A0106S	16.5-18.0	06/13/89		X	A0103S	X				
A0107S	23.5-24.0	06/13/89		X	*					
A0108W	-	06/13/89		X	A0103S			X	X	X
A0109S	28.4-30.0	06/14/89	X	X	A0103S				X	X
A0110S	33.5-35.0	06/14/89		X	*					
A0111S**	39.9-40.8	06/14/89	X	X	A0103S				X	X

* - Sample taken analysis not conducted per WHC
** - Sample was saturated

1100-1, Battery Acid Pit
Borehole: BAP-1

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM	Analysis CLP	SDG # CLP	Sample Duplicate	Sample Split	Field Blank	Matrix Spike	Matrix Spike Duplicate
A1001S	1.5-2.0	08/07/89		X	A1001S					
A1002S	2.2-4.2	08/07/89	X	X	A1001S					
A1003S	2.2-4.2	08/07/89		X	A1001S	X				
A1004S	5.3-6.1	08/07/89		X	A1001S				X	X
A1005S	5.3-6.1	08/07/89		X	A-1005		X		X	X
A1006S	6.1-6.8	08/07/89	X		-					
A1007W	-	08/08/89		X	A1001S			X		
A1008W	-	08/08/89		X	A1001S			X	X	X
A1009S	7.8-8.8	08/08/89	X		-					
A1010S	8.8-9.6	08/08/89		X	A1001S					
A1011S	11.4-11.9	08/08/89		X	A1001S					
A1012W	-	08/09/89		X	A1001S			X		
A1013S	13.4-13.9	08/09/89	X		-					
A1014S	13.9-15.8	08/09/89		X	A1001S					
A1015S	16.3-17.5	08/09/89	X	X	A1001S					
A1016S	18.1-19.8	08/09/89		X	A1001S					

1100-2, Paint and Solvent Pit
Borehole: DP-4

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM	Analysis CLP	SDG # CLP	Sample Duplicate	Sample Split	Field Blank	Matrix Spike	Matrix Spike Duplicate
A0401W	-	07/12/89		X	A0401W			X	X	X
A0402S	0.8-1.4	07/12/89	X	X	A0401W					
A0403S	0.8-1.4	07/12/89		X	A0401W	X				
A0404S	1.9-3.1	07/12/89	X	X	A0401W					
A0405S	1.9-3.1	07/12/89		X	A-0405		X		X	X
A0406S	3.3-5.1	07/12/89	X	X	A0401W					
A0407S	5.9-6.6	07/13/89		X	A0401W					
A0408S	7.2-8.6	07/13/89		X	A0401W					
A0409S	9.7-10.7	07/13/89		X	A0401W					
A0410S	10.7-12.4	07/13/89	X		-					
A0411S	12.9-14.4	07/13/89		X	A0401W					
A0412S	16.0-17.0	07/14/89	X		-					
A0413S	18.5-20.0	07/14/89		X	A0401W				X	X

1100-2, Paint and Solvent Pit
Borehole: DP-5

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM	Analysis CLP	SDG # CLP	Sample Duplicate	Sample Split	Field Blank	Matrix Spike	Matrix Spike Duplicate
A0501S	0.5-2.0	07/18/89		X	A0501S					
A0502S	0.5-2.0	07/18/89		X	A0501S	X				
A0503S	2.6-3.6	07/18/89	X		-					
A0504S	4.5-6.0	07/18/89		X	A0501S					
A0505S	6.6-7.1	07/18/89	X		-					
A0506S	8.2-9.7	07/18/89		X	A0501S					
A0507W	-	07/19/89		X	A0501S			X	X	X
A0508W	-	07/19/89		X	A0501S			X	X	X
A0509S	10.0-11.0	07/19/89	X		-					
A0510S	12.3-14.0	07/19/89		X	A0501S					
A0511S	12.3-14.0	07/19/89		X	A-0511		X		X	X
A0512S	15.0-15.7	07/19/89	X		-					
A0513S	16.2-18.0	07/19/89	X	X	A0501S					
A0514S	18.2-20.0	07/19/89		X	A0501S					

1100-2, Paint and Solvent Pit
Borehole: DP-6

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM	Analysis CLP	SDG # CLP	Sample Duplicate	Sample Split	Field Blank	Matrix Spike	Matrix Spike Duplicate
A0601W	-	07/21/89		X	A0501S			X		
A0602S	0.5-2.0	07/21/89		X	A0501S					
A0603S	0.5-2.0	07/21/89	X		-					
A0604S	2.5-3.7	07/21/89	X		-					
A0605S	4.2-5.7	07/21/89		X	A0501S				X	X
A0606S	4.2-5.7	07/21/89		X	A-0606		X		X	X
A0607S	4.2-5.7	07/24/89	X		-					
A0608S	6.3-7.9	07/24/89		X	A0608S					
A0609S	7.9-9.0	07/24/89	X		-					
A0610S	10.5-11.8	07/24/89		X	A0608S					
A0611S	12.8-13.8	07/24/89	X		-					
A0612S	14.1-15.8	07/25/89		X	A0608S					
A0613S	14.1-15.8	07/25/89		X	A0608S	X				
A0614S	16.3-17.3	07/25/89	X		-					
A0615S	18.1-20.0	07/25/89		X	A0608S					

1100-2, Paint and Solvent Pit
Borehole: DP-9

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM	Analysis CLP	SDG # CLP	Sample Duplicate	Sample Split	Field Blank	Matrix Spike	Matrix Spike Duplicate
A1101S	1.0-2.0	09/13/89		X	A1101S				X	X
A1102S	2.6-3.6	09/14/89	X		-					
A1103S	5.75-6.75	09/14/89		X	A1101S					
A1104S	6.75-7.10	09/14/89	X		-					
A1105S	7.5-9.0	09/15/89		X	A1101S					
A1106S	9.2-11.5	09/15/89		X	A1101S					
A1107S	9.2-11.5	09/15/89		X	A-1107		X		X	X
A1108S	9.0-9.2	09/15/89	X		-					
A1109S	9.2-11.5	09/15/89	X		-					
A1110S	9.2-11.5	09/15/89	X		-					
A1111S	11.7-13.4	09/15/89		X	A1101S					
A1112S	13.5-14.5	09/15/89	X		-					
A1113S	15.5-16.5	09/15/89	X		-					
A1114S	16.5-18.6	09/15/89		X	A1101S					
A1115S	20.3-21.8	09/18/89		X	A1101S				X	X
A1116S	20.3-21.8	09/18/89		X	A1101S	X				
A1117S	21.8-22.1	09/18/89	X		-					
A1118S	22.8-29.5	09/18/89		X	A1101S					
A1119W	-	09/19/89		X	A1101S			X	X	X
A1120S	25.0-26.0	09/19/89	X		-					
A1121S	29.3-30.5	09/19/89		X	A1101S					
A1122S	31.1-32.1	09/19/89	X		-					
A1123S	33.8-35.3	09/19/89		X	A1101S					
A1124S	35.5-36.8	09/19/89	X		-					
A1125S**	36.9-38.1	09/20/89	X	X	A1101S					
A1126S**	38.3-39.8	09/20/89		X	A1101S					

** - Sample was saturated

1100-3, Antifreeze and Degreaser Pit
Borehole: DP-1

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM	Analysis CLP	SDG # CLP	Sample Duplicate	Sample Split	Field Blank	Matrix Spike	Matrix Spike Duplicate
A0901S	1.8-4.0	08/02/89		X	A0803S					
A0902S	4.0-5.1	08/02/89	X		-					
A0903S	4.9-6.9	08/02/89		X	A0803S					
A0904W	-	08/02/89		X	A0803S			X		
A0905S	6.9-7.9	08/02/89	X		-					
A0906S	7.9-10.1	08/02/89		X	A0803S					
A0907S	9.9-12.3	08/02/89		X	A0803S					
A0908S	11.9-12.9	08/02/89	X		-					
A0909S	14.1-16.6	08/03/89		X	A0803S					
A0910S	14.1-16.6	08/03/89		X	A0803S	X				
A0911S	15.5-16.5	08/03/89	X		-					
A0912S	17.9-20.0	08/03/89		X	A0803S					

1100-3, Antifreeze and Degreaser Pit
Borehole: DP-2

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM	Analysis CLP	SDG # CLP	Sample Duplicate	Sample Split	Field Blank	Matrix Spike	Matrix Spike Duplicate
A0801S	1.3-2.0	07/28/89		X	A0608S					
A0802S	2.0-3.5	07/28/89	X		-					
A0803S	4.5-6.0	07/31/89		X	A0803S					
A0804S	6.5-8.0	07/31/89	X		-					
A0805W	-	07/31/89		X	A0803S			X	X	X
A0806S	8.5-10.2	07/31/89	X	X	A0803S					
A0807S	12.6-14.3	07/31/89	X	X	A0803S					
A0808S	12.6-14.3	07/31/89		X	A0803S	X				
A0809S	15.0-16.0	08/01/89	X		-					
A0810S	16.0-17.0	08/01/89		X	A0803S				X	X
A0811S	17.6-20.0	08/01/89	X	X	A0803S					

1100-3, Antifreeze and Degreaser Pit
Borehole: DP-3

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM	Analysis CLP	SDG # CLP	Sample Duplicate	Sample Split	Field Blank	Matrix Spike	Matrix Spike Duplicate
A0701W	-	07/27/89		X	A0608S			X	X	X
A0702S	1.3-2.0	07/27/89		X	A0608S					
A0703S	2.3-3.3	07/27/89	X		-					
A0704S	4.3-5.9	07/27/89		X	A0608S				X	X
A0705S	7.1-8.1	07/27/89	X		-					
A0706S	8.3-10.2	07/27/89		X	A0608S					
A0707S	10.1-10.8	07/27/89	X		-					
A0708S	11.7-13.0	07/28/89		X	A0608S					
A0709S	11.7-13.0	07/28/89		X	A0608S	X				
A0710S	13.2-14.3	07/28/89	X		-					
A0711S	15.2-16.0	07/28/89	X	X	A0608S					
A0712S	15.2-16.0	07/28/89		X	A-0712		X		X	X
A0713S	17.7-19.8	07/28/89		X	A0608S					

1100-3, Antifreeze and Degreaser Pit
Borehole: DP-8

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM	Analysis CLP	SDG # CLP	Sample Duplicate	Sample Split	Field Blank	Matrix Spike	Matrix Spike Duplicate
A1201S	1.0-2.5	09/26/89		X	A1201S				X	X
A1202S	2.5-3.7	09/26/89	X		-					
A1203S	4.5-6.3	09/26/89		X	A1201S					
A1204S	4.5-6.3	09/26/89		X	A-1204		X			
A1205S	7.2-8.9	09/26/89		X	A1201S					
A1206S	7.2-8.9	09/26/89		X	A-1204		X			
A1207S	7.7-8.9	09/27/89	X		-					
A1208S	10.8-12.5	09/27/89		X	A1201S					
A1209S	12.5-13.0	09/27/89	X		-					
A1210S	13.3-15.0	09/27/89		X	A1201S					
A1211W	-	09/27/89		X	A1201S			X	X	X
A1212S	15.1-16.1	09/27/89	X		-					
A1213S	16.8-18.3	09/27/89		X	A1201S					
A1214S	18.3-18.7	09/27/89	X		-					
A1215S	20.5-22.2	09/27/89	X	X	A1201S					
A1216S	23.7-26.4	09/28/89	X	X	A1201S					
A1217S	23.7-26.4	09/28/89		X	A1201S	X				
A1218S	26.4-27.4	09/28/89	X		-					
A1219S	27.4-28.7	09/28/89		X	*					
A1220S	30.2-31.4	09/28/89	X		-					
A1221S**	32.0-34.0	09/28/89		X	A1201S					
A1222S**	32.0-34.0	09/28/89		X	A-1222		X		X	X

* - Sample taken, analysis not performed because chain of custody was broken
** - Sample was saturated

1100-4, Antifreeze Tank
Borehole: ATS-1

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM	Analysis CLP	SDG # CLP	Sample Duplicate	Sample Split	Field Blank	Matrix Spike	Matrix Spike Duplicate
A1301S	1.2-2.7	11/01/89		X	A1301S				X	X
A1302S	4.1-5.6	11/01/89		X	A1301S					
A1303S	4.1-5.6	11/01/89		X	A1301S	X				
A1304S	6.1-7.4	11/01/89		X	A1301S					
A1305W	-	11/02/89		X	A1301S			X	X	X
A1306S	8.5-9.7	11/02/89		X	A1301S				X	X
A1307S #	10.9-11.6	11/07/89		X	A1307S					
A1308S #	11.9-12.9	11/09/89		X	A1307S					
A1309S #	12.9-14.3	11/09/89		X	A1307S				X	X
A1310S	12.9-14.3	11/09/89		X	A1310		X			
A1311S #	15.6-15.8	11/09/89		X	A1307S					
A1312S #	15.8-16.5	11/10/89		X	A1312S				X	X

- Ethylene Glycol Analysis completed

1100-4, Antifreeze Tank
Borehole: MW-3

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM	Analysis CLP	SDG # CLP	Sample Duplicate	Sample Split	Field Blank	Matrix Spike	Matrix Spike Duplicate
A2401W	-	02/07/90		X	A2401W			X		
A2402S	0.35-2.50	02/07/90		X	A2401W				X	
A2403S	2.5-4.1	02/07/90	X		-					
A2404S	5.2-7.6	02/07/90		X	A2401W				X	X
A2405S	5.2-7.6	02/07/90		X	A2401W	X				
A2406S	7.4-8.8	02/07/90	X		-					
A2407S	10.7-13.2	02/07/90		X	A2401W					
A2408S	15.1-16.9	02/08/90	X		-					
A2409S	17.8-20.4	02/08/90		X	A2401W					
A2410S	23.2-24.8	02/08/90	X		-					
A2411S	25.5-27.9	02/09/90		X	A2401W					
A2412S	35.3-37.0	02/09/90	X		-					
A2413S	36.6-39.2	02/09/90		X	A2413		X			
A2414S	36.6-39.2	02/09/90		X	A2414S					
A2415S	40.5-42.2	02/12/90	X		A2414S					
A2416S	41.2-43.1	02/12/90		X	A2414S					
A2417S	46.4-49.0	02/12/90		X	A2414S					
A2418S**	49.8-50.9	02/12/90		X	A2414S				X	X
MW-3-1**	64.7-67.0	02/14/90	X		-					
MW-3-2**	74.0-76.3	02/15/90	X		-					
MW-3-3**	81.74-83.74	02/16/90	X		-					

** - Sample was saturated

Horn Rapids Landfill
Borehole: HRL-2

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM	Analysis CLP	SDG # CLP	Sample Duplicate	Sample Split	Field Blank	Matrix Spike	Matrix Spike Duplicate
A1801W	-	01/18/90		X	A1615S			X		
A1802S	0.0-2.5	01/18/90		X	A1615S					
A1803S	3.4-4.8	01/18/90	X		-					
A1804S	5.1-7.9	01/18/90		X	A1615S					
A1805S	5.1-7.9	01/18/90		X	A1615S	X			X	X
A1806S	8.0-8.9	01/18/90	X		-					
A1807S	9.8-13.3	01/18/90		X	A1615S					
A1808S	9.8-13.3	01/18/90		X	A1808		X			
A1809S	12.5-13.5	01/18/90	X		-					
A1810S	13.9-16.2	01/19/90		X	A1615S					
A1811S	16.5-17.6	01/19/90	X		-					
A1812S	17.7-19.9	01/19/90		X	A1615S					
A1813S	20.0-21.7	01/19/90	X		-					
A1814S**	23.0-25.3	01/19/90		X	A1615S					

** - Sample was saturated

Horn Rapids Landfill
Borehole: HRL-3

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM	Analysis CLP	SDG # CLP	Sample Duplicate	Sample Split	Field Blank	Matrix Spike	Matrix Spike Duplicate
A2001W	-	01/22/90		X	A1901S			X	X	X
A2002S	0.0-2.5	01/22/90		X	A1901S					
A2003S	2.8-4.4	01/22/90	X		-					
A2004S	4.6-7.5	01/22/90		X	A1901S					
A2005S	4.6-7.5	01/22/90		X	A1901S	X				
A2006S	8.0-9.3	01/22/90	X		-					
A2007S	10.8-13.0	01/23/90		X	A1901S					
A2008S	13.3-14.5	01/23/90	X		-					
A2009S	14.5-17.0	01/23/90		X	A1901S					
A2010S	14.5-17.0	01/23/90		X	A2010		X			
A2011S	17.6-18.8	01/23/90	X		-					
A2012S	19.4-20.7	01/23/90		X	A1901S				X	X
A2013S**	22.0-23.2	01/23/90	X		-					
A2014S**	23.2-25.1	01/23/90		X	A1901S					

** - Sample was saturated

Horn Rapids Landfill
Borehole: HRL-4

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM	Analysis CLP	SDG # CLP	Sample Duplicate	Sample Split	Field Blank	Matrix Spike	Matrix Spike Duplicate
A2201W	-	01/26/90		X	A1912S			X	X	X
A2202S	0.0-2.8	01/26/90		X	A1912S				X	X
A2203S	3.2-4.6	01/26/90	X		-					
A2204S	5.4-8.0	01/26/90		X	A1912S					
A2205S	5.4-8.0	01/26/90		X	A1912S	X				
A2206S	8.2-9.7	01/26/90	X		-					
A2207S	10.5-13.6	01/26/90		X	A1912S					
A2208S	10.5-13.6	01/26/90		X	A2208		X			
A2209S	13.6-14.4	01/26/90	X		-					
A2210S	14.6-16.9	01/26/90		X	A1912S					
A2211S	17.4-18.9	01/29/90	X		-					
A2212S	19.4-21.3	01/29/90		X	A1912S					
A2213S**	21.5-23.2	01/29/90	X		-					
A2214S**	23.2-25.0	01/29/90		X	A2214S					

** - Sample was saturated

Horn Rapids Landfill
Borehole: HRL-5

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM	Analysis CLP	SDG # CLP	Sample Duplicate	Sample Split	Field Blank	Matrix Spike	Matrix Spike Duplicate
A1501W	-	01/08/90		X	A1501W			X	X	X
A1502S	0.0-2.1	01/08/90		X	A1501W				X	X
A1503S	3.8-6.0	01/08/90	X	X	A1501W					
A1504S	6.4-8.6	01/09/90		X	A1501W					
A1505S	8.6-9.4	01/09/90	X		-					
A1506S	9.4-11.6	01/09/90		X	A1501W					
A1507S	9.4-11.6	01/09/90		X	A1501W	X				
A1508S	11.8-13.1	01/09/90	X		-					
A1509S	13.1-15.5	01/09/90		X	A1501W					
A1510S	13.1-15.5	01/09/90		X	A1510		X			
A1511S	15.5-16.0	01/09/90	X		-					
A1512S	16.0-17.6	01/09/90		X	A1501W					
A1513S	19.9-21.5	01/09/90		X	A1501W					
A1514S	21.9-22.8	01/10/90	X		-					
A1515S**	23.6-25.6	01/10/90		X	A1501W					
A1517W	-	01/10/90		X	A1501W			X		

** - Sample was saturated

Horn Rapids Landfill
Borehole: HRL-6

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM	Analysis CLP	SDG # CLP	Sample Duplicate	Sample Split	Field Blank	Matrix Spike	Matrix Spike Duplicate
A1601S	2.4-4.8	01/10/90		X	A1501W					
A1602S	4.8-7.1	01/10/90		X	A1501W					
A1603W	-	01/10/90		X	A1501W			X	X	X
A1604S	7.1-9.4	01/10/90	X	X	A1501W					
A1605S	7.1-9.4	01/10/90		X	A1605		X			
A1606S	9.4-11.6	01/10/90	X	X	A1501W					
A1607S	11.6-13.9	01/10/90		X	A1501W					
A1608S	11.6-13.9	01/10/90		X	A1501W	X				
A1609S	16.2-18.5	01/11/90	X		-					
A1610S	18.5-20.8	01/11/90	X		-					
A1611S	21.5-23.0	01/11/90	X		-					
A1612S	23.0-24.2	01/12/90		X	A1501W					
A1613S	24.2-25.0	01/12/90		X	A1501W					
A1614S	24.2-25.0	01/12/90	X		-					
A1615S	25.0-25.2	01/15/90	X	X	A1615S	X			X	X
A1616S**	25.8-27.8	01/15/90	X	X	A1615S					

** - Sample was saturated

Horn Rapids Landfill
Borehole: HRL-7

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM	Analysis CLP	SDG # CLP	Sample Duplicate	Sample Split	Field Blank	Matrix Spike	Matrix Spike Duplicate
A2301S	0.0-2.5	01/31/89		X	A2214S					
A2302S	2.7-4.3	01/31/89	X		-					
A2303S	4.8-7.2	01/31/89		X	A2214S					
A2304S	4.8-7.2	01/31/89		X	A2214S	X			X	X
A2305S	7.3-8.4	01/31/89	X		-					
A2306S	8.9-11.2	01/31/89		X	A2214S					
A2307S	8.9-11.2	01/31/89		X	A2307		X			
A2308W	-	01/31/89		X	A2214S			X		
A2309S	11.2-12.2	01/31/89	X		-					
A2310S	12.7-15.1	02/01/89		X	A2214S					
A2311S	15.3-16.5	02/01/89	X		-					
A2312S	16.9-19.0	02/01/89		X	A2214S					
A2313S	19.0-20.0	02/01/89	X		-					
A2314S**	22.7-25.0	02/01/89		X	A2214S					

** - Sample was saturated

Horn Rapids Landfill
Borehole: HRL-8

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM	Analysis CLP	SDG # CLP	Sample Duplicate	Sample Split	Field Blank	Matrix Spike	Matrix Spike Duplicate
A1401W	-	12/19/89		X	A1401W			X	X	X
A1402S	0.0-2.5	12/19/89		X	A1401W					
A1403S	2.5-4.4	12/19/89	X		-					
A1404S	5.9-7.4	12/19/89		X	A1401W				X	X
A1405S	4.5-8.2	12/19/89	X		-					
A1406S	8.7-10.9	12/19/89		X	A1401W					
A1407S	8.7-10.9	12/19/89		X	A1407		X			
A1408S	10.9-12.8	12/20/89	X	X	A1401W					
A1409S	15.0-17.3	12/20/89		X	A1401W					
A1410S	17.6-18.8	12/20/89	X		-					
A1411S	20.7-22.6	12/20/89		X	A1401W					
A1412S	20.7-22.6	12/20/89		X	A1401W	X				
A1413S	22.6-23.1	12/20/89	X		-					
A1414S	23.1-24.6	12/20/89		X	A1401W					
A1415S**	26.3-28.1	12/20/89		X	A1401W					
A1416W	-	12/20/89		X	A1401W			X		

** - Sample was saturated

Horn Rapids Landfill
Borehole: HRL-9

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM	Analysis CLP	SDG # CLP	Sample Duplicate	Sample Split	Field Blank	Matrix Spike	Matrix Spike Duplicate
A1701S	0.0-2.5	01/15/90		X	A1615S					
A1702W	-	01/15/90		X	A1615S			X	X	X
A1703S	2.8-3.7	01/15/90	X		-					
A1704S	3.7-4.6	01/15/90		X	A1615S				X	X
A1705S	5.0-5.8	01/15/90	X		-					
A1706S	6.8-9.1	01/16/90		X	A1615S					
A1707S	6.8-9.1	01/16/90		X	A1615S	X				
A1708S	9.4-10.4	01/16/90	X		-					
A1709S	10.9-13.3	01/16/90		X	A1615S					
A1710S	10.9-13.3	01/16/90		X	A1710		X			
A1711S	14.2-15.2	01/16/90	X		-					
A1712S	16.7-19.2	01/16/90		X	A1615S					
A1713S	20.4-21.7	01/16/90	X		-					
A1714S	21.7-23.8	01/17/90		X	A1615S					
A1715S**	24.3-27.0	01/17/90		X	A1615S					

** - Sample was saturated

Horn Rapids Landfill
Borehole: HRL-10

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM	Analysis CLP	SDG # CLP	Sample Duplicate	Sample Split	Field Blank	Matrix Spike	Matrix Spike Duplicate
A1901S	0.0-2.3	01/22/90		X	A1901S					
A1902S	2.3-4.0	01/22/90		X	A1901S					
A1903S	2.3-4.0	01/22/90		X	A1903		X			
A1904S	4.0-6.3	01/22/90	X		-					
A1905S	6.9-9.1	01/22/90		X	A1901S					
A1906S	6.9-9.1	01/22/90		X	A1901S	X				
A1907S	9.1-11.4	01/22/90	X		-					
A1908S	11.4-13.7	01/22/90	X		-					
A1909W	-	01/23/90		X	A1901S			X	X	X
A1910S	16.9-17.8	01/23/90	X	X	A1901S					
A1911S	17.8-20.1	01/23/90	X	X	A1901S					
A1912S	25.9-27.9	01/25/90		X	A1912S					
A1913S	27.9-30.3	01/25/90	X		-					

Table G-7. Ground Water Monitoring Well Physical Sample Summary.

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM
MW-1-1	10.5 - 12.1	01/11/90	X
MW-1-2	21.0 - 22.0	01/13/90	X
MW-1-3	29.3 - 31.3	01/13/90	X
MW-1-4	34.0 - 35.0	01/13/90	X
MW-1-5	40.0 - 41.7	01/15/90	X
MW-1-6	44.3 - 46.3	01/15/90	X
MW-1-7	47.0 - 48.0	01/15/90	X
MW-1-8	55.2 - 56.8	01/16/90	X
MW-1-9	92.0 - 94.0	01/22/90	X
MW-2-1	11.5 - 12.8	01/25/90	X
MW-2-2	19.0 - 20.0	01/25/90	X
MW-2-3	26.0 - 27.0	01/26/90	X
MW-4-1	8.5 - 9.5	11/09/89	X
MW-4-2	16.0 - 17.0	11/10/89	X
MW-4-3	31.0 - 32.0	11/13/89	X
MW-4-4	50.0 - 52.0	11/15/89	X
MW-4-5	56.0 - 58.0	11/16/89	X
MW-4-6	60.0 - 62.0	11/17/89	X
MW-5-1	2.4 - 2.5	12/07/89	X
MW-5-2	5.8 - 6.0	12/07/89	X
MW-5-3	14.5 - 15.0	12/07/89	X
MW-5-4	18.5 - 19.0	12/08/89	X
MW-5-5	34.5 - 35.0	12/11/89	X
MW-5-6	48.0 - 48.5	12/12/89	X
MW-5-7	50.0 - 50.5	12/12/89	X
MW-5-8	54.5 - 55.0	12/13/89	X
MW-5-9	64.5 - 66.5	12/14/89	X
MW-5-10	69.7 - 70.7	12/15/89	X
MW-5-11	74.5 - 76.5	12/15/89	X
MW-5-12	79.5 - 81.5	12/18/89	X
MW-5-13	86.6 - 88.6	12/18/89	X
MW-6-1	24.0 - 25.0	11/13/89	X
MW-6-2	43.0 - 44.4	11/13/89	X
MW-6-3	49.4 - 51.4	11/15/89	X
MW-6-4	85.0 - 87.0	11/20/89	X
MW-6-5	89.0 - 91.0	11/20/89	X
MW-7-1	41.6 - 44.2	12/07/89	X
MW-7-2	45.4 - 48.4	12/07/89	X
MW-7-3	54.2 - 56.2	12/07/89	X
MW-7-4	87.3 - 89.3	12/07/89	X
MW-8-1	3.5 - 4.0	10/23/89	X
MW-8-2	28.0 - 30.5	10/30/89	X
MW-8-3	30.0 - 30.5	10/30/89	X

Table G-7. Ground Water Monitoring Well Physical Sample Summary.

Sample Id	Sample Depth (ft)	Sample Date	Analysis ASTM
MW-9-1	4.6 - 5.2	01/03/90	X
MW-9-2	- - -	01/04/90	X
MW-9-3	14.1 - 15.2	01/04/90	X
MW-9-4	25.0 - 26.3	01/05/90	X
MW-9-5	32.0 - 32.5	01/05/90	X
MW-9-6	35.9 - 37.9	01/05/90	X
MW-9-7	62.6 - 63.2	01/17/90	X
MW-9-8	66.8 - 67.6	01/18/90	X
MW-9-9	69.0 - 69.6	01/18/90	X
MW-10-1	9.5 - 10.5	11/06/89	X
MW-10-2	14.5 - 15.0	11/07/89	X
MW-10-3	18.6 - 19.0	11/07/89	X
MW-10-4	41.5 - 42.0	11/09/89	X
MW-10-5	47.0 - 49.0	11/09/89	X
MW-10-6	65.5 - 67.5	11/14/89	X
MW-11-1	8.6 - 9.4	12/15/89	X
MW-11-2	43.0 - 44.0	12/19/89	X
MW-11-3	49.0 - 50.0	12/19/89	X
MW-11-4	53.0 - 53.5	12/19/89	X
MW-12-1	1.0 - 1.5	01/13/90	X
MW-12-2	3.5 - 4.0	01/13/90	X
MW-12-3	5.5 - 6.0	01/13/90	X
MW-12-4	6.5 - 7.0	01/13/90	X
MW-12-5	7.0 - 7.5	01/13/90	X
MW-12-6	10.0 - 10.5	01/13/90	X
MW-12-7	11.5 - 12.0	01/13/90	X
MW-12-8	16.5 - 17.0	01/13/90	X
MW-12-9	26.5 - 27.0	01/15/90	X
MW-12-10	33.5 - 34.0	01/15/90	X
MW-12-11	57.7 - 58.2	01/16/90	X
MW-12-12	58.2 - 58.7	01/16/90	X
MW-13-1	9.5 - 10.0	01/08/90	X
MW-13-2	13.0 - 13.5	01/08/90	X
MW-13-3	14.0 - 14.5	01/08/90	X
MW-13-4	17.5 - 18.0	01/08/90	X
MW-13-5	25.5 - 26.0	01/09/90	X
MW-13-6	43.5 - 44.0	01/09/90	X
MW-14-1	7.6 - 8.6	12/29/89	X
MW-14-2	10.8 - 11.5	12/29/89	X
MW-14-3	20.5 - 21.0	01/02/90	X
MW-14-4	21.5 - 22.0	01/02/90	X
MW-14-5	31.0 - 31.5	01/02/90	X
MW-14-6	33.0 - 33.5	01/02/90	X

APPENDIX H
SOIL PHYSICAL ANALYTICAL RESULTS

The purpose of this appendix is to provide a summary of soil physical analytical results and the grain size distribution plots for samples collected during 1100-EM-1 Phase I RI. Analyses were conducted by Westinghouse Hanford and Golder Associates. A complete set of data is available in the DOE-RL 1100-EM-1 Administrative Record. The DOE-RL 1100-EM-1 Administrative Record is managed by Westinghouse Hanford's Department of Engineering Environmental Information Management Center, and is located at the following address:

U.S. Department of Energy-Richland Operations Office
Administrative Record Center
345 Hills Street
Richland, WA 99352

This appendix is further divided into subappendices for background, surface, and subsurface soils samples results organized by operable subunit and the operable unit monitoring wells soil samples results. Refer in the text to Figure 2-11-2-18 for sampling locations.

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SUBAPPENDIX H-1
BACKGROUND SOIL PHYSICAL ANALYTICAL RESULT

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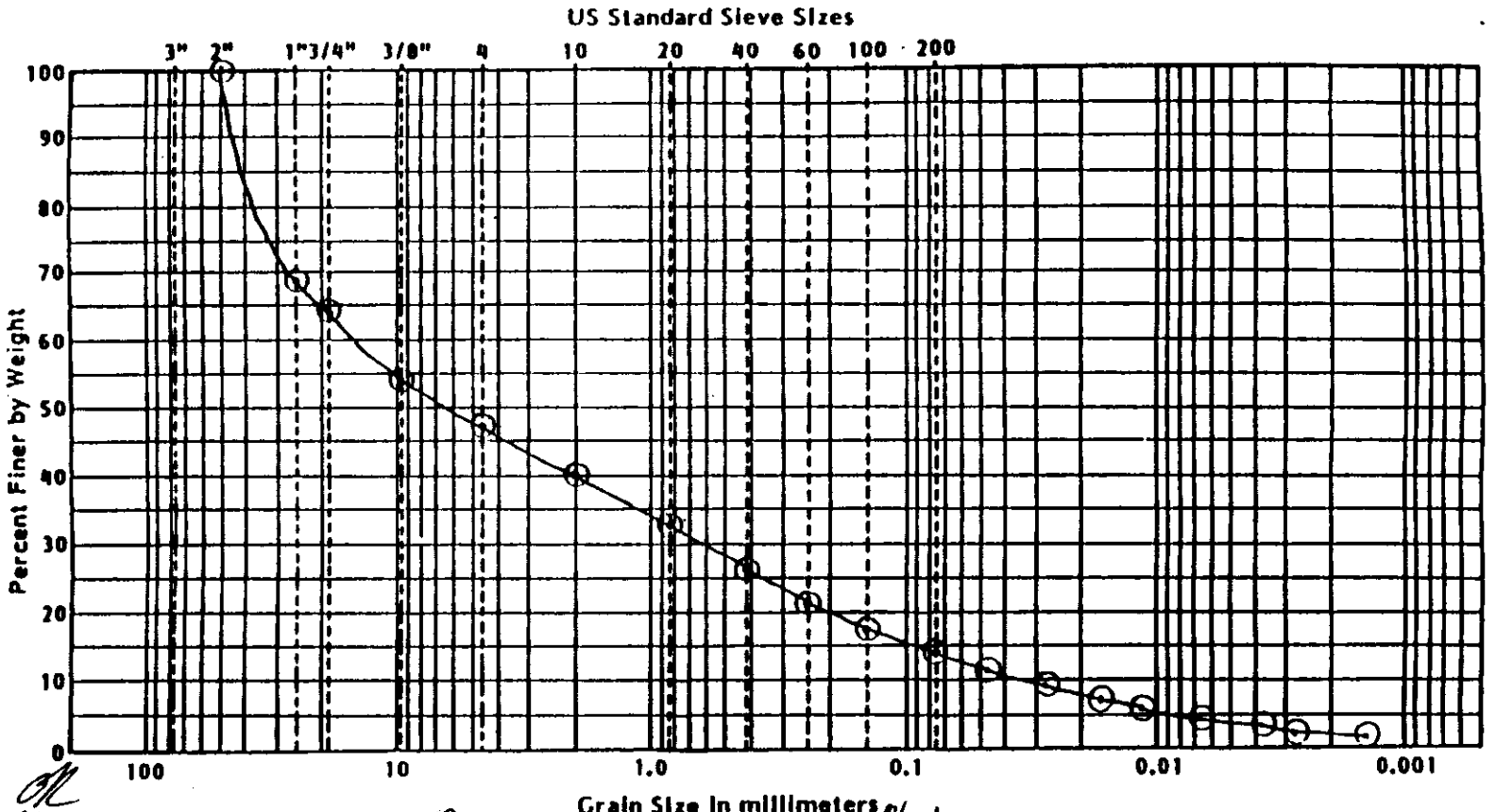
TABLE H-1. SUMMARY OF SOIL PHYSICAL ANALYTICAL RESULTS FOR BACKGROUND SAMPLES

Background Borehole	Sample Id	Sample Depth (ft)	Sample Date	Moisture Content (%)	Unified Soil Classification (Group Criteria Only)
BAP-2	A0202	5.5 - 6.5	06/20/89	1.7	Gravel with fines
	A0203	8.3 - 9.6	06/20/89	1.8	Gravel with fines
	A0208	19.5 - 21.0	06/21/89	2.0	Gravel with fines
	A0210	34.4 - 35.4	06/22/89	2.2	Gravel with fines
	A0211	44.4 - 45.6	06/29/89	**	Sand
HRL-1	A0302	7.0 - 8.0	06/29/89	1.7	Gravel with fines
	A0307	15.0 - 16.0	06/29/89	3.6	Sand with fines
DP-7	A0101	0.7 - 2.0	06/07/89	2.4	Gravel with fines
	A0105	16.5 - 18.0	06/13/89	1.6	Gravel with fines
	A0109	28.4 - 30.0	06/14/89	3.7	Sand with fines
	A0111	39.9 - 40.8	06/14/89	**	Sand with fines

Preliminary, Unvalidated Data To Be Used by Cognizant Engineer Only



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
		52%			34%	14%

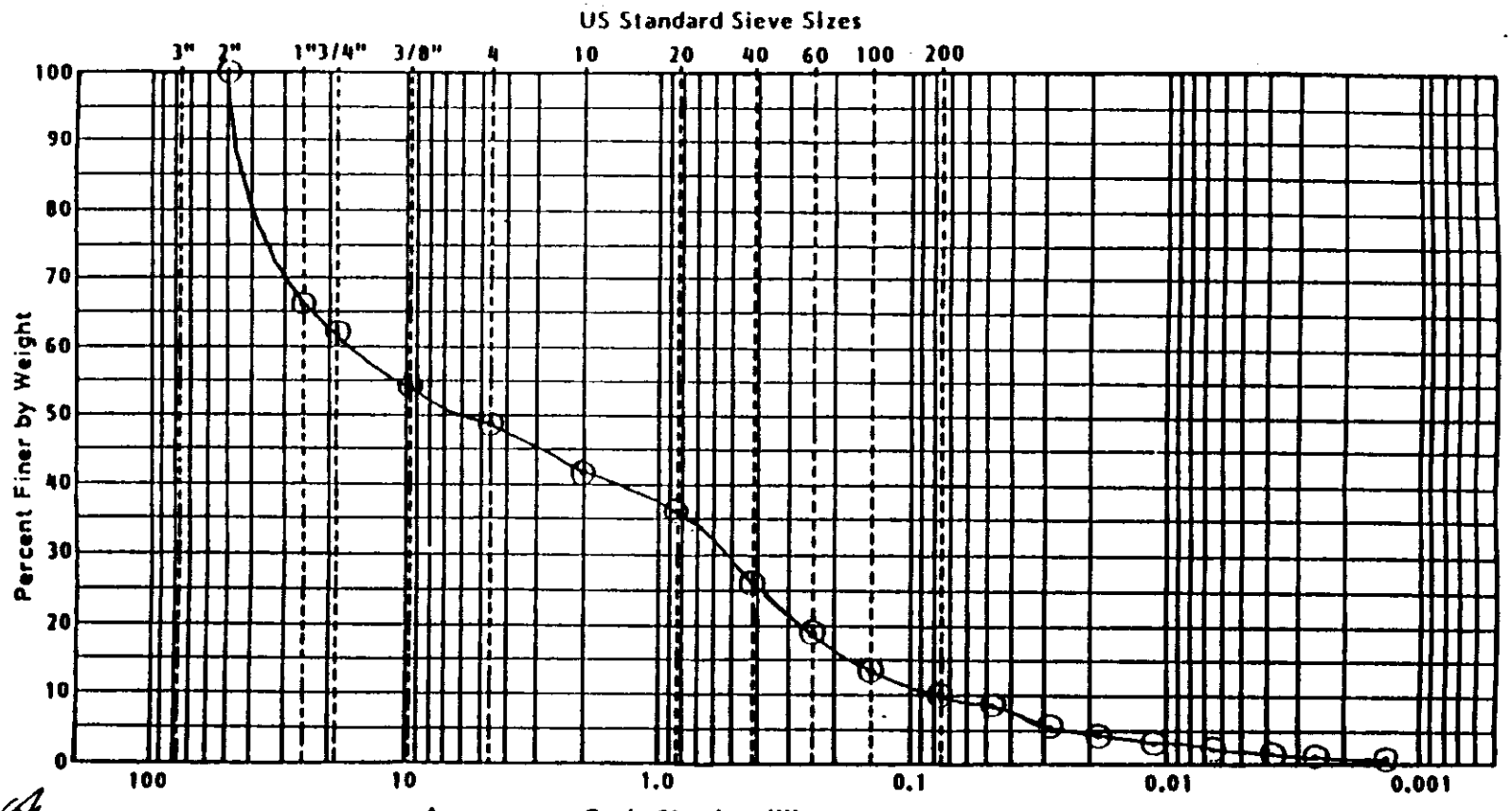
Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description or Classification
BAP-2 A0203		1.8				Dark gray coarse to fine GRAVEL and fine to coarse SAND, some silt. (GM). Note: Insufficient sample received. Does not conform to ASTM D-422

Figure
GRAIN SIZE DISTRIBUTION

Project: WHC / 100-KR-1 / WA
Project No. 893-1252-001 Date 2/13/93 Tested by SBM Approved by KLS

Golder Associ

Preliminary, Unvalidated Data To Be Used by Cognizant Engineer Only



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
		9%			29%	20%

Boring No.	Elev. or Depth	W_n	W_L	W_p	I_p	Description or Classification
BAP-2 A0202						Dark gray coarse to fine GRAVEL and fine to coarse SAND. (GP-GM) little silt. Note: Insufficient sample received. Does not conform to ASTM D-422

Project: W HC / 1100 - EM-1 / WA

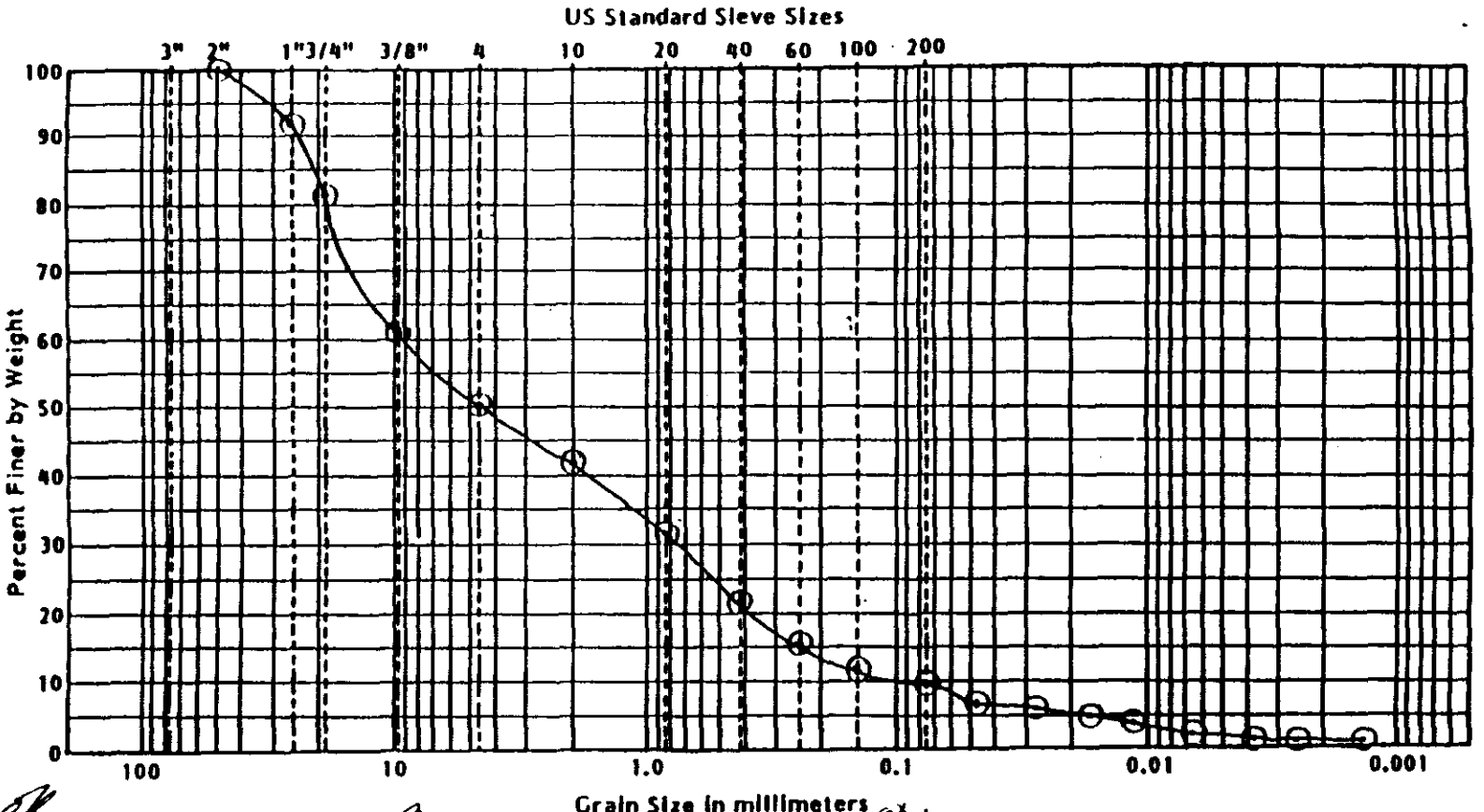
Project No. 893-12551.001 Date 2/12/90 Tested by CDM Approved by RKB

Figure
GRAIN SIZE DISTRIBUTION

Golder Associates

GR
MD
2/16-90

Preliminary, Unvalidated Data To Be Used by Cognizant Engineer Only



50 80

Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
		50%		30%		20%

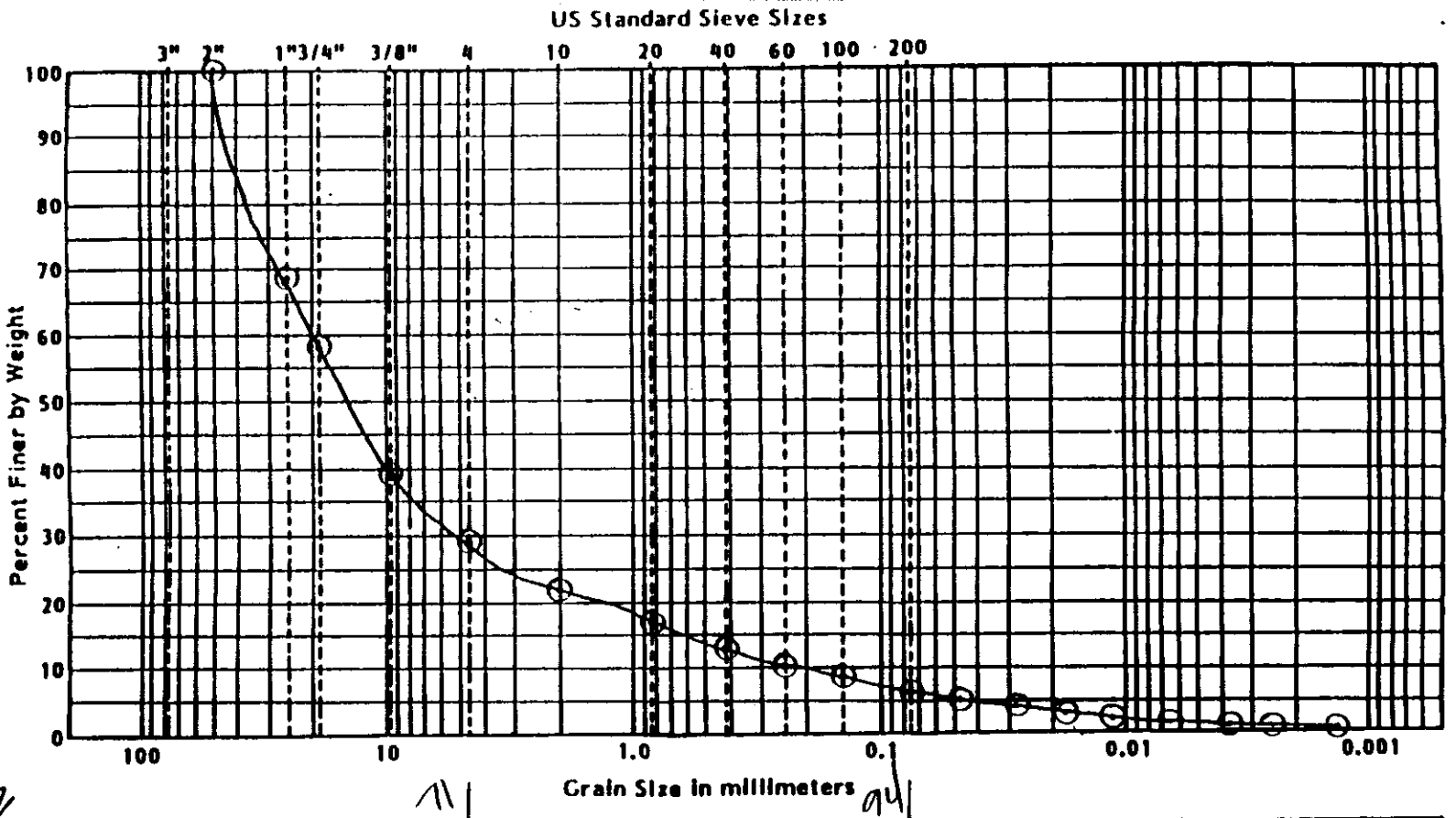
Boring No.	Elev. or Depth	W_n	W_L	W_p	I_p	Description or Classification
BAP-2 A0208		2.0				Grayish black fine to coarse SAND and GRAVEL, little silt. (GP-GM) Note: Insufficient sample received.

Figure
GRAIN SIZE DISTRIBUTION

Project: BHC/UBA-EMI/WA
Project No. 88-1254.001 Date 2/11/89 Tested by SAM Approved by KKB

Golder Assoc

Preliminary, Unvalidated Data To Be Used by Cognizant Engineer Only



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
		11%			83%	6%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description or Classification
BAP-2 A0210		2.2				Dark gray coarse to fine GRAVEL, some coarse to fine sand, little silt. (GP-GM) Note: Insufficient sample received. Does not conform to ASTM D-422

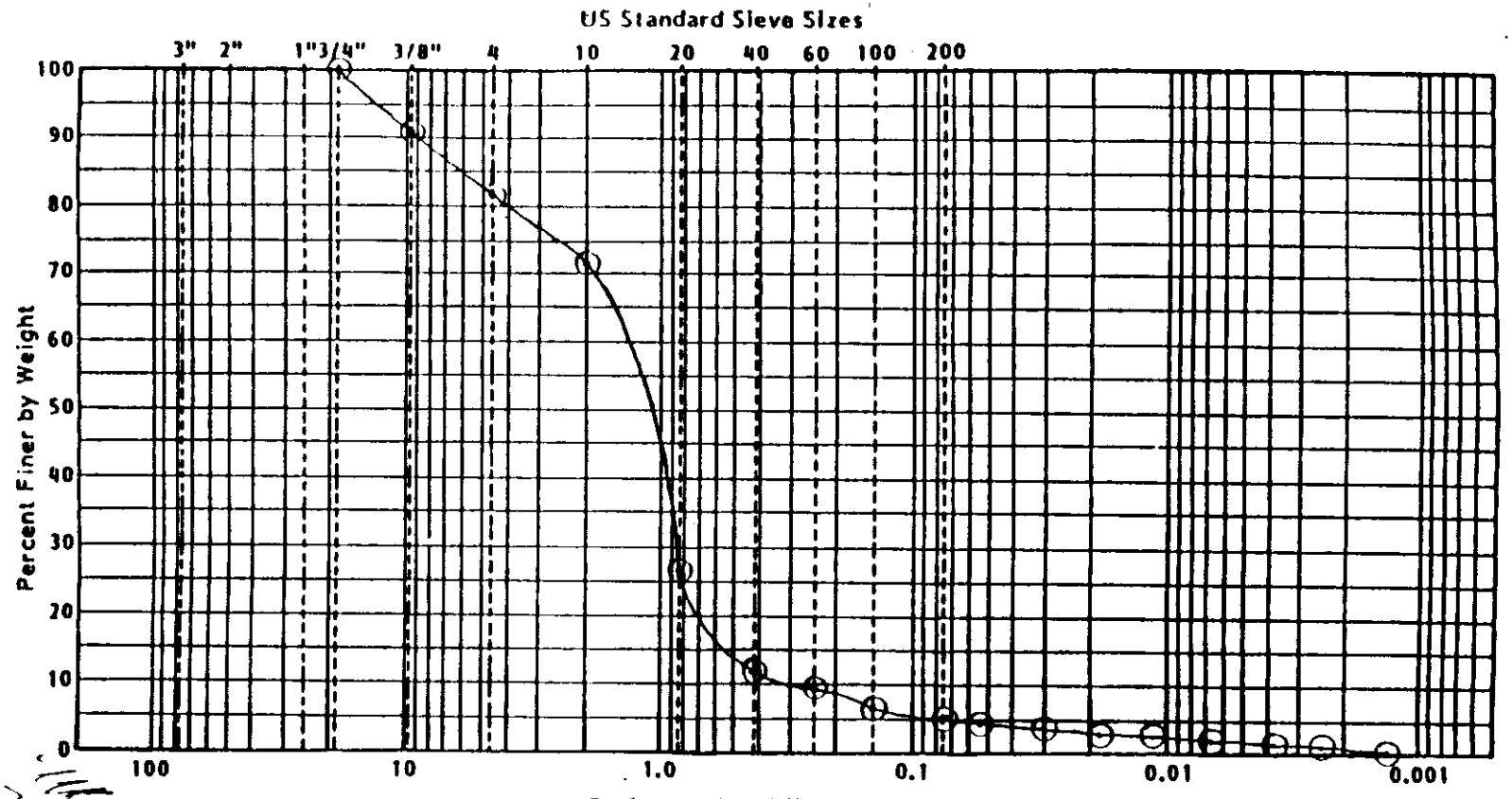
Project: SHS/100-GM-1 (WA
Project No. 123-1257-001 Date 2/18/92 Tested by GBM Approved by KKS

Figure
GRAIN SIZE DISTRIBUTION

Golder Associates

OK MD 2-26-92

Preliminary, Unvalidated Data -- To Be Used by Cognizant Engineer Only



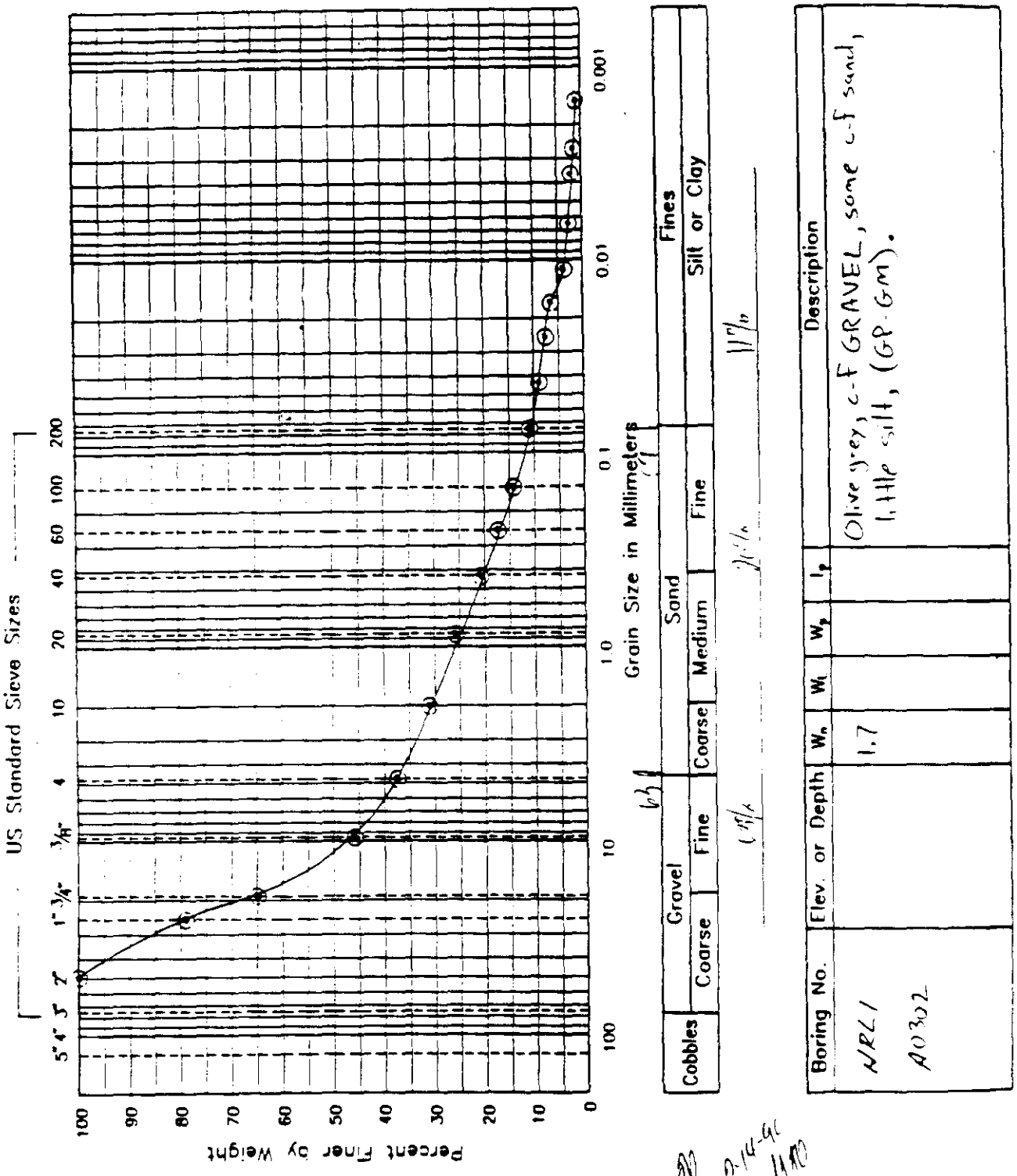
Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
		18%			77%	5%

Boring No.	Elev. or Depth	W_n	W_L	W_p	I_p	Description or Classification
BAP-2 A0211		7.9				Grayish black medium SAND, some fine gravel, little silt. (SP-SM)
						Note: Insufficient sample received.

Project: 200 West Area / WA
Project No. 87-1254-00 Date 2/12/88 Tested by CDM Approved by [illegible]

Golder Associates

Figure
GRAIN SIZE DISTRIBUTION

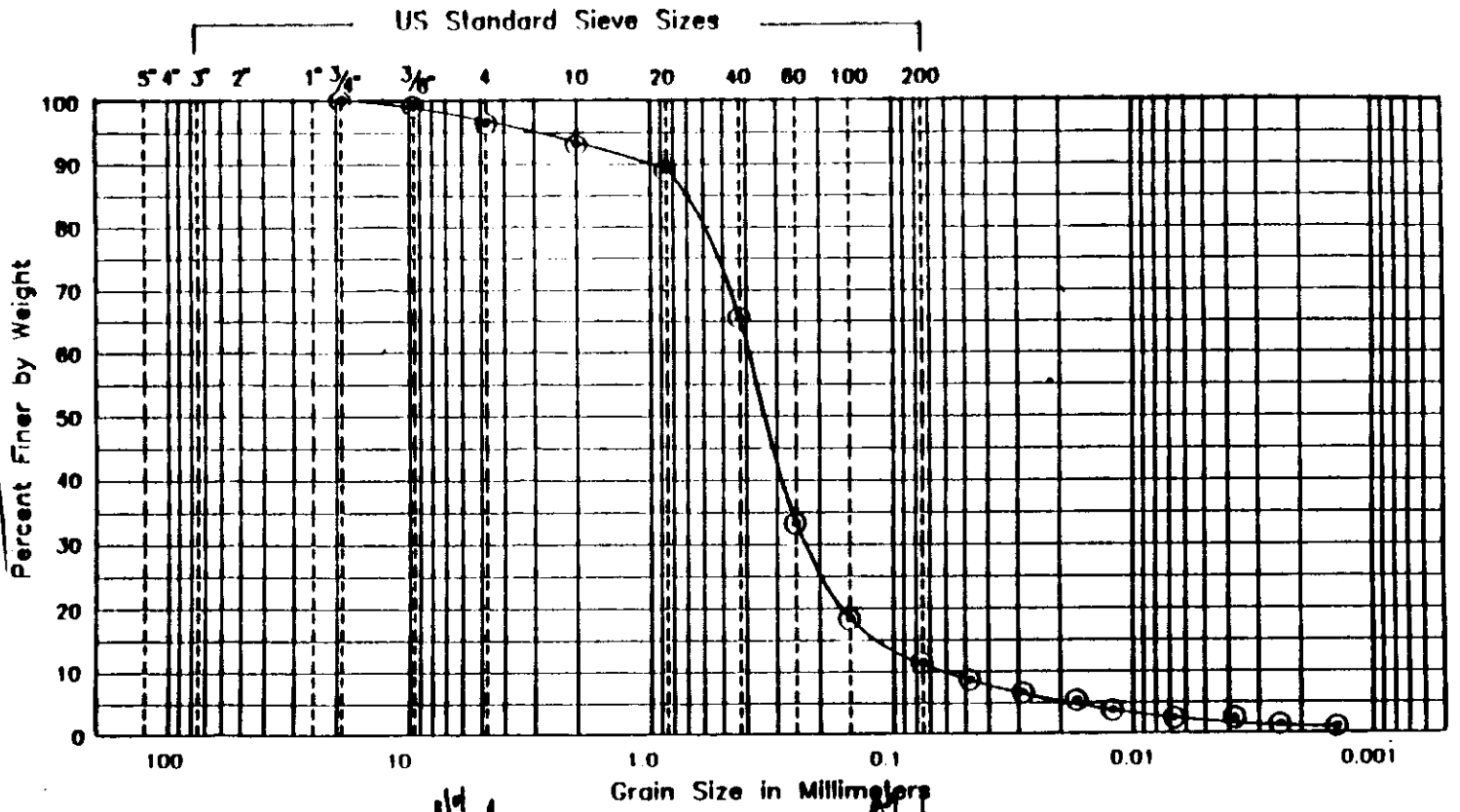


Preliminary, Unvalidated Data -- To Be Used by Cognizant Engineer Only

GRAIN SIZE DISTRIBUTION

Project WHC/[illegible]-EM-1/WH
Project No #63-1254.221 Date 9/21/92 Tested By [illegible] Approved By [illegible]

Golder Associates



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	1%			45%		11%

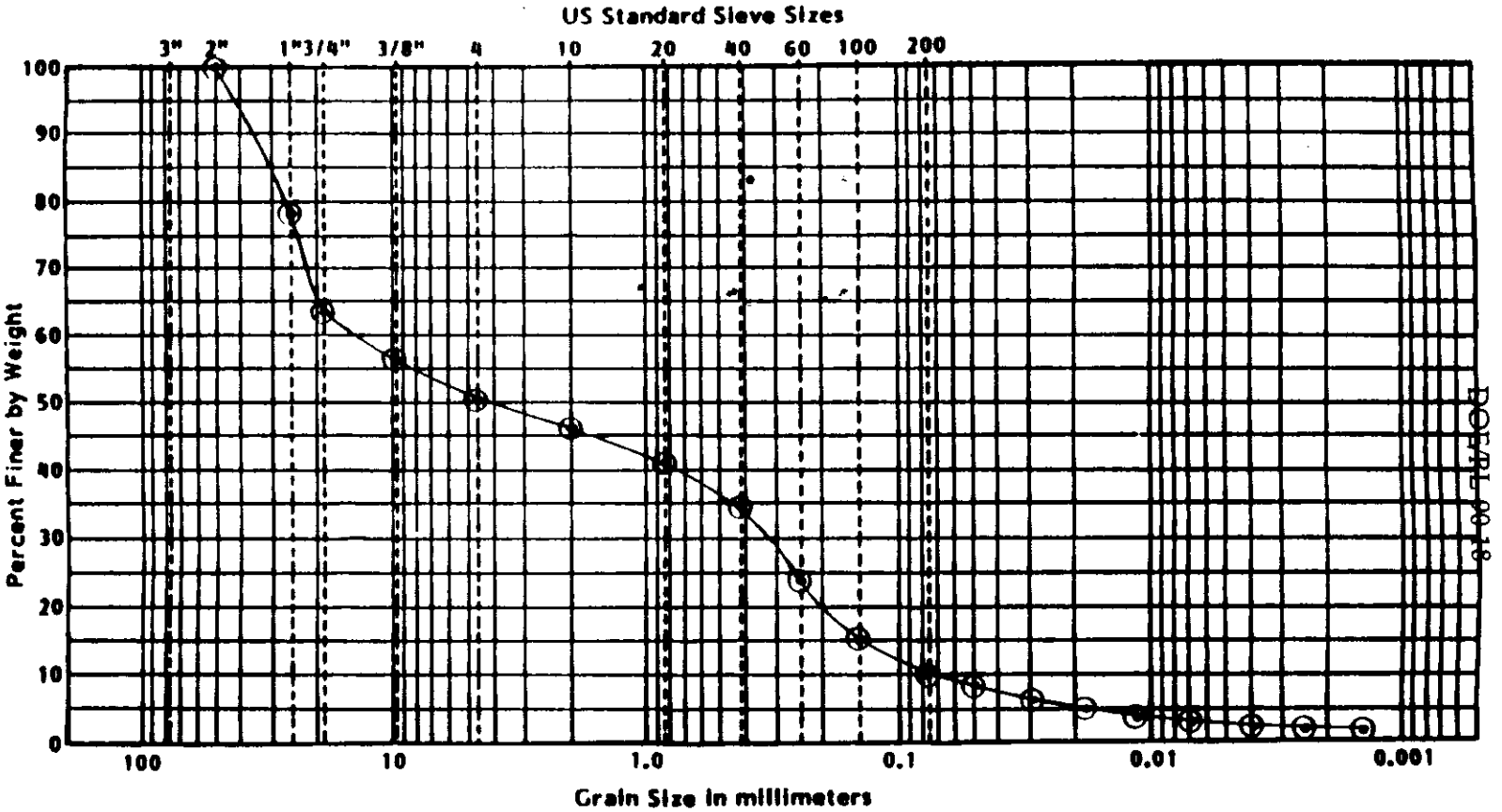
Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
HRL1 A0307		3.6				Medium grey, F-m SAND, some silt, trace fine gravel, (SW-SM).

Preliminary, Unvalidated Data -- To Be Used by Cognizant Engineer Only

GRAIN SIZE DISTRIBUTION

Project WHC/INC-EPA-1/UH
Project No. 883-1958 00/ Date 10/16/90 Tested By
Reviewed By

Golder Associate



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

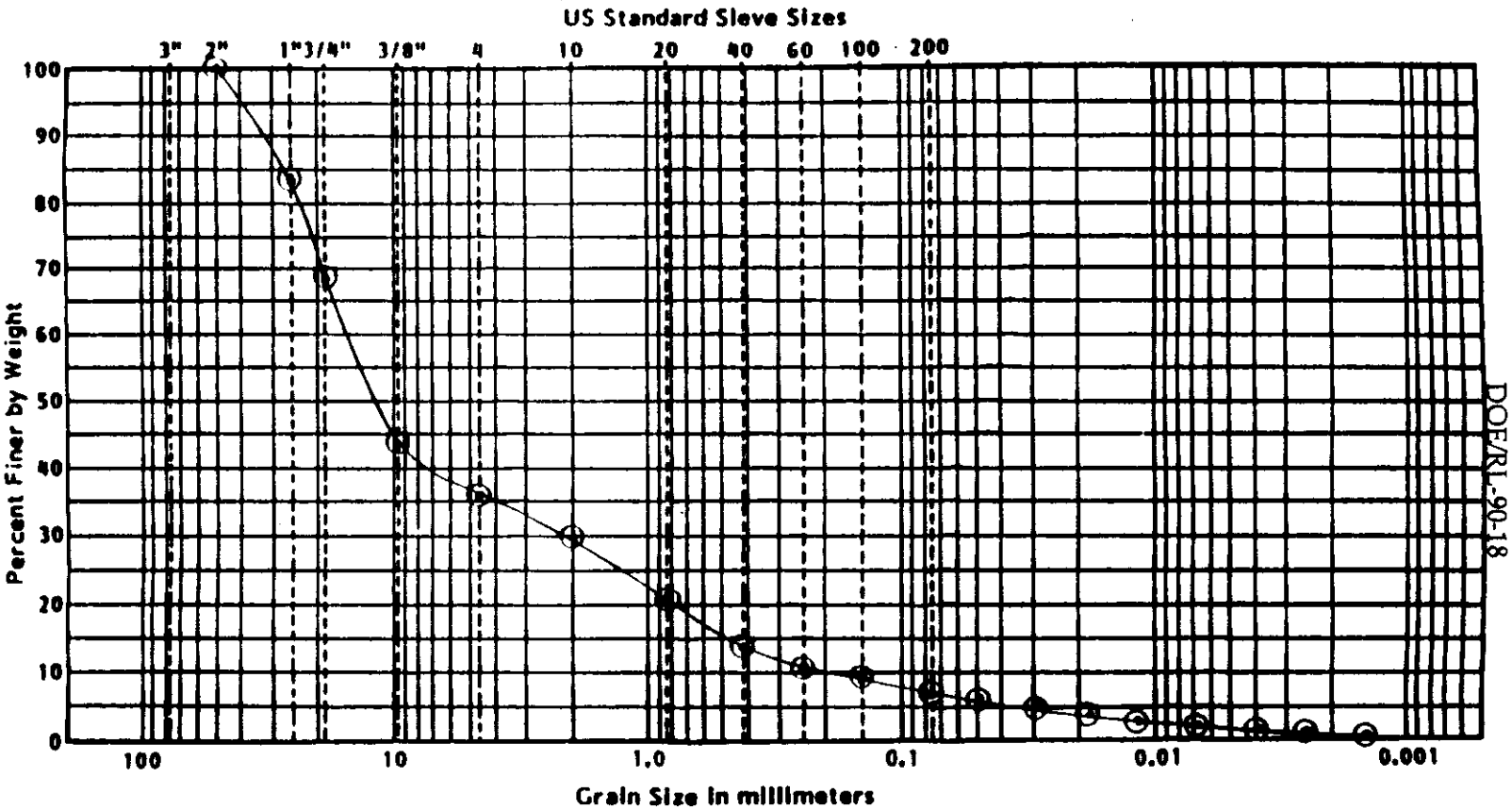
Boring No.	Elev. or Depth	W_n	W_L	W_p	I_p	Description or Classification
DP-7 A0101		2.4%				Olive grey, coarse to fine GRAVEL and fine to coarse SAND, little silt, (GP-GM).

Project: WHC/1100-EM-1/WA
Project No. 883-1754-001 Date 7-6-89 Tested by DPO Approved by [illegible]

Golder Associates

Figure
GRAIN SIZE DISTRIBUTION

DOE/RL 90-18



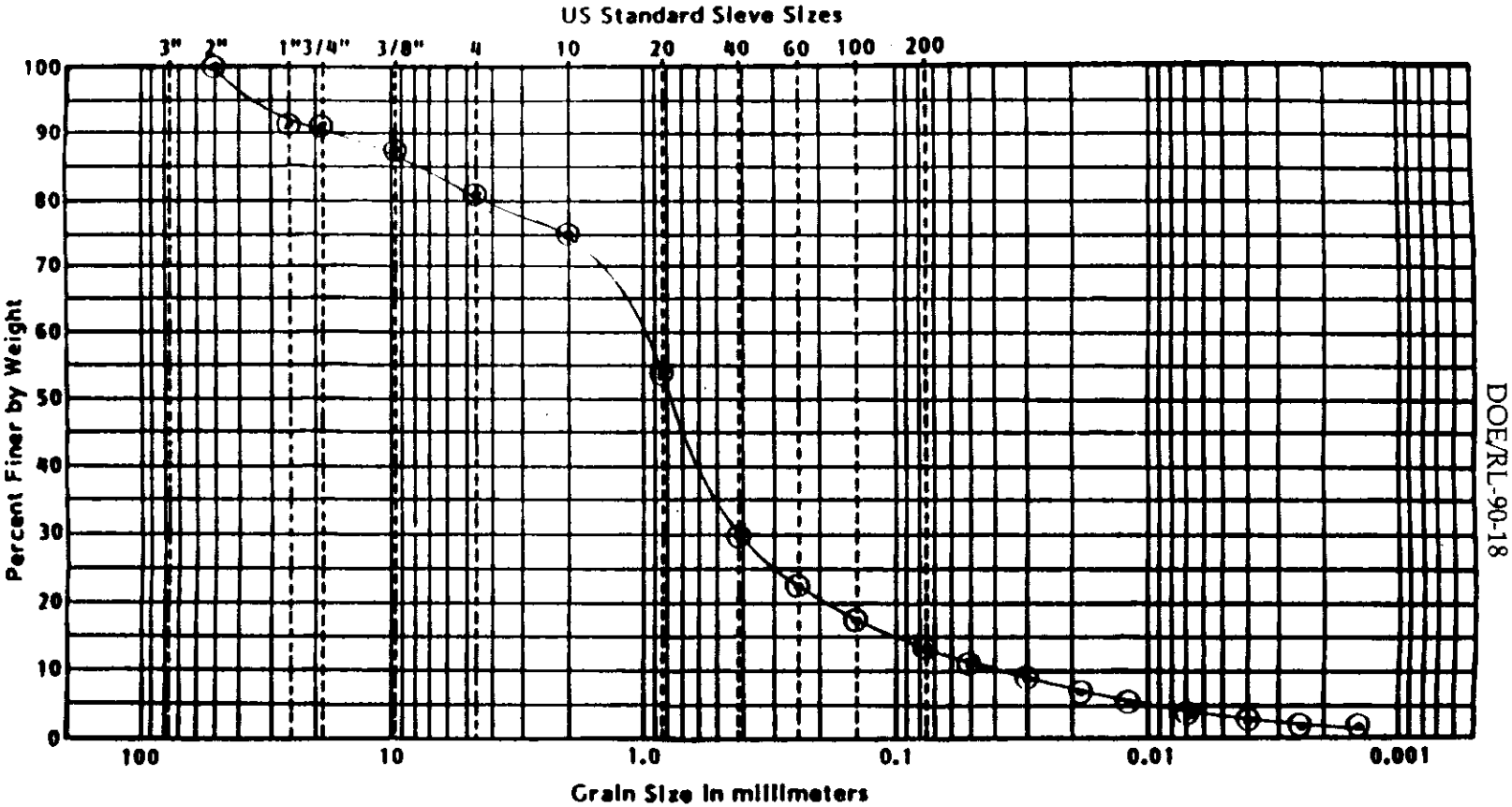
Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

Boring No.	Elev. or Depth	W_n	W_L	W_p	I_p	Description or Classification
DP-7 A0105		1.6%				Greyish black, sandy fine to coarse GRAVEL, little silt, (GW-GM).

Project: WHC/1100-EM-1/WA
Project No. 883-1154.001 Date: 7-6-89 Tested by: DPO Approved by: [illegible]

Golder Associates

Figure
GRAIN SIZE DISTRIBUTION



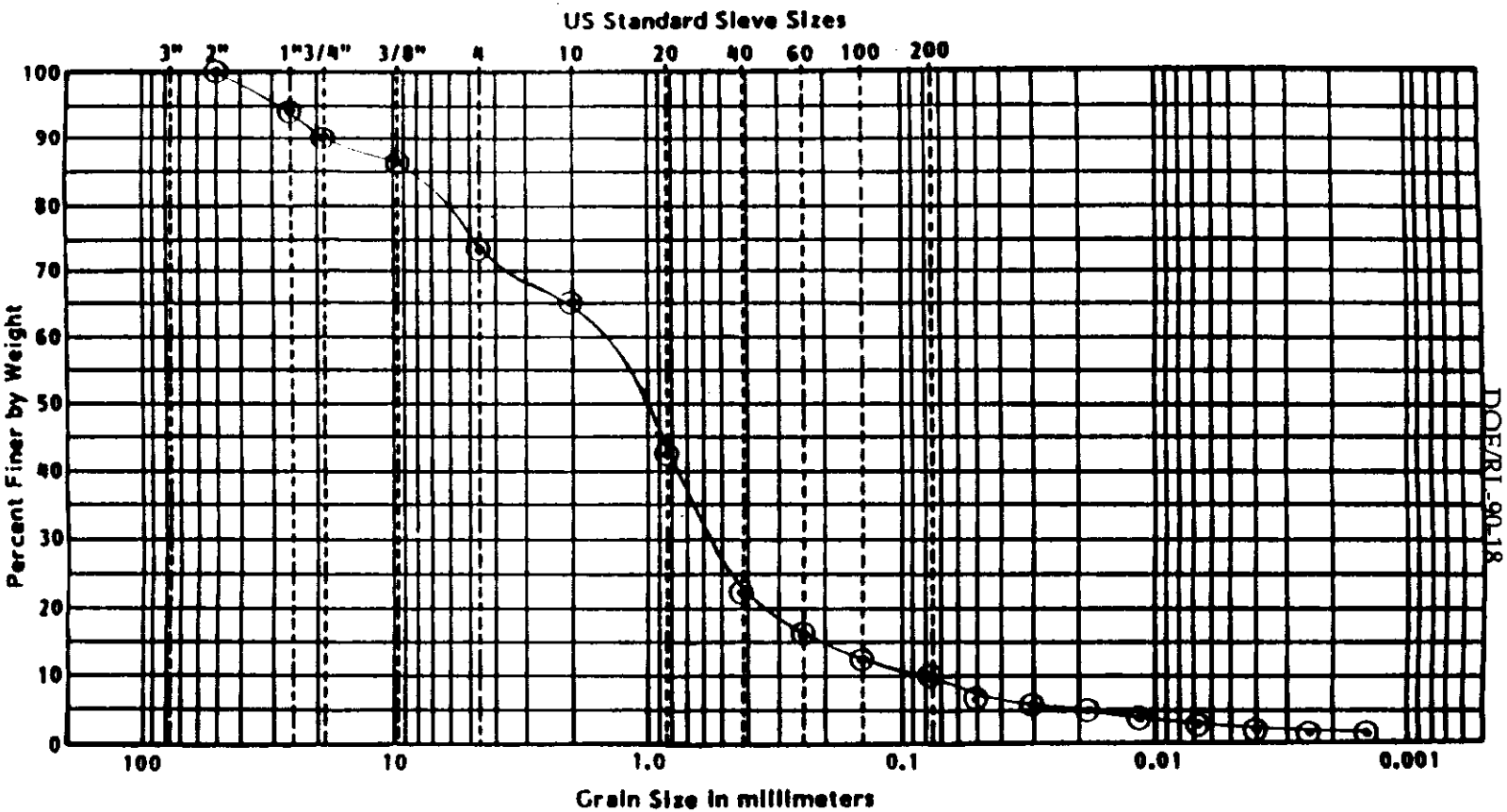
Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

Boring No.	Elev. or Depth	W_n	W_L	W_p	I_p	Description or Classification
DP-7 A0109		3.7%				Brownish black, medium to fine SAND, some fine to coarse gravel, some silt, (SM).

Project: WHC/1100-EM-1/WA
Project No. 883-1754.001 Date 7-6-89 Tested by DPO Approved by KKD

Golder Associates

Figure
GRAIN SIZE DISTRIBUTION



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

Boring No.	Elev. or Depth	W_n	W_L	W_p	I_p	Description or Classification
DP-7 A0111						Olive black, gravelly fine to coarse SAND, little silt, (SW-SM).

Project: WHC/1100-EM-1/WA
Project No. 8883-1854-001 Date 7-6-89 Tested by DPO Approved by [illegible]

Golder Associat

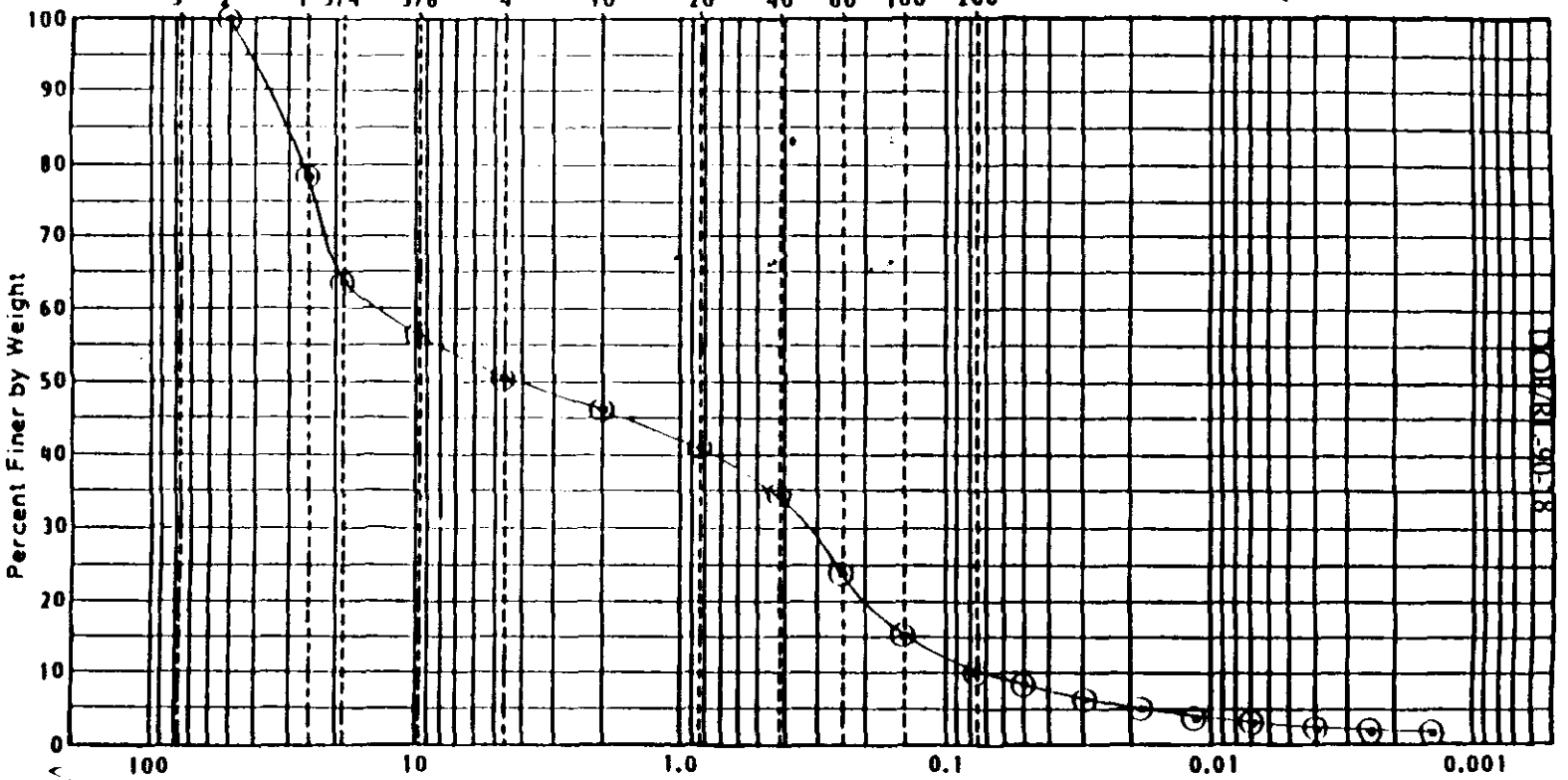
Figure
GRAIN SIZE DISTRIBUTION

Preliminary, Unvalidated Data
Not To Be Used By Consultant Engineer Only

Validated 2/14/90

US Standard Sieve Sizes

3" 2" 1"3/4" 3/8" 4 10 20 40 60 100 200



DOW/RI-90-18

Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
		50%			40%	10%

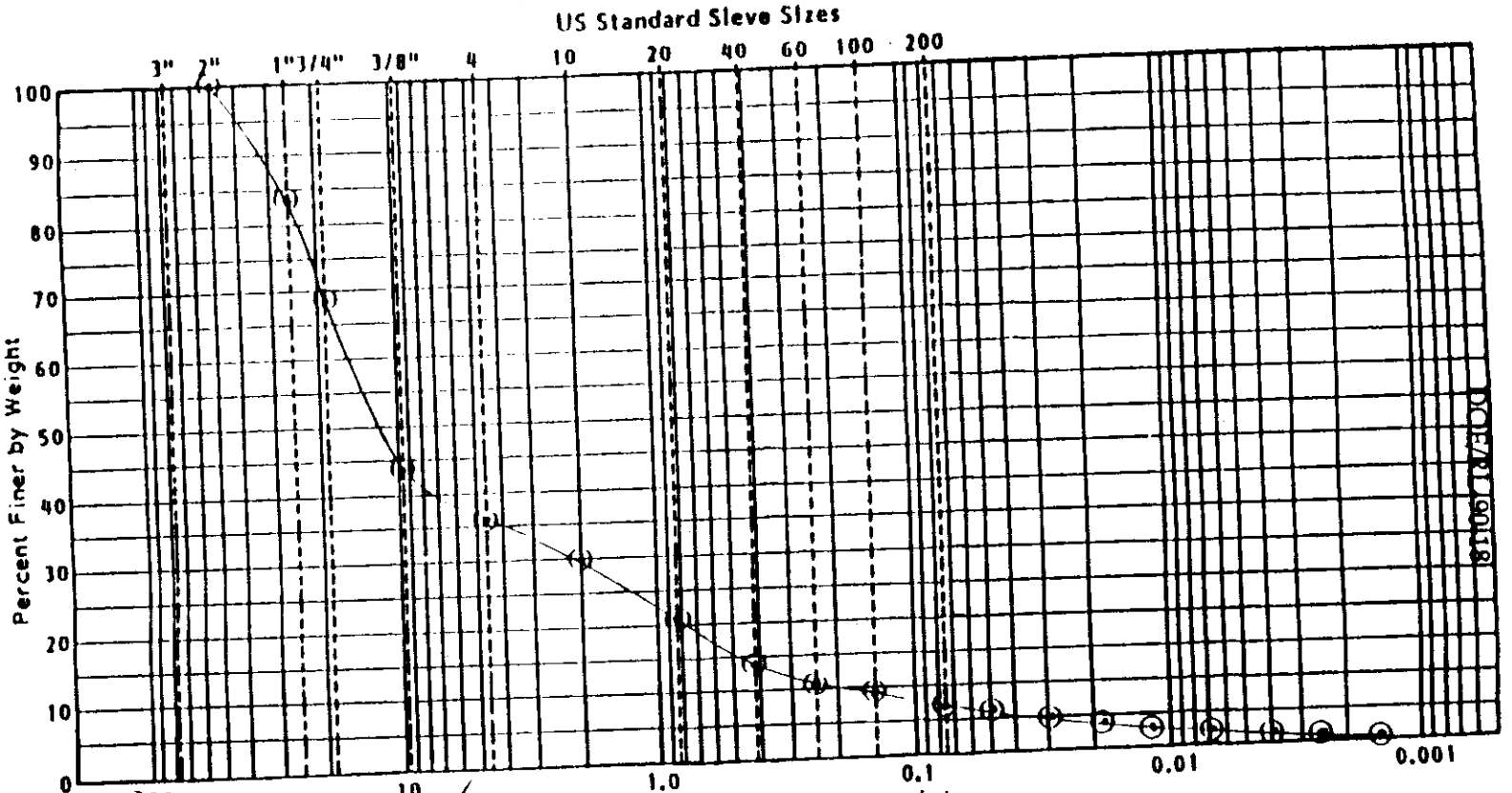
Boring No.	Elev. or Depth	W_n	W_L	W_p	I_p	Description or Classification
DP-7 A0101		2.4%				Olive grey, coarse to fine GRAVEL and fine to coarse SAND, little silt, (GP-GM).

Figure
GRAIN SIZE DISTRIBUTION

Project: WHC 1100-EN-1/WA
Project No. 683-1754.001 Date 7-6-90 Tested by DPO Approved by KLB

Golder Associates

Preliminary, Unvalidated Data -- To Be Used by Cognizant Engineer Only



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
		15%			29%	6%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description or Classification
DP-7 A0105		1.6%				Greyish black, sandy fine to coarse GRAVEL, little silt, (GW-GM).

Project: U-46/1100-EM-1/WA

Project No. 983-1054-001 Date 7-6-90 Tested by DPO Approved by

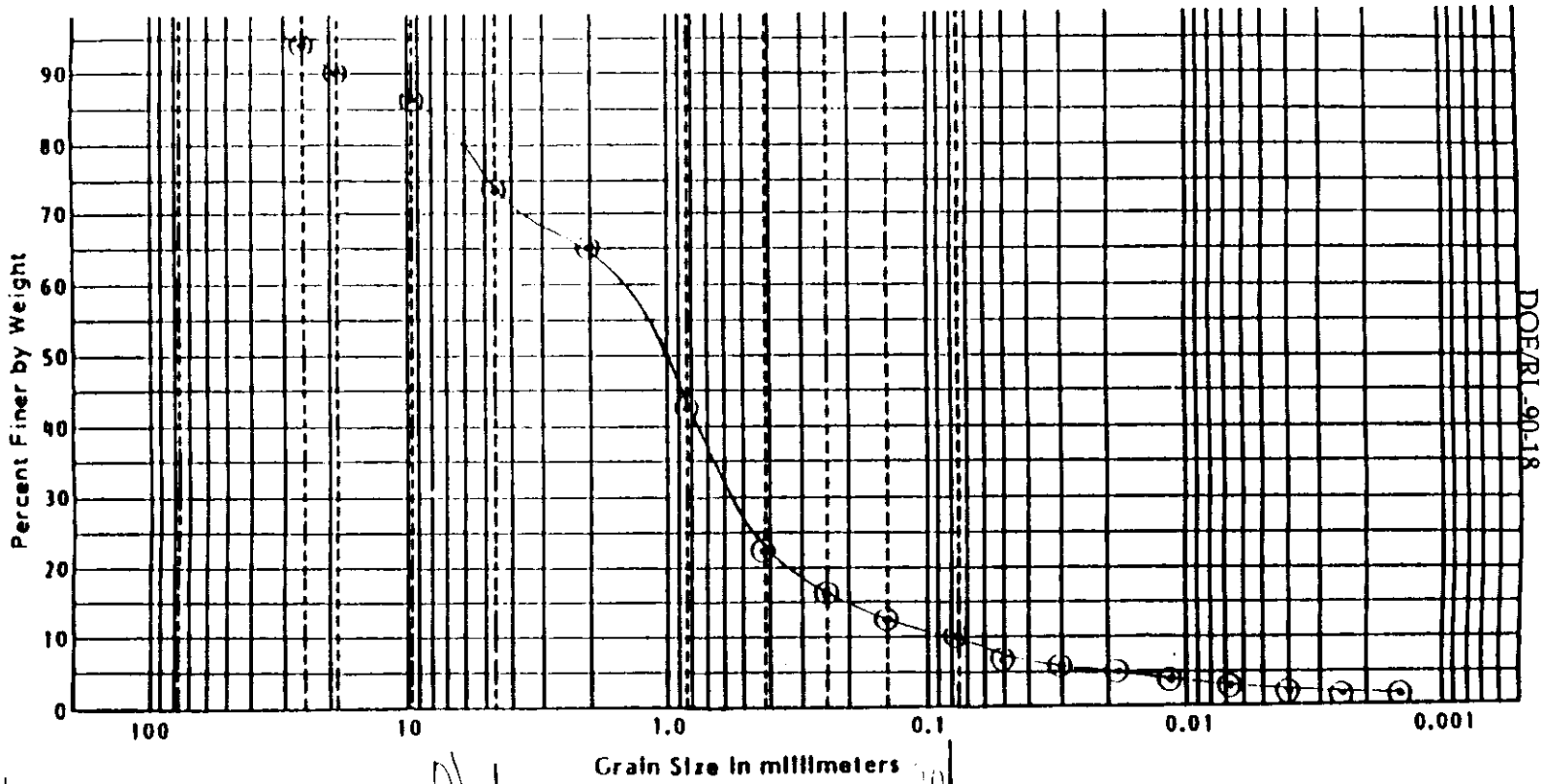
Golder Asso

Figure

GRAIN SIZE DISTRIBUTION

DP-7 | | | | | | fine to coarse gravel, [illegible]

A0109 Preliminary, Unvalidated Data - To Be Used by Cognizant Engineer Only



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description or Classification
DP-7 A0111						Olive black, gravelly fine to coarse SAND, little silt, (SW-SM).

Figure

GRAIN SIZE DISTRIBUTION

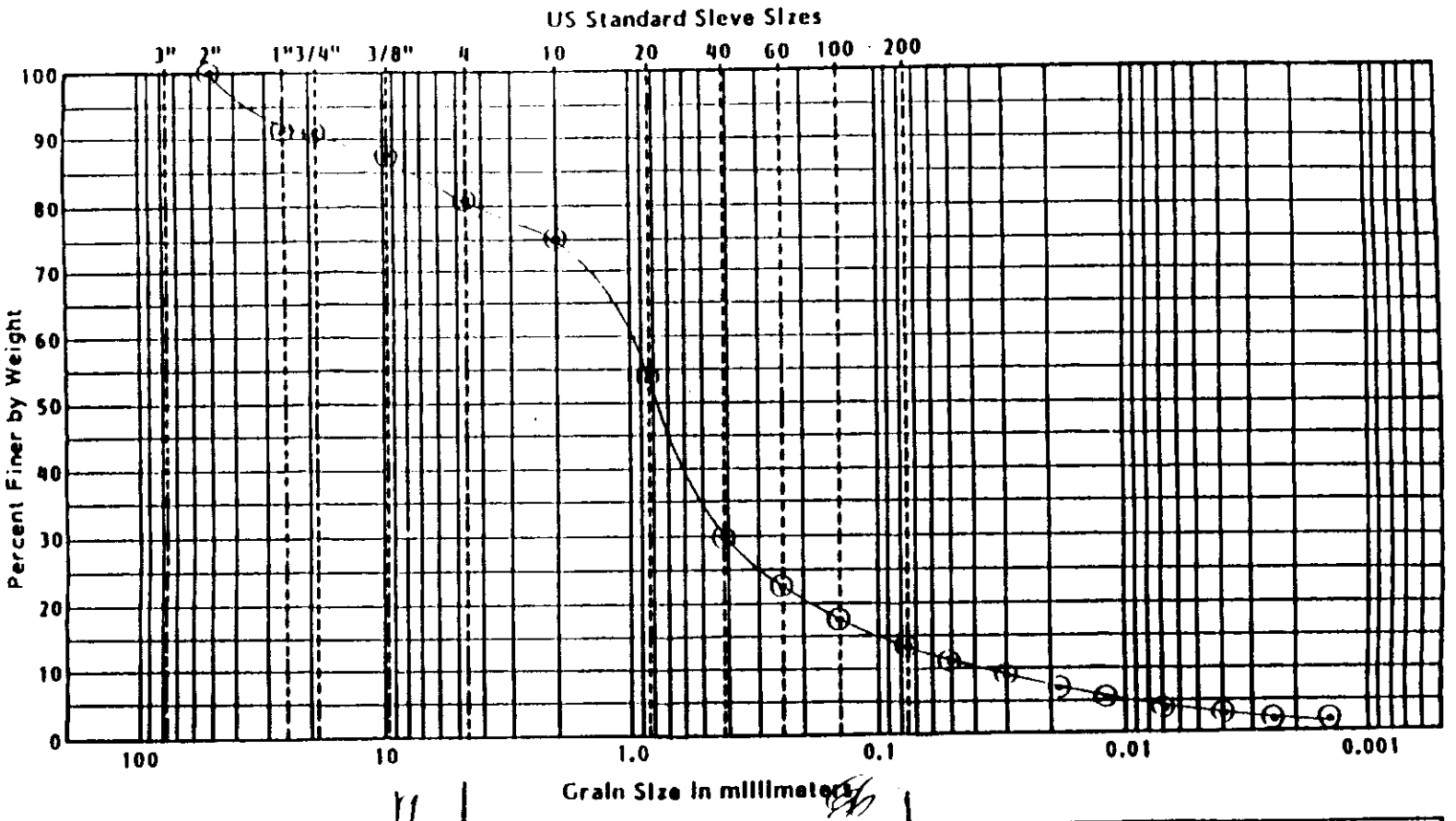
WHC/1100-EN-1/WA

No. 283-1754-001 Date 7-6-89 Tested by DPO Approved by [illegible]

Golder Associates

Golder Associates

Preliminary, Unvalidated Data -- To Be Used by Cognizant Engineer Only



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	11%				61%	14%

Boring No.	Elev. or Depth	W_n	W_L	W_p	I_p	Description or Classification
DP-7 A0109		3.7%				Brownish black, medium to fine SAND, some fine to coarse gravel, some silt, (SM).

Project: 100-HC/1100-EM-1/WA
Project No. 983-1254-001 Date 7-6-90 Tested by DPO Approved by KKS

Golder Associates

Figure
GRAIN SIZE DISTRIBUTION

SUBAPPENDIX H-2
SURFACE SOIL PHYSICAL ANALYTICAL RESULTS

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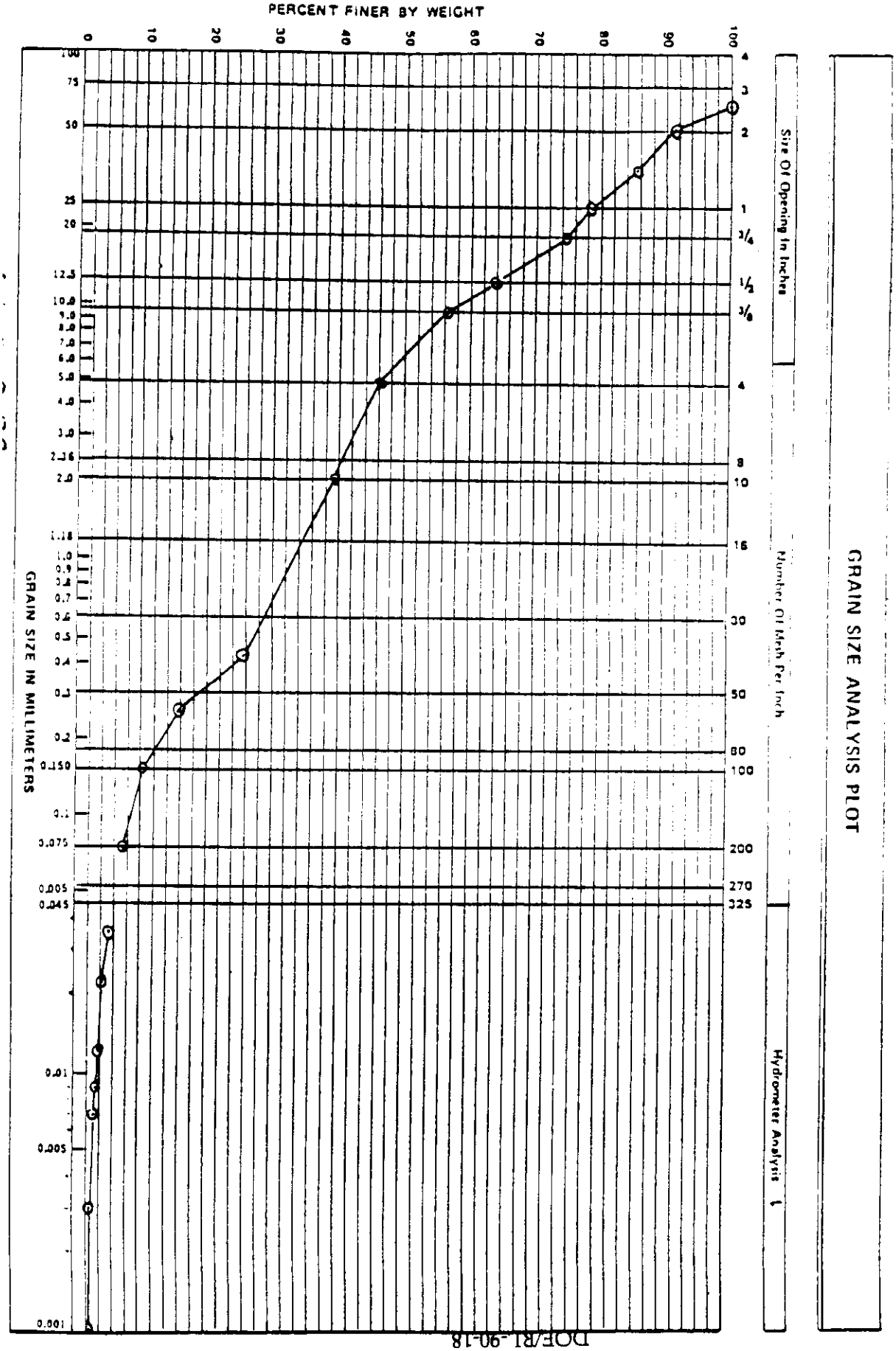
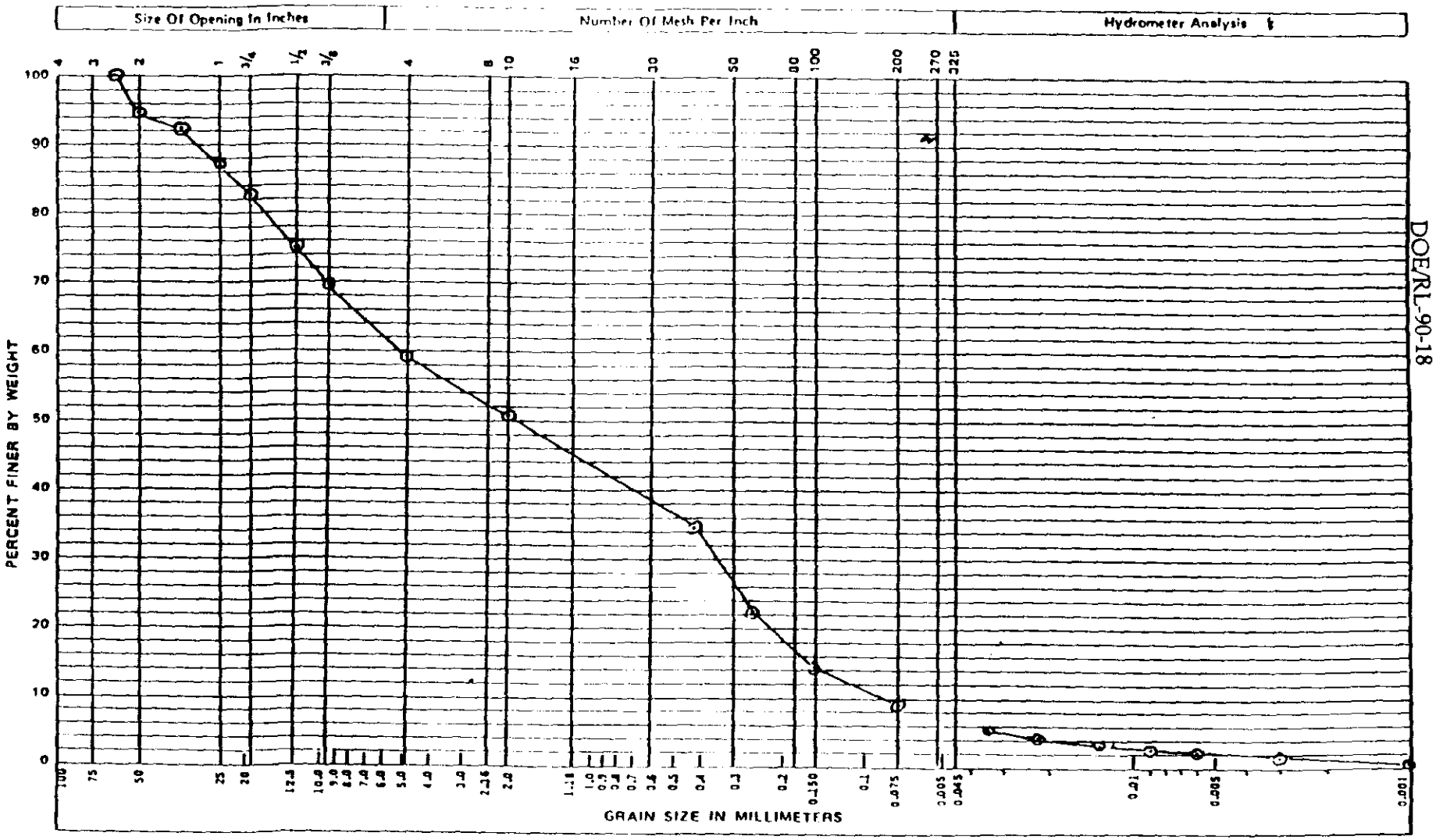
TABLE H-2. SUMMARY OF SOIL PHYSICAL ANALYTICAL RESULTS FOR SURFACE SAMPLES

Subunit	Sample Id	Sample Date	Unified Soil Classification (Group Criteria Only)
1100-2	1100-2-D-3	03/09/90	Gravel with fines
	1100-2-F-4	03/09/90	Sand with fines
	1100-2-H-1	03/09/90	Sand with fines
	1100-2-HH-1	03/09/90	Sand with fines
1100-3	1100-3-E-5	03/09/90	Sand with fines
	1100-3-F-8	03/09/90	Gravel with fines
	1100-3-H-5	03/09/90	Sand with fines
	1100-3-H-8	03/09/90	Sand with fines
1100-6	AH-219	01/25/90	Sand with fines
	AH-220	01/25/90	Sand with fines
	AH-221	01/25/90	Sand
Horn Rapids Landfill	HRL-H-2	03/09/90	Sand
	HRL-D-4	03/09/90	Sand with fines
	HRL-C-1	03/09/90	Sand with fines
	HRL-M-4	03/09/90	Gravel
	HRL-R-7	03/09/90	Gravel
	HRL-T-6	03/09/90	Gravel


GRAIN SIZE ANALYSIS PLOT
PERCENT FINER BY WEIGHT
0
10
20
30
40
50
60
70
80
90
100
Size Of Opening In Inches
4
3
2
1
3/4
1/2
3/8
Number Of Mesh Per Inch
4
8
10
16
30
50
80
100
200
270
325
Hydrometer Analysis
GRAIN SIZE IN MILLIMETERS
100
75
50
25
20
12.5
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.36
2.0
1.18
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.150
0.1
0.075
0.005
0.045
0.01
0.005
0.001

GRAIN SIZE ANALYSIS PLOT



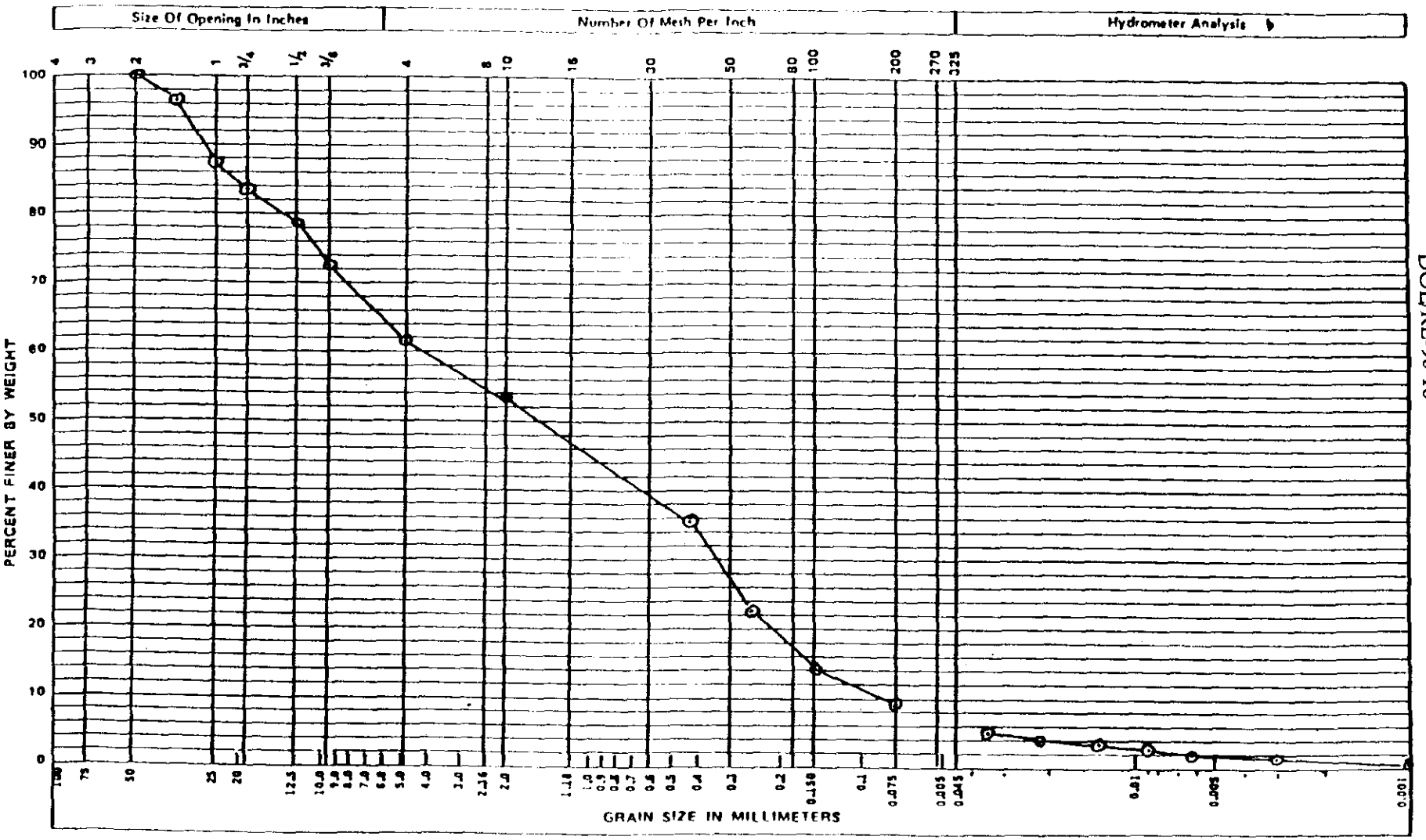
Specimen No. 0-129 Procedure No. ETAL-07 Rev. 1 Date Issued 11-15-89

Sample Description: SANDY GRAVEL

Plotted by: R.G. ALEXANDER

1/1 D

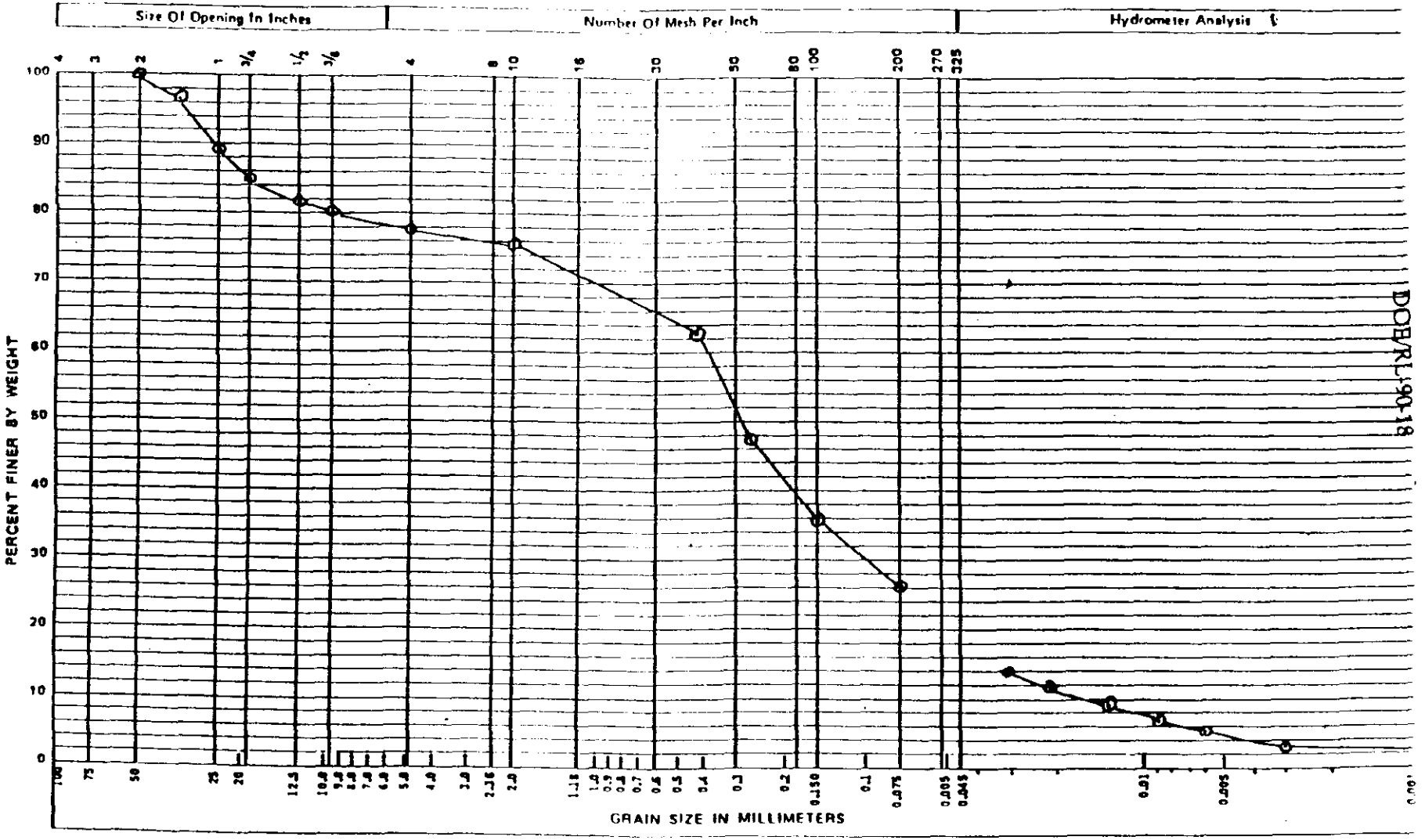
GRAIN SIZE ANALYSIS PLOT



Specimen No. 0-130 Procedure No. ETAL-07 Rev. 1 Date Issued 11-15-89

Sample Description

GRAIN SIZE ANALYSIS PLOT



Specimen No 0-131 Procedure No ETAL-07 Rev 1 Date Issued 11-15-89

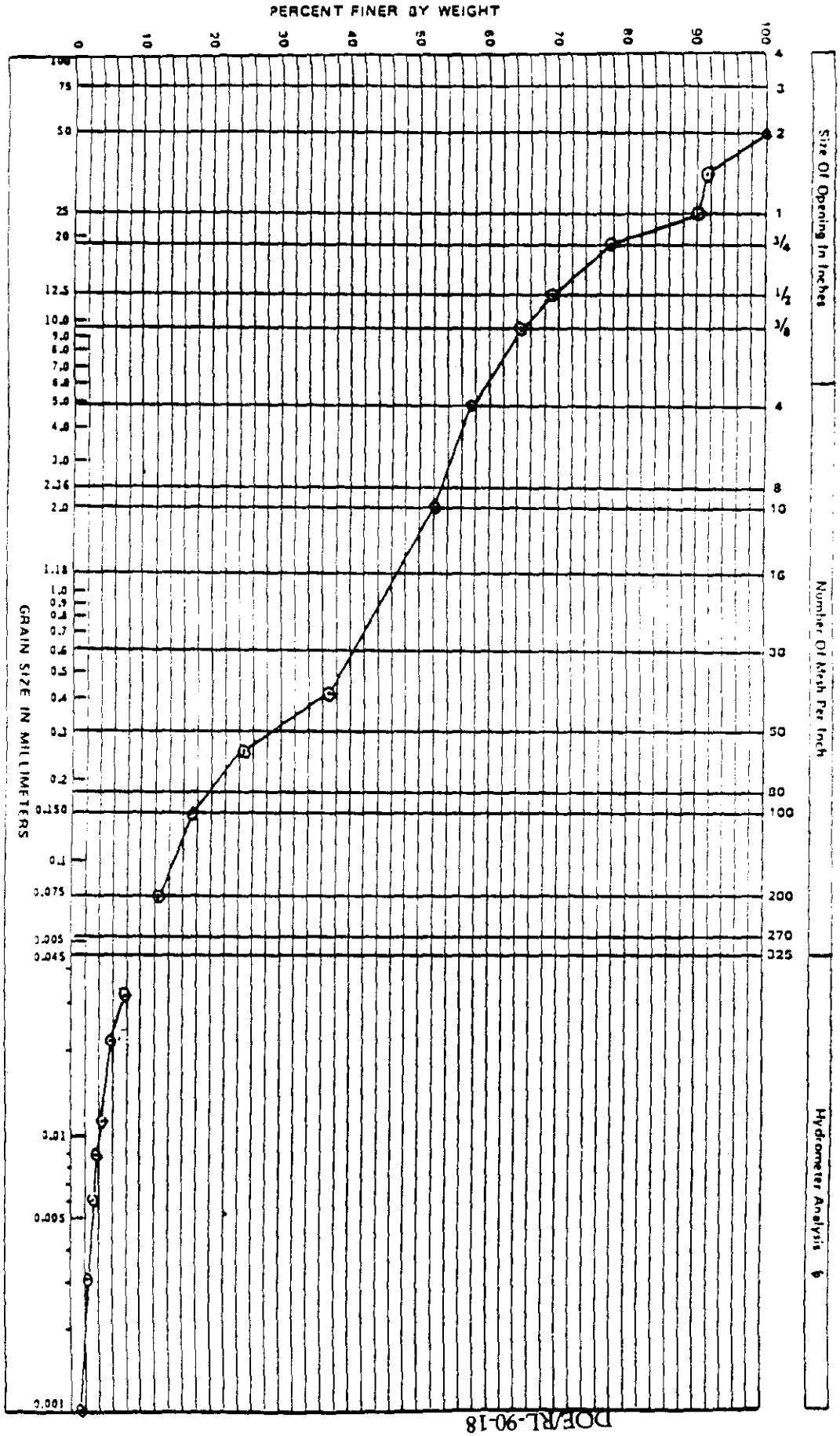
Sample Description: SANDY GRAVEL 1100-2-HH-1

Plotted by: R.G ALEXANDER Date: 3-12-90

Checked by: J F Relyea Date: 3-16-90

DOE/RL-90-18

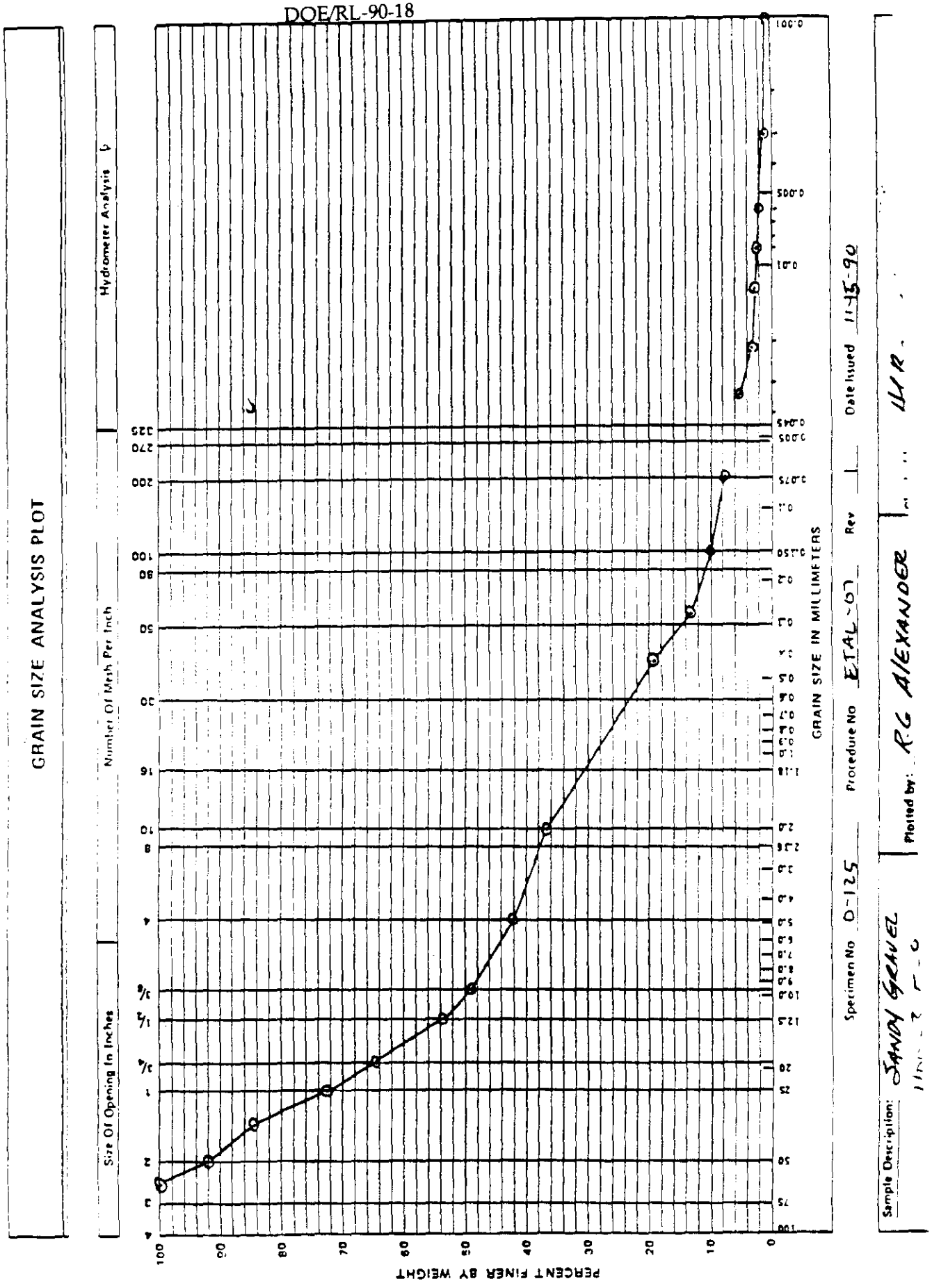
GRAIN SIZE ANALYSIS PLOT



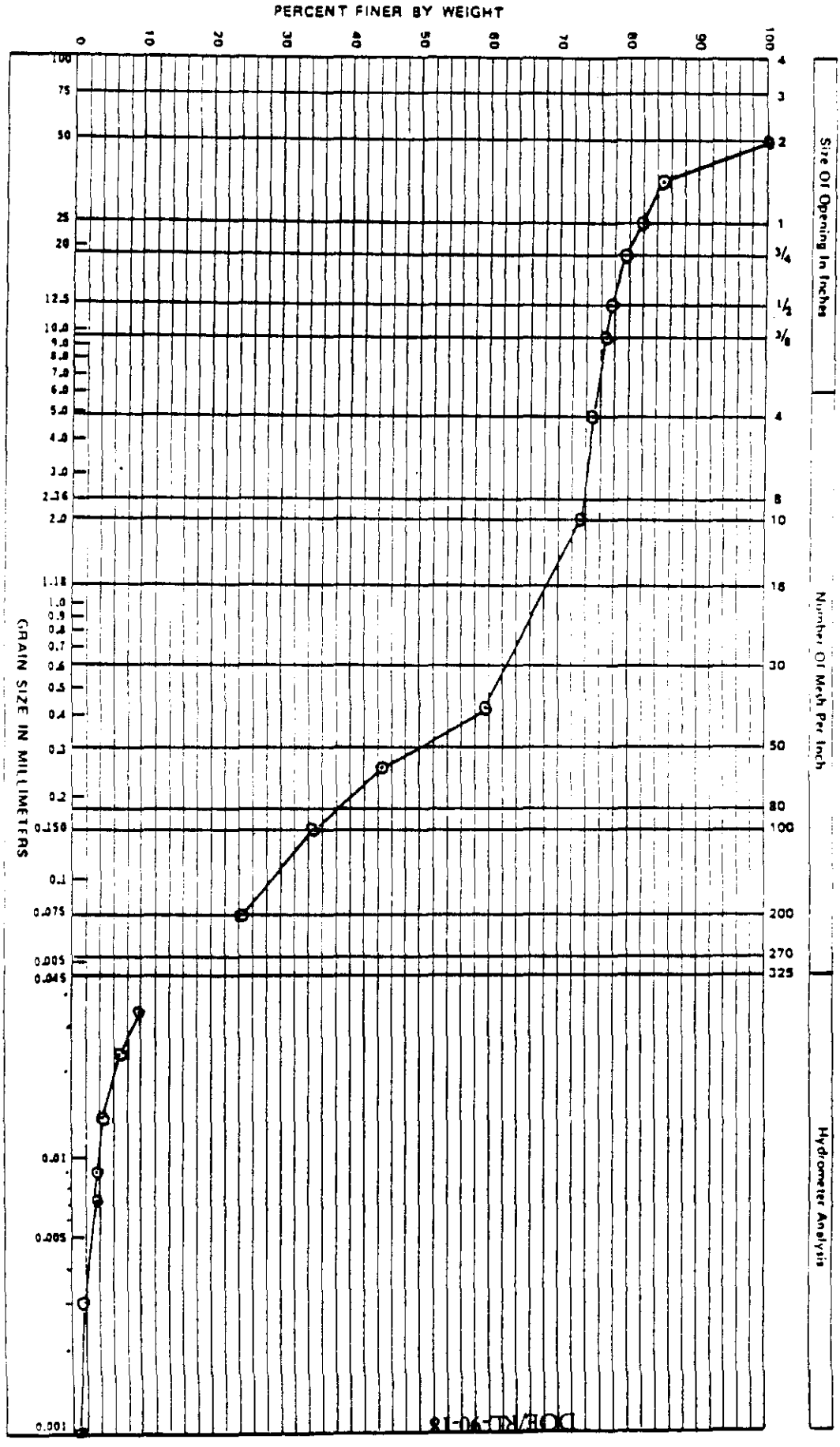
Specimen No. 0-124

Procedure No. ETAC-07 Rev. 1

Date Issued 11-15-89


GRAIN SIZE ANALYSIS PLOT
Hydrometer Analysis
Number Of Mesh Per Inch
Size Of Opening In Inches
PERCENT FINER BY WEIGHT
GRAIN SIZE IN MILLIMETERS
Specimen No D-125
Procedure No ETAL-07
Rev
Date Issued 11-15-90
Sample Description: SANDY GRAVEL
Plotted by: R.G. ALEXANDER

GRAIN SIZE ANALYSIS PLOT



Sample Description: SANDY GRAVEL

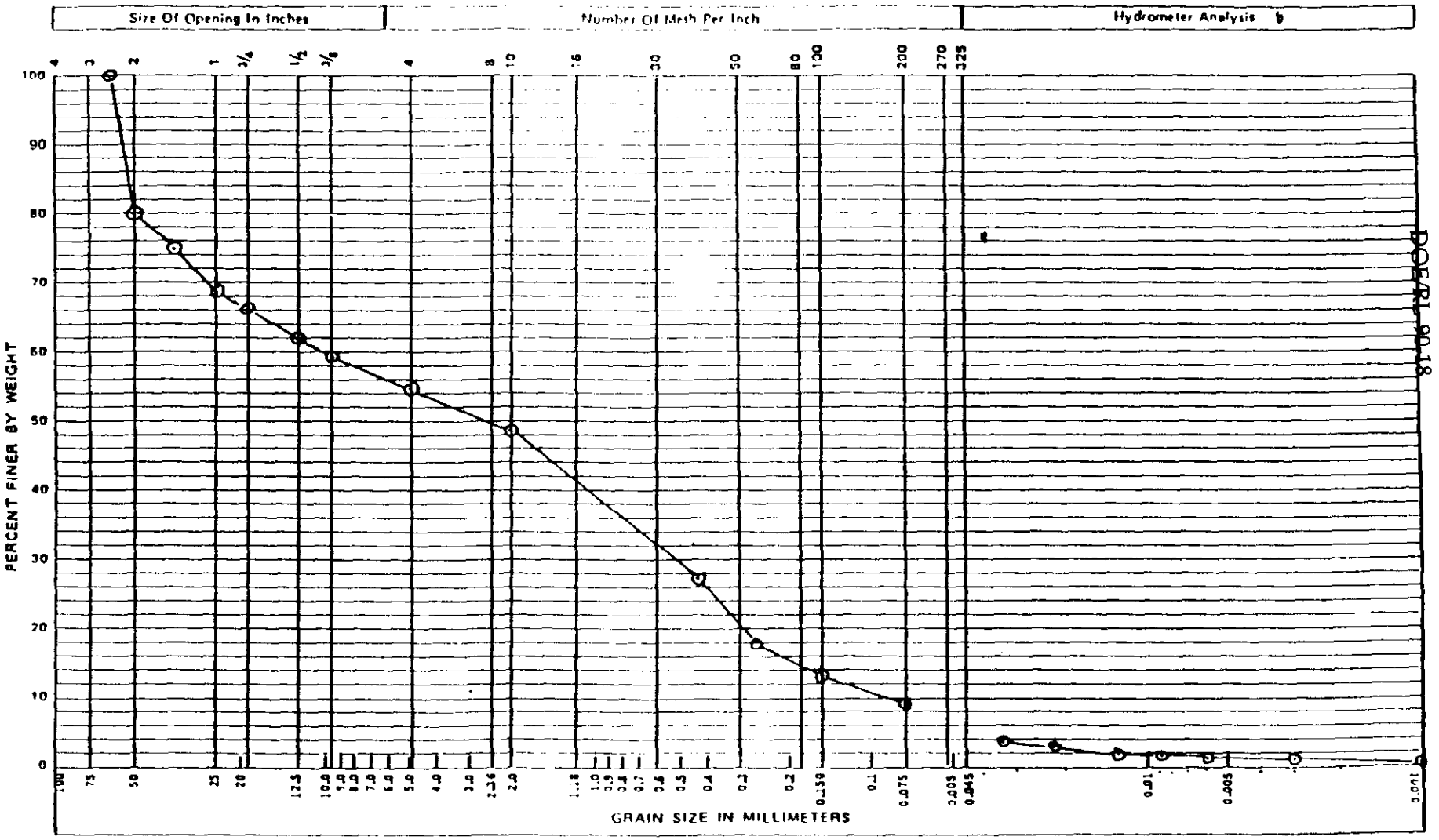
Specimen No. 0-126

Procedure No. ETMC-07

Rev 1

Date Issued 11-15-89

GRAIN SIZE ANALYSIS PLOT



Specimen No. 0-127 Procedure No. ETAL 07 Rev 1 Date Issued 11-15-89

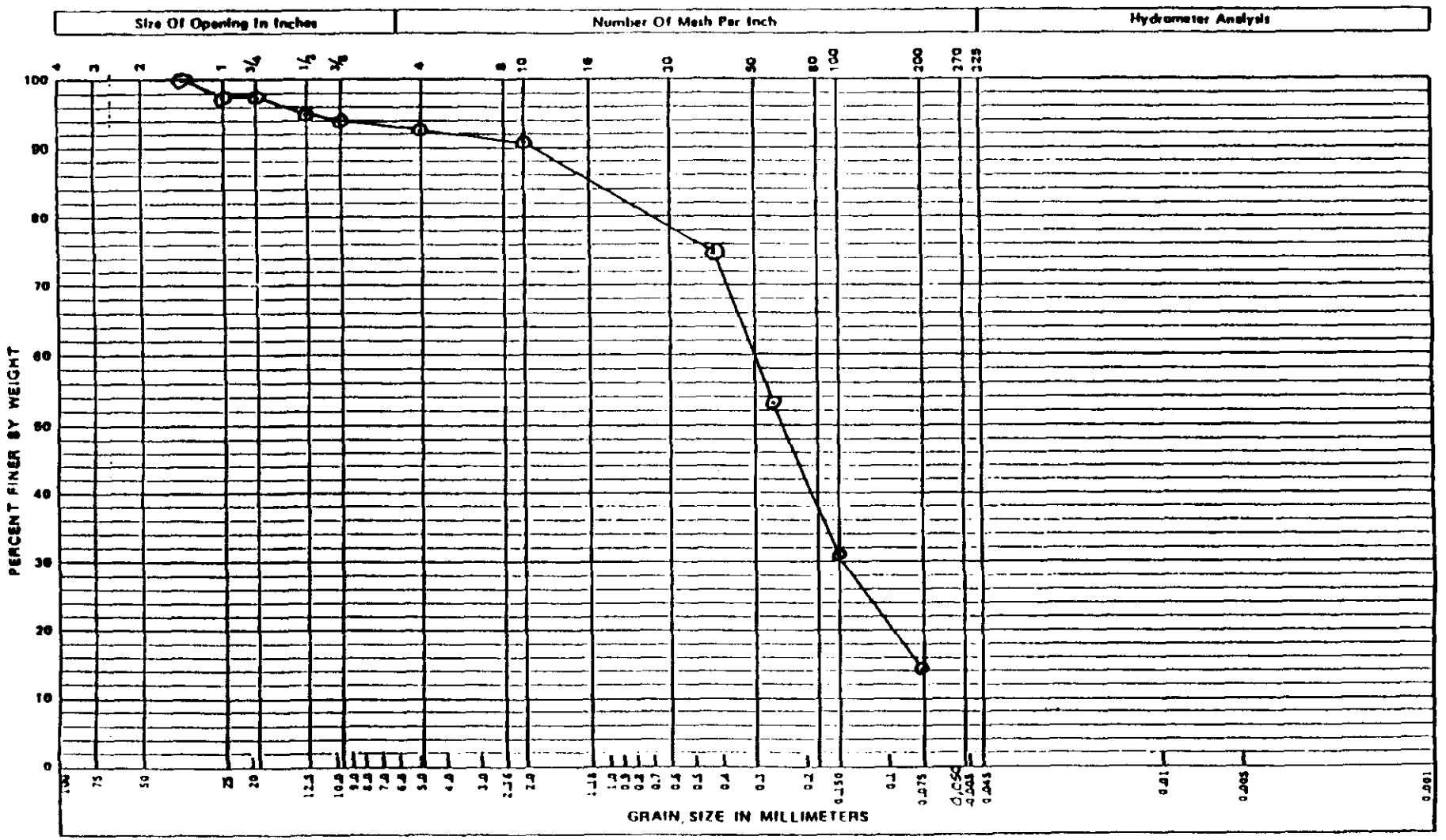
Sample Description: SANDY GRAVEL 1100-3-H-8

Plotted by: R.G ALEXANDER

Checked by: HCBarnes

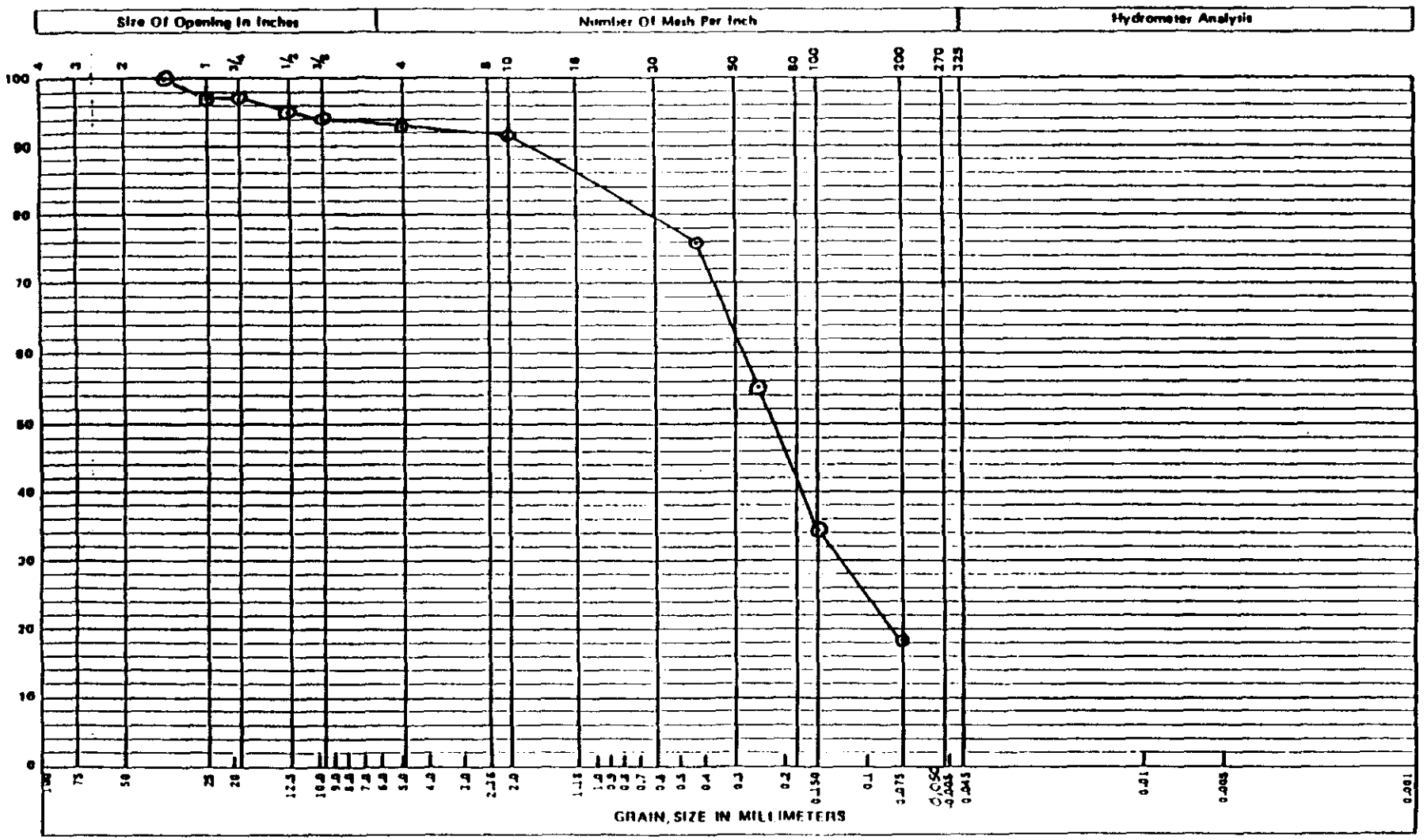
DOE/RL-90-18

GRAIN SIZE ANALYSIS PLOT



Specimen No. 0-052 Procedure No ETAL-67 Rev. 1 Date Issued 11-15-89

GRAIN SIZE ANALYSIS PLOT



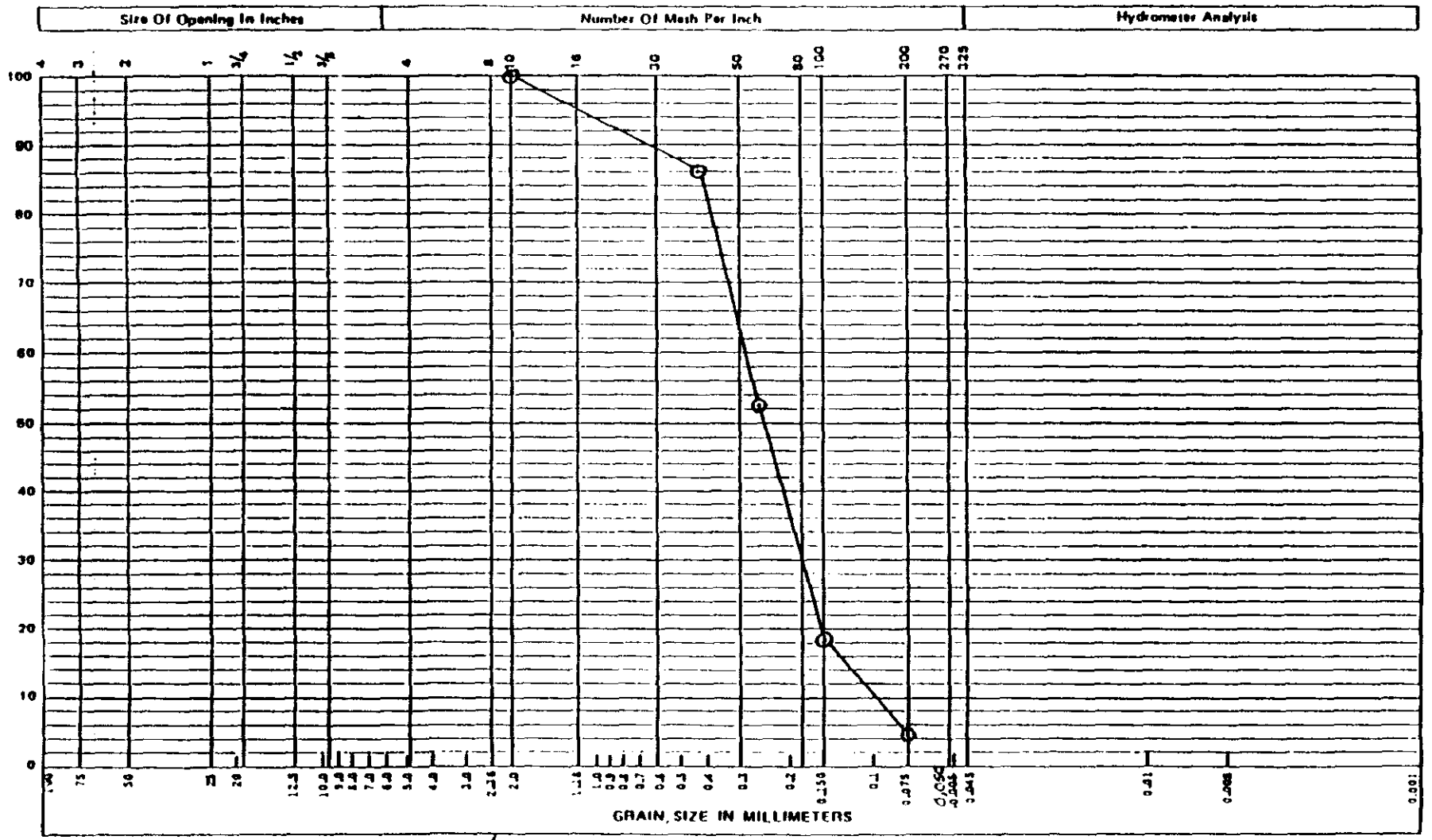
Specimen No. O-058 Procedure No. ETML-07 Rev. 1 Date Issued 11-15-89

Sample Description: SAND AH-220

Plotted by: R.G. ALEXANDER

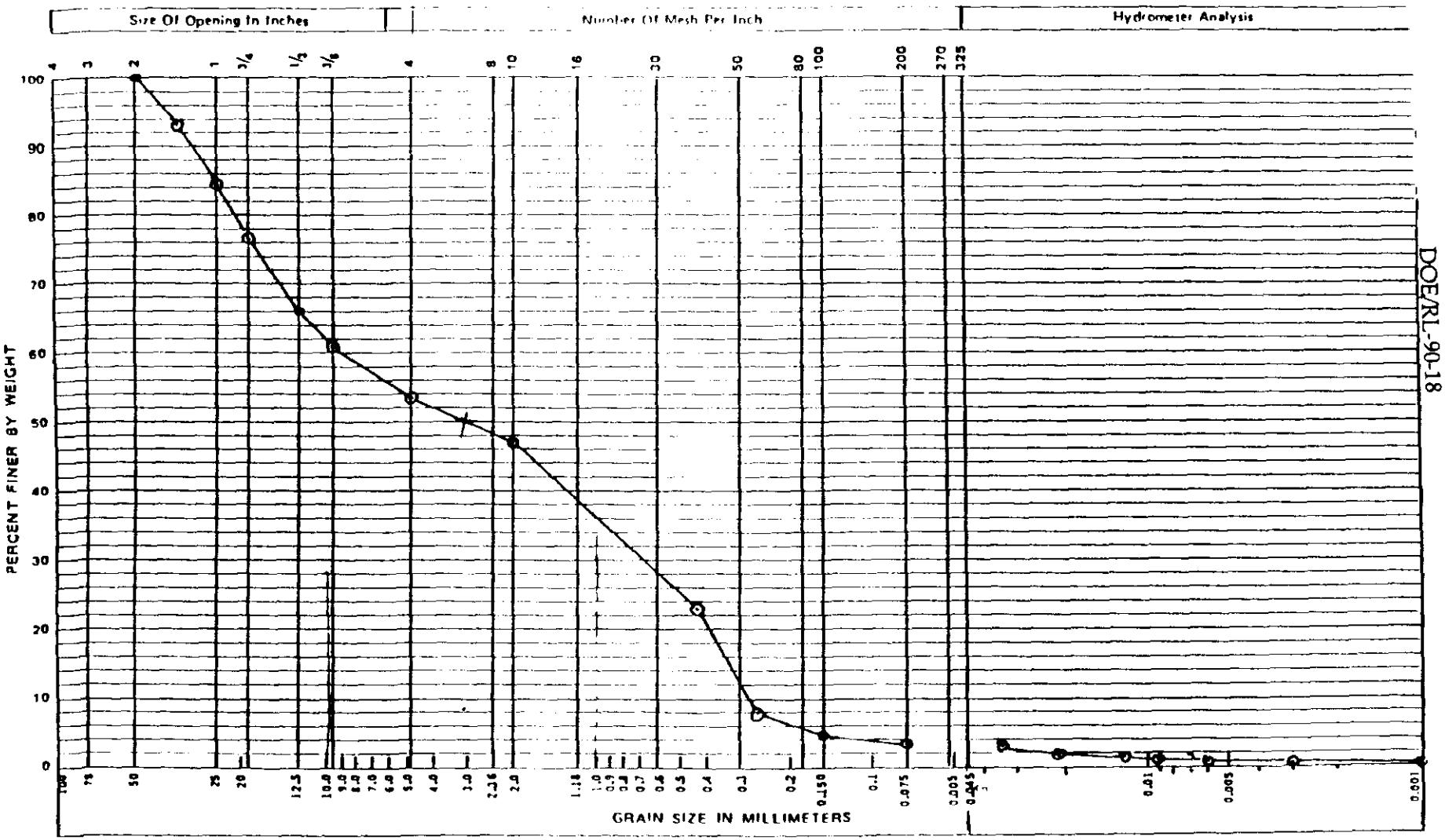
Checked by: HL Benny

GRAIN SIZE ANALYSIS PLOT



Specimen No. 0-054 Procedure No ETAL-07 Rev. 1 Date Issued 11-15-89

GRAIN SIZE ANALYSIS PLOT



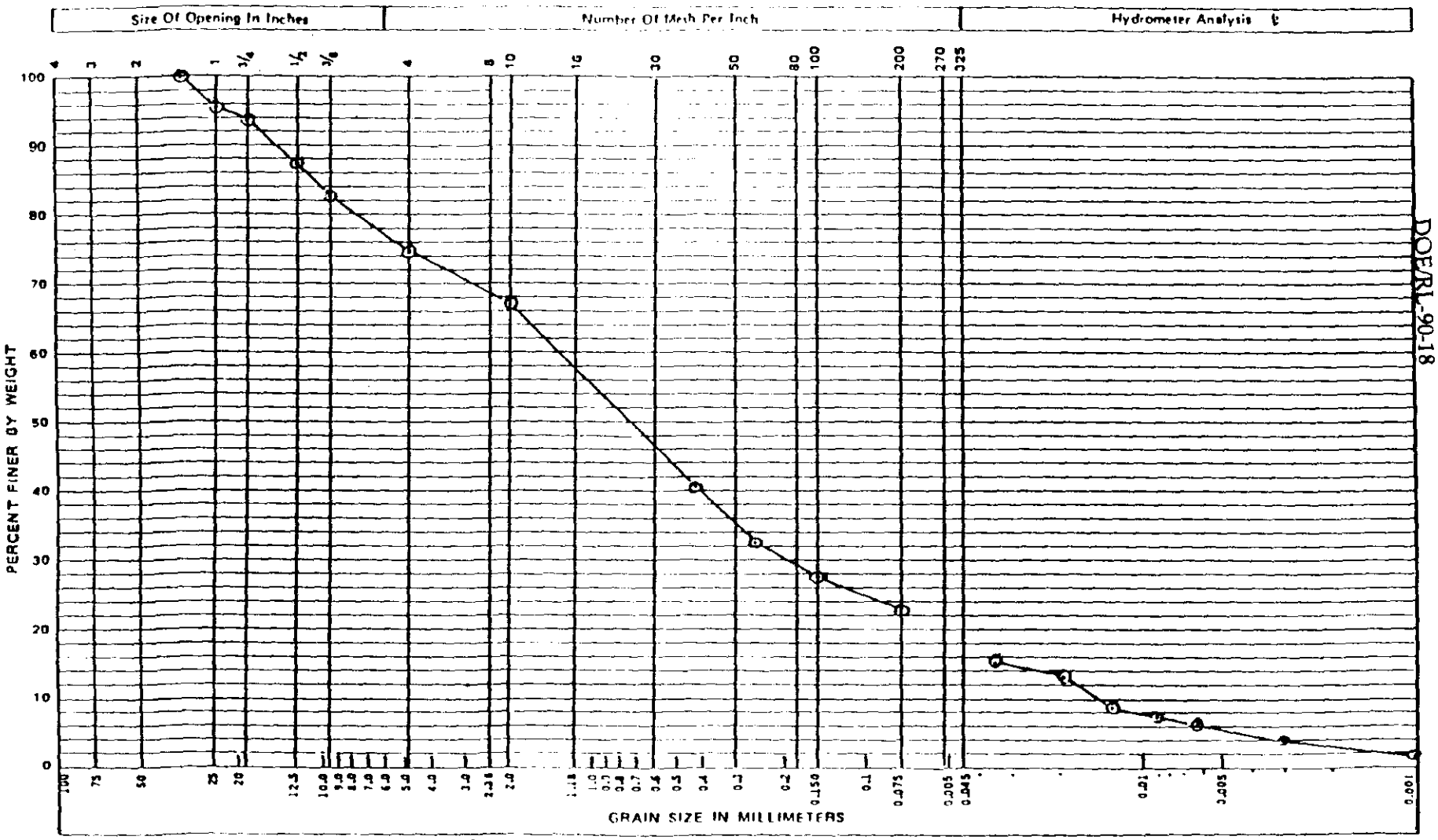
Specimen No 0-118 Procedure No ETAL-07 Rev 1 Date Issued 11-15-89

Sample Description: SANDY GRAVEL HRL-H-2

Plotted by: R.G. ALEXANDER

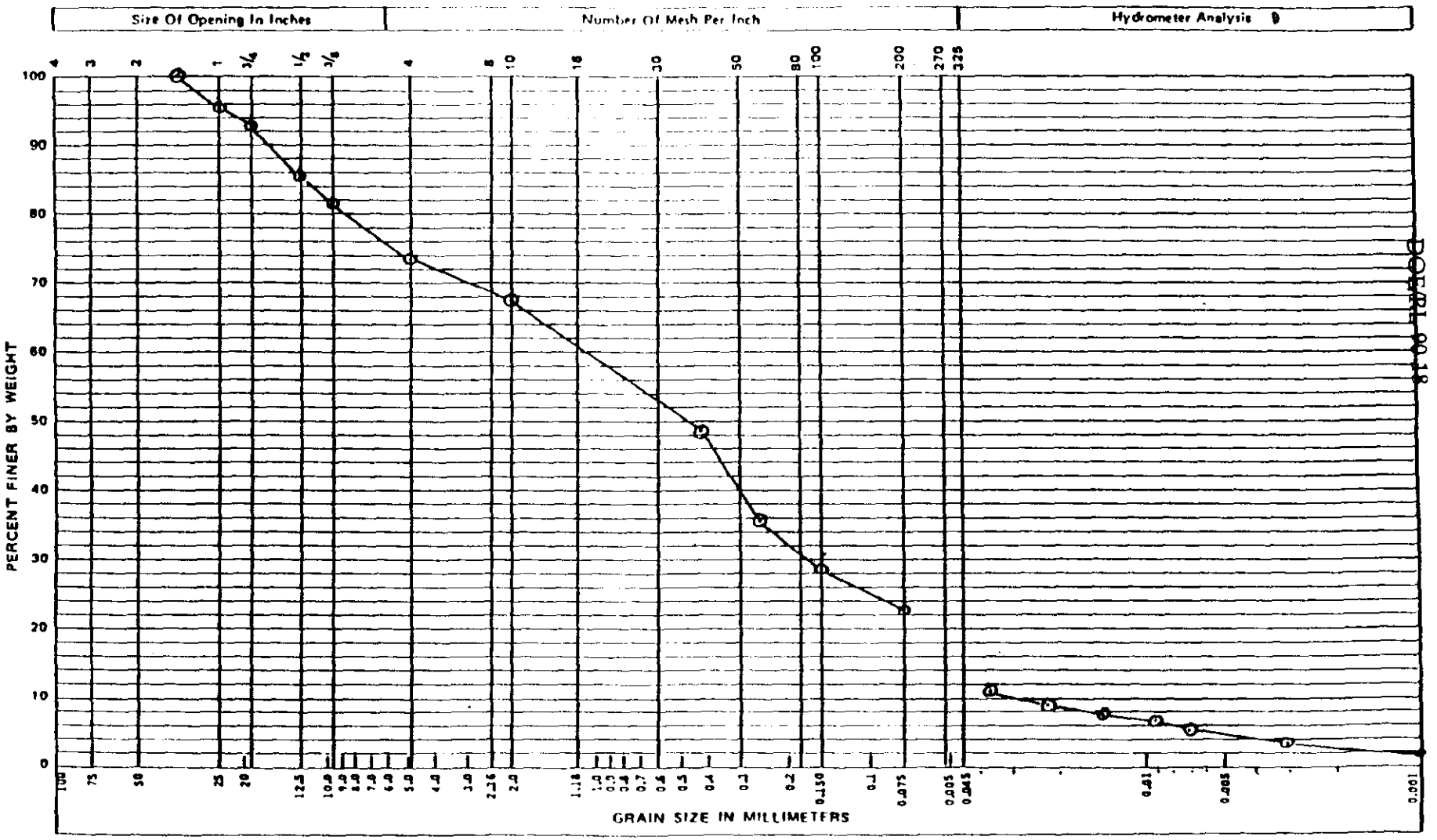
Checked by: HLBenny

GRAIN SIZE ANALYSIS PLOT



Specimen No. 0-119 Procedure No. ETAL-07 Rev. 1 Date Issued 11-15-90

GRAIN SIZE ANALYSIS PLOT



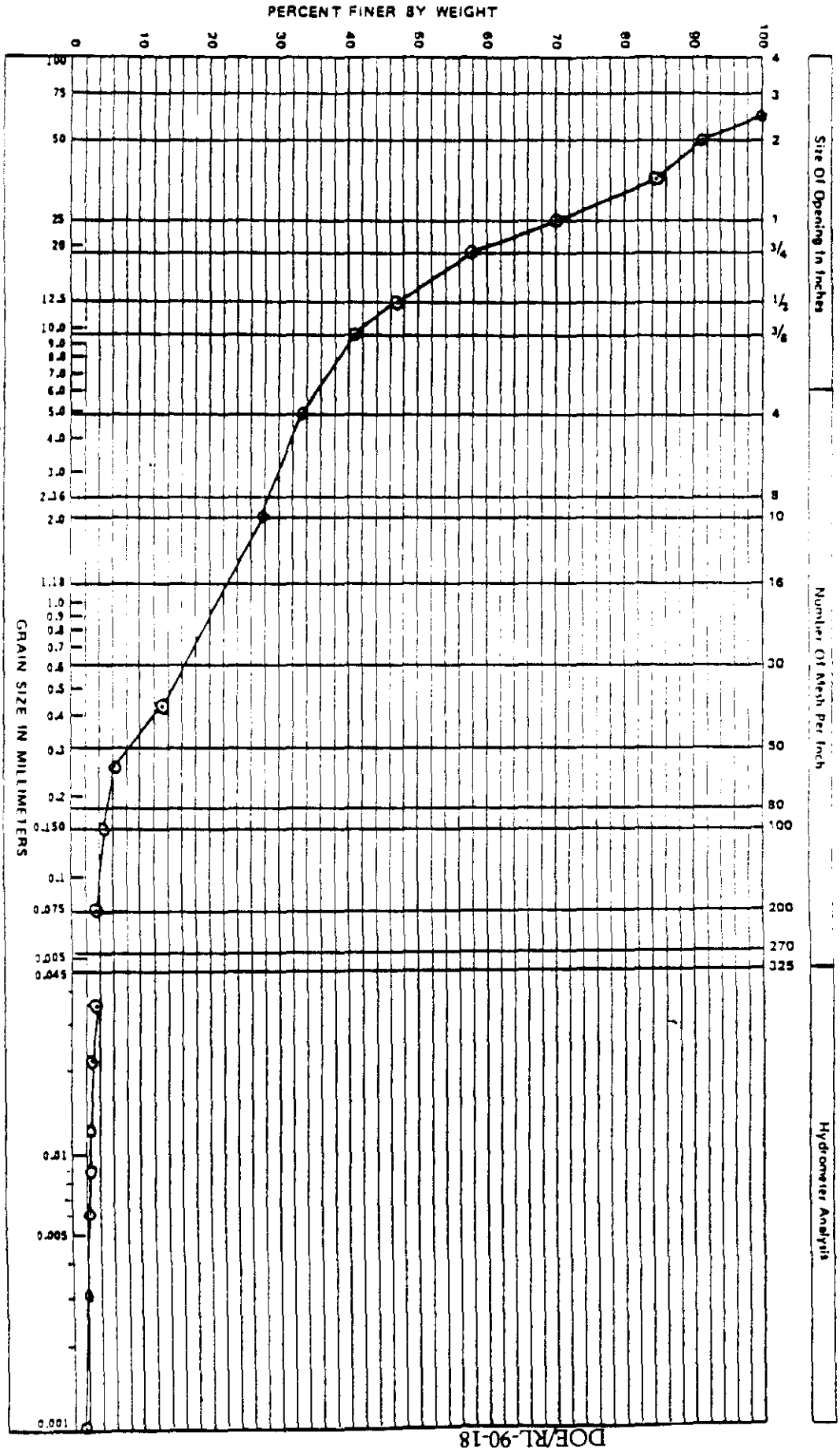
Specimen No. 0-120 Procedure No. ETAL-07 Rev. 1 Date Issued 11-15-89

Sample Description: SILTY SAND HRL-C-1

Plotted by: R.G. ALEXANDER

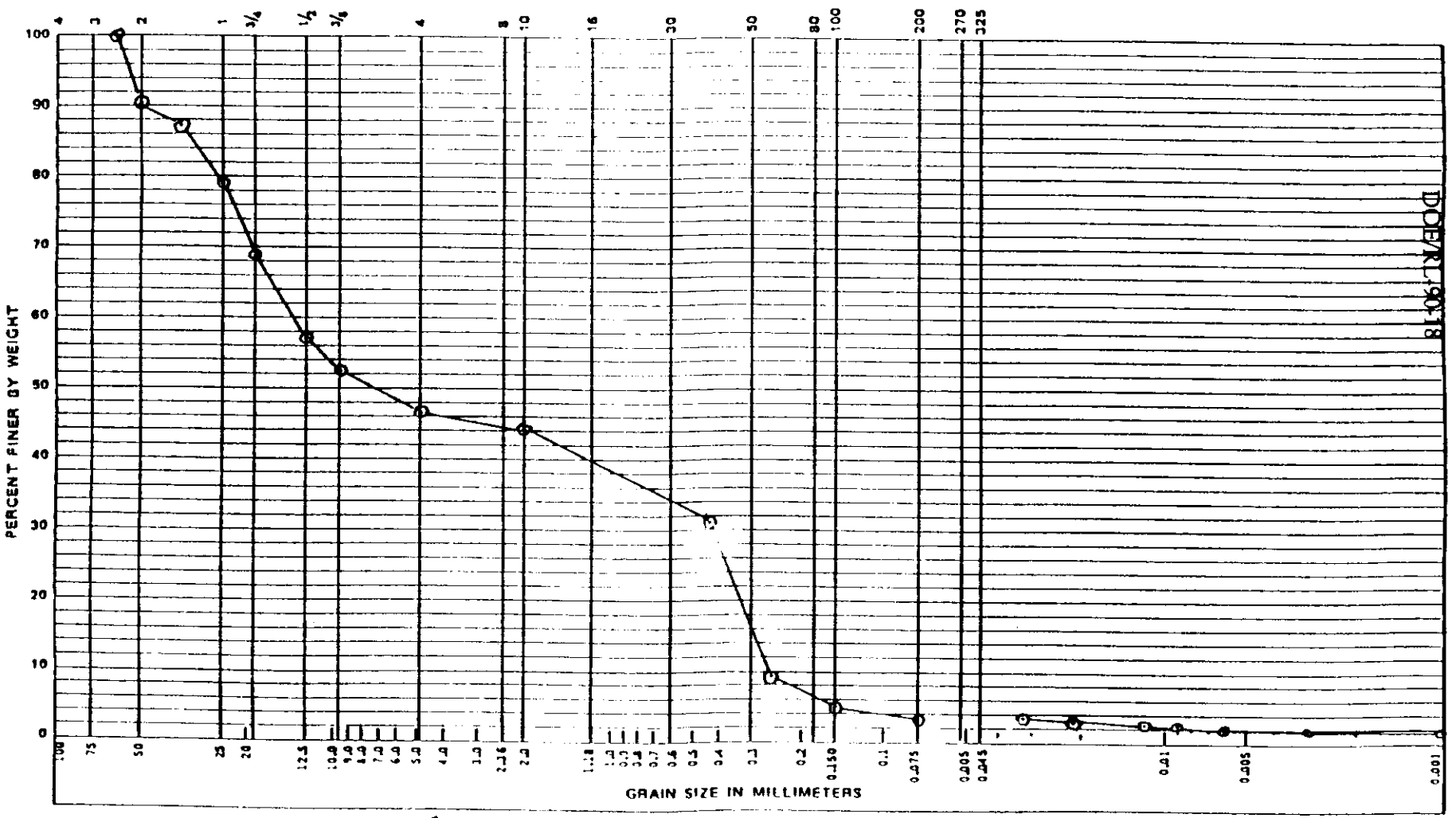
Checked by: HL Benny

GRAIN SIZE ANALYSIS PLOT



Specimen No 0-121 Procedure No ETAL-07 Rev 1 Date Issued 11-15-89

GRAIN SIZE ANALYSIS PLOT

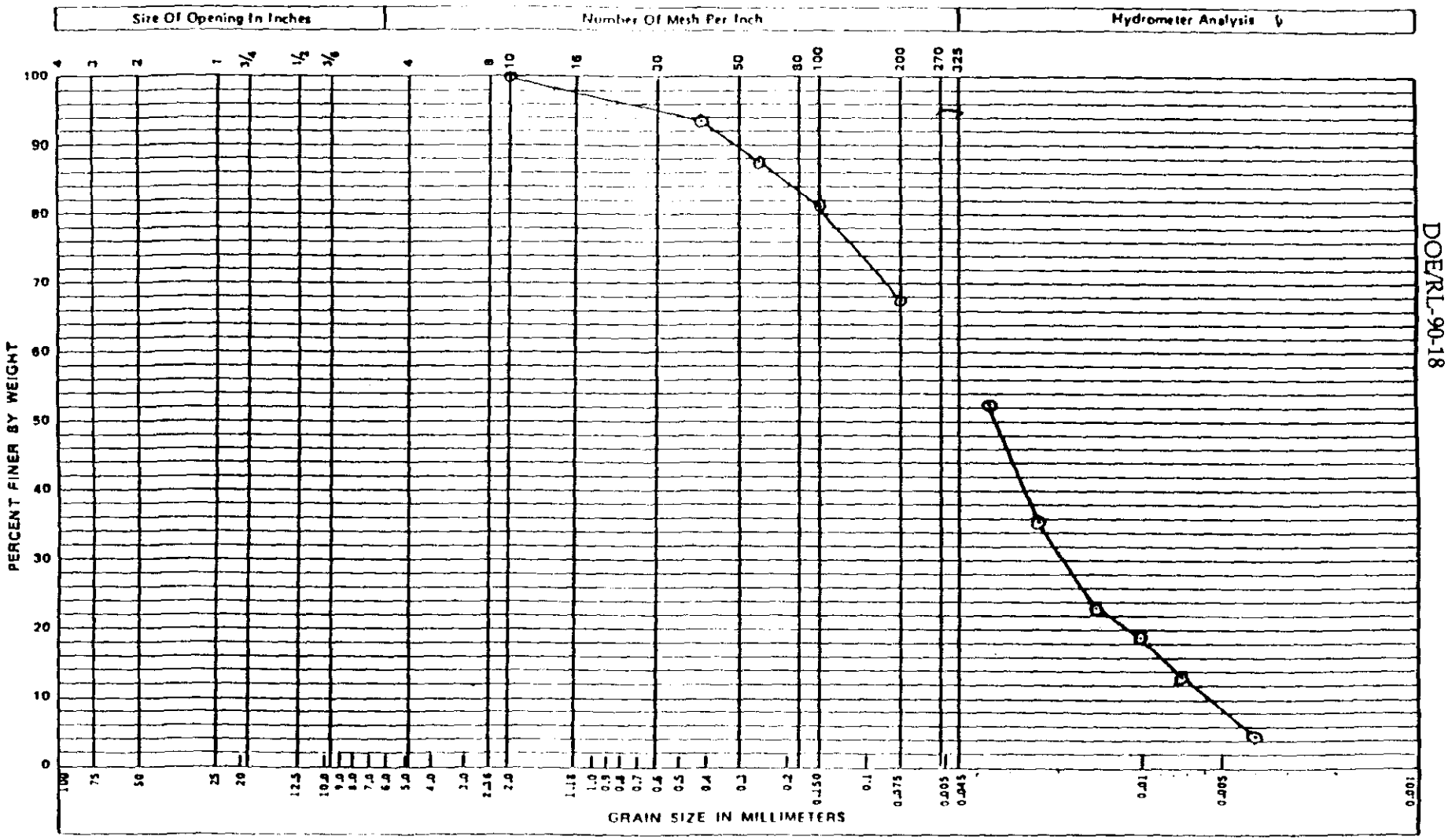


Specimen No 0-122 Procedure No. ETAL-07 Rev. 1 Date Issued 11-15-93

Sample Description: SANDY GRAVEL

DOE/RL-90-18

GRAIN SIZE ANALYSIS PLOT



Specimen No 0-Ø123 Procedure No. ETAL-07 Rev. 1 Date Issued

SUBAPPENDIX H-3
SUBSURFACE SOIL PHYSICAL ANALYTICAL RESULTS

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H-3. SUMMARY OF SOIL PHYSICAL RESULTS FOR SUBSURFACE SAMPLES

1100-2, Paint and Solvent Pit

Borehole	Sample Id	Sample Depth (ft)	Sample Date	Moisture Content %	Unified Soil Classification
DP-4	A0402S	0.8-1.4	07/12/89	0.8	Well graded sands - Sand and silt mixtures
DP-4	A0404S	1.9-3.1	07/12/89	3.2	Sand and silt mixtures
DP-4	A0406S	3.3-5.1	07/12/89	5.3	NR
DP-4	A0410S	10.7-12.4	07/13/89	2.5	Poorly graded gravels - Gravel and silt mixtures
DP-4	A0412S	16.0-17.0	07/14/89	2.7	Poorly graded gravels - Gravel and silt mixtures
DP-5	A0503S	2.6-3.6	07/18/89	2.9	Sand and silt mixtures
DP-5	A0505S	6.6-7.1	07/18/89	5.4	Sand and silt mixtures
DP-5	A0509S	10.0-11.0	07/19/89	4.4	Poorly graded sands - Sand and silt mixtures
DP-5	A0512S	15.0-15.7	07/19/89	4.8	Well graded sands - Sand and silt mixtures
DP-5	A0513S	16.2-18.0	07/19/89	4.2	Poorly graded sands
DP-6	A0603S	0.5-2.0	07/21/89	1.2	Sand and silt mixtures
DP-6	A0604S	2.5-3.7	07/21/89	1.6	Sand and silt mixtures
DP-6	A0607S	4.2-5.7	07/24/89	4.3	Sand and silt mixtures
DP-6	A0609S	7.9-9.0	07/24/89	2.3	Poorly graded sands - Sand and silt mixtures
DP-6	A0611S	12.8-13.8	07/24/89	3.2	Well graded sands - Sand and silt mixtures
DP-6	A0614S	16.3-17.3	07/25/89	3.2	Poorly graded sands - Sand and silt mixtures
DP-9	A1102S	2.6-3.6	09/14/89	2.6	Sand and silt mixtures
DP-9	A1104S	6.75-7.10	09/14/89	7.2	Gravel and silt mixtures
DP-9	A1108S	9.0-9.2	09/15/89	3.8	Sand and silt mixtures - Well graded sands
DP-9	A1109S	9.2-11.5	09/15/89	3.9	Sand and silt mixtures - Poorly graded sands
DP-9	A1110S	9.2-11.5	09/15/89	10.8	Sand and silt mixtures - Poorly graded sands
DP-9	A1112S	13.5-14.5	09/15/89	4.6	Sand and silt mixtures - Poorly graded sands
DP-9	A1113S	15.5-16.5	09/15/89	4.0	Sand and silt mixtures - Well graded sands
DP-9	A1117S	21.8-22.1	09/18/89	3.0	Sand and silt mixtures - Poorly graded sands
DP-9	A1120S	25.0-26.0	09/19/89	2.7	Gravel and silt mixtures - Poorly graded gravels
DP-9	A1122S	31.1-32.1	09/19/89	2.5	Gravel and silt mixtures - Well graded gravels
DP-9	A1124S	35.5-36.8	09/19/89	3.7	Gravel and silt mixtures - Well graded gravels
DP-9	A1125S	36.9-38.1	09/20/89	**	NR

** - Sample was saturated

H-3. SUMMARY OF SOIL PHYSICAL RESULTS FOR SUBSURFACE SAMPLES

1100-1, Battery Acid Pit					
Borehole	Sample Id	Sample Depth (ft)	Sample Date	Moisture Content %	Unified Soil Classification
BAP-1	A1002S	2.2-4.2	8/7/90	8.9	Sand and silt mixtures
BAP-1	A1006S	6.1-6.8	8/7/90	4.7	Gravel and silt mixtures
BAP-1	A1009S	7.8-8.8	8/8/90	2.9	Sand and silt mixtures
BAP-1	A1013S	13.4-13.9	8/9/90	3.2	Sand and silt mixtures
BAP-1	A1015S	16.3-17.5	8/9/90	2.3	Gravel and silt mixtures - Poorly graded gravels

H-3. SUMMARY OF SOIL PHYSICAL RESULTS FOR SUBSURFACE SAMPLES

1100-3, Antifreeze and Degreaser Pit					
Borehole	Sample Id	Sample Depth (ft)	Sample Date	Moisture Content %	Unified Soil Classification
DP-1	A0902S	4.0-5.1	08/02/89	2.5	Sand and silt mixtures - Well graded sands
DP-1	A0905S	6.9-7.9	08/02/89	2.4	Sand and silt mixtures - Well graded sands
DP-1	A0908S	11.9-12.9	08/02/89	4.9	Sand and silt mixtures
DP-1	A0911S	15.5-16.5	08/03/89	5.8	Sand and silt mixtures - Poorly graded sands
DP-2	A0802S	2.0-3.5	07/28/89	1.3	Sand and silt mixtures - Well graded sands
DP-2	A0804S	6.5-8.0	07/31/89	2.7	Gravel and silt mixtures - Poorly graded gravels
DP-2	A0806S	8.5-10.2	07/31/89	3.8	Sand and silt mixtures - Poorly graded sands
DP-2	A0807S	12.6-14.3	07/31/89	3.9	Sand and silt mixtures - Well graded sands
DP-2	A0809S	15.0-16.0	08/01/89	2.8	Sand and silt mixtures
DP-2	A0811S	17.6-20.0	08/01/89	3.6	Sand and silt mixtures - Poorly graded sands
DP-3	A0703S	2.3-3.3	07/27/89	1.5	Sand and silt mixtures
DP-3	A0705S	7.1-8.1	07/27/89	2.5	Gravel and silt mixtures - Poorly graded gravels
DP-3	A0707S	10.1-10.8	07/27/89	4.4	Sand and silt mixtures - Poorly graded sands
DP-3	A0710S	13.2-14.3	07/28/[illegible]	3.7	Poorly graded sands
DP-3	A0711S	15.2-16.0	07/28/[illegible]	3.9	Poorly graded sands
DP-8	A1202S	2.5-3.7	09/26/89	1.5	Sand and silt mixtures
DP-8	A1207S	7.7-8.9	09/27/89	2.1	Poorly graded sands - Sand and silt mixtures
DP-8	A1209S	12.5-13.0	09/27/89	NR	Well graded sands - Sand and silt mixtures
DP-8	A1212S	15.1-16.1	09/27/89	2.0	Poorly graded sands - Sand and silt mixtures
DP-8	A1214S	18.3-18.7	09/27/89	2.1	Well graded sands - Sand and silt mixtures
DP-8	A1215S	20.5-22.2	09/27/89	2.5	Poorly graded sands - Sand and silt mixtures
DP-8	A1216S	23.7-26.4	09/28/89	3.0	Poorly graded sands - Sand and silt mixtures
DP-8	A1218S	26.4-27.4	09/28/89	2.0	Well graded sands - Sand and silt mixtures
DP-8	A1220S	30.2-31.4	09/28/89	2.3	Poorly graded sands - Sand and silt mixtures

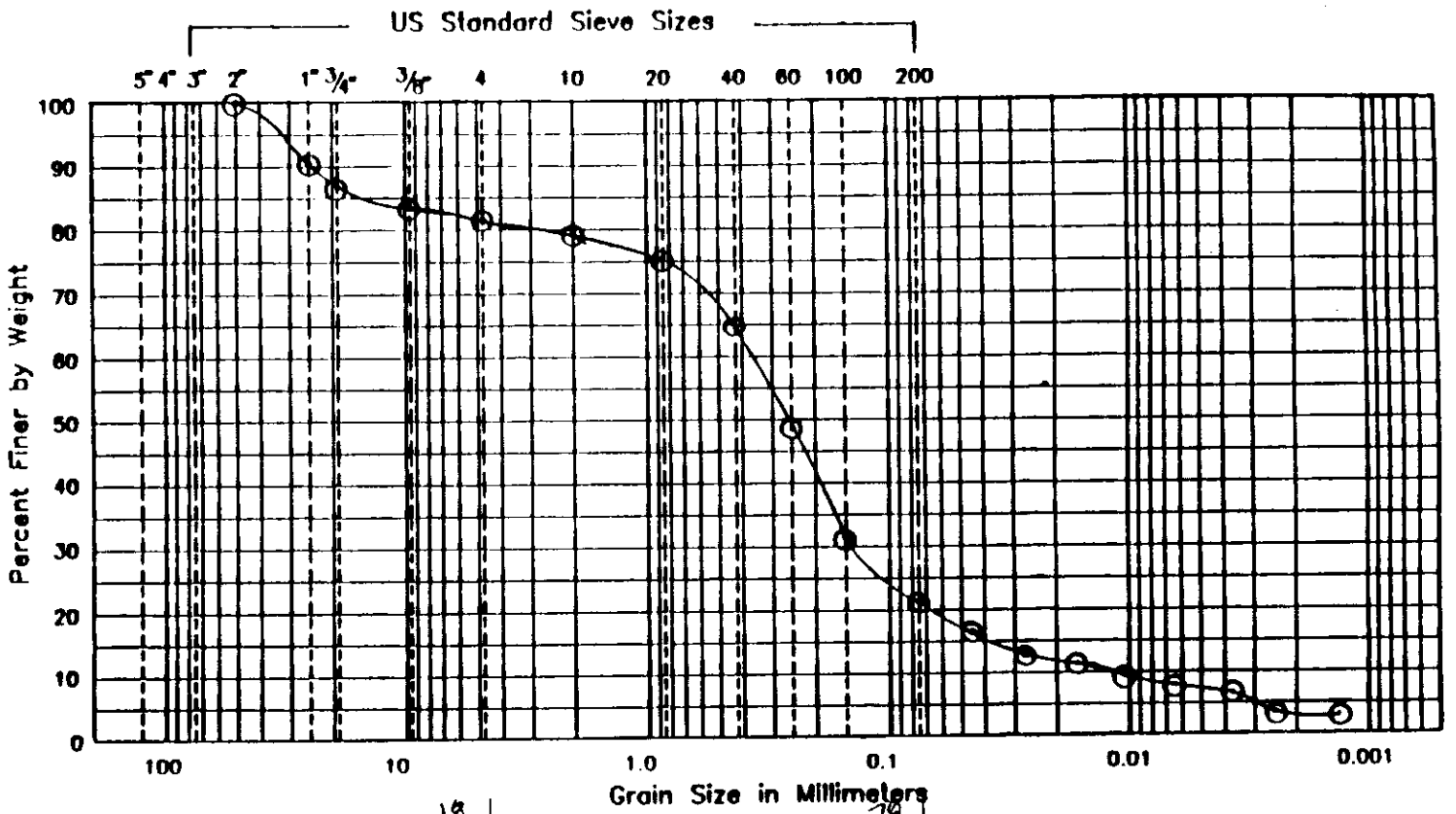
H-3. SUMMARY OF SOIL PHYSICAL RESULTS FOR SUBSURFACE SAMPLES

Horn Rapids Landfill					
Borehole	Sample Id	Sample Depth (ft)	Sample Date	Moisture Content %	Unified Soil Classification
HRL-2	A1803S	3.4-4.8	01/18/90	3.1	Sand and silt mixtures
HRL-2	A1806S	8.0-8.9	01/18/90	1.8	Poorly graded sands - Sand and silt mixtures
HRL-2	A1809S	12.5-13.5	01/18/90	1.7	Sand and silt mixtures
HRL-2	A1811S	16.5-17.6	01/19/90	1.7	Gravel and silt mixtures
HRL-2	A1813S	20.0-21.7	01/19/90	2.3	Sand and silt mixtures
HRL-3	A2003S	2.8-4.4	01/22/90	3.5	Poorly graded gravels
HRL-3	A2006S	8.0-9.3	01/22/90	2.2	Well graded gravels - Gravel and silt mixtures
HRL-3	A2008S	13.3-14.5	01/23/90	2.6	Well graded sands - Well graded gravels
HRL-3	A2011S	17.6-18.8	01/23/90	2.4	Poorly graded gravels - Gravel and silt mixtures
HRL-3	A2013S	22.0-23.2	01/23/90	**	Poorly graded gravels - Gravel and silt mixtures
HRL-4	A2203S	3.2-4.6	01/26/90	3.0	Well graded gravels - Gravel and silt mixtures
HRL-4	A2206S	8.2-9.7	01/26/90	1.7	Poorly graded gravels - Gravel and silt mixtures
HRL-4	A2209S	13.6-14.4	01/26/90	2.5	Poorly graded sands
HRL-4	A2211S	17.4-18.9	01/29/90	4.2	Gravel and silt mixtures
HRL-4	A2213S	21.5-23.2	01/29/90	**	Poorly graded gravels - Gravel and silt mixtures
HRL-5	A1503S	3.8-6.0	01/08/90	2.7	Gravel and silt mixtures - Poorly graded gravels
HRL-5	A1505S	8.6-9.4	01/09/90	2.9	Sand and silt mixtures - Poorly graded sands
HRL-5	A1508S	11.8-13.1	01/09/90	3.0	Gravel and silt mixtures
HRL-5	A1511S	15.5-16.0	01/09/90	3.2	Sand and silt mixtures
HRL-5	A1514S	21.9-22.8	01/10/90	3.3	Sand and silt mixtures
HRL-6	A1604S	7.1-9.4	01/10/90	1.8	Poorly graded gravels
HRL-6	A1606S	9.4-11.6	01/10/90	2.1	Well graded gravels
HRL-6	A1609S	16.2-18.5	01/11/90	3.0	Poorly graded gravels
HRL-6	A1610S	18.5-20.8	01/11/90	3.1	Poorly graded gravels
HRL-6	A1611S	21.5-23.0	01/11/90	3.0	Gravel and silt mixtures
HRL-6	A1514S	24.2-25.0	01/12/90	1.9	Sand and silt mixtures
HRL-6	A1615S	25.0-25.2	01/15/90	3.1	Sand and silt mixtures
HRL-6	A1616S	25.8-27.8	01/15/90	**	Poorly graded gravels - Gravel and silt mixtures
HRL-7	A2302S	2.7-4.3	01/31/89	2.5	Poorly graded gravels - Gravel and silt mixtures
HRL-7	A2305S	7.3-8.4	01/31/89	2.2	Gravel and silt mixtures
HRL-7	A2309S	11.2-12.2	01/31/89	2.3	Gravel and silt mixtures
HRL-7	A2311S	15.3-16.5	02/01/89	3.6	Gravel and silt mixtures
HRL-7	A2313S	19.0-20.0	02/01/89	1.5	Gravel and silt mixtures
HRL-8	A1403S	2.5-4.4	12/19/89	3.1	Gravel and silt mixtures - Poorly graded gravels
HRL-8	A1405S	4.5-8.2	12/19/89	3.8	Sand and silt mixtures
HRL-8	A1408S	10.9-12.8	12/20/89	4.1	Gravel and silt mixtures
HRL-8	A1410S	17.6-18.8	12/20/89	3.4	Gravel and silt mixtures - Poorly graded gravels
HRL-8	A1413S	22.6-23.1	12/20/89	1.8	Gravel and silt mixtures
HRL-9	A1703S	2.8-3.7	01/15/90	2.5	Well graded gravels - Gravel and silt mixtures
HRL-9	A1705S	5.0-5.8	01/15/90	1.9	Gravel and silt mixtures
HRL-9	A1708S	9.4-10.4	01/16/90	2.7	Well graded gravels - Gravel and silt mixtures
HRL-9	A1711S	14.2-15.2	01/16/90	2.8	Poorly graded gravels - Gravel and silt mixtures
HRL-9	A1713S	20.4-21.7	01/16/90	2.8	Well graded gravels - Gravel and silt mixtures
HRL-10	A1904S	4.0-6.3	01/22/90	1.8	Gravel and silt mixtures - Well graded gravels
HRL-10	A1907S	9.1-11.4	01/22/90	2.5	Gravel and silt mixtures - Well graded gravels
HRL-10	A1908S	11.4-13.7	01/22/90	2.2	Sand and silt mixtures - Well graded sands
HRL-10	A1910S	16.9-17.8	01/23/90	3.7	Sand and silt mixtures
HRL-10	A1911S	17.8-20.1	01/23/90	3.0	Gravel and silt mixtures - Poorly graded gravels
HRL-10	A1913S	27.9-30.3	01/25/90	3.6	Poorly graded gravels

** - Sample was saturated

GRAIN SIZE DISTRIBUTION

Project: WHC/UDQ-EPI-1/WA
Project No. 883-13544 Date 9-1-90 Tested by VC Reviewed by KKP



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	18				70	
	12%				[illegible]	17%

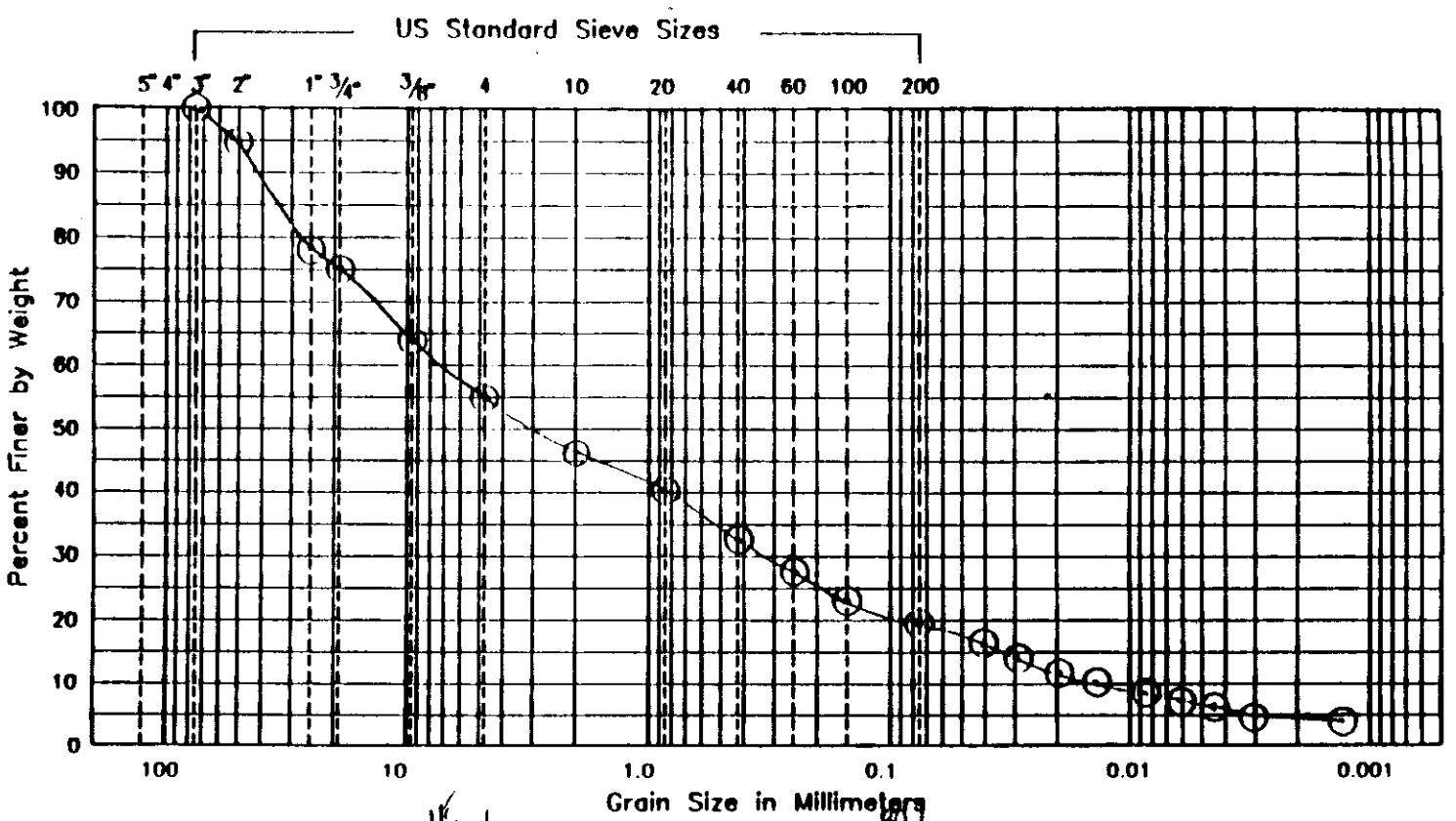
Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1992		8.9				Light olive brown, f-m SAND, some silt, some gravel, (SM).

Golder Associates

GRAIN SIZE DISTRIBUTION

Project [illegible]
Project No. [illegible] Date 4/18 Tested By [illegible] Reviewed By [illegible]

Golder Associates



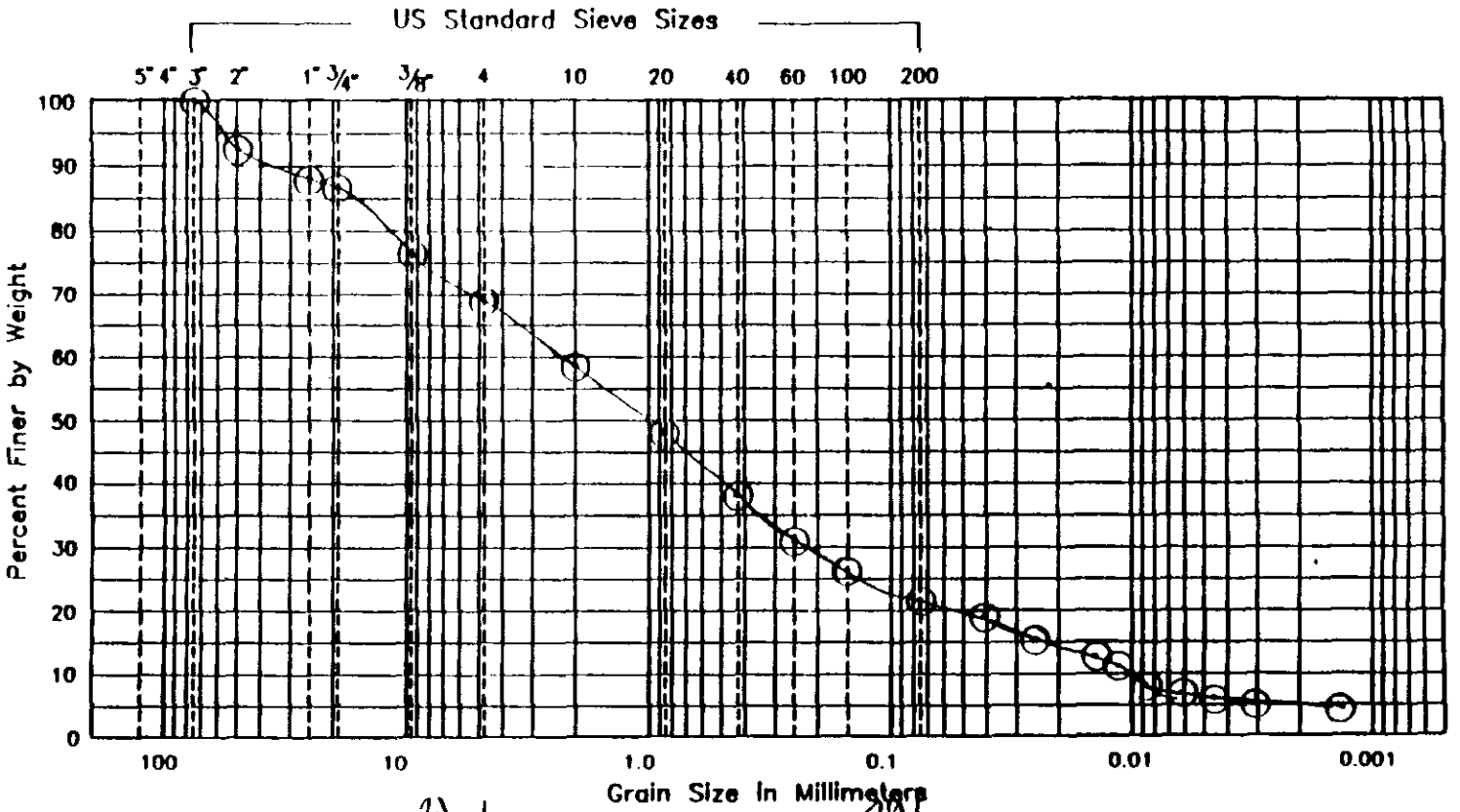
Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	11%			71%		20%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1006		4.7				Olive grey, F-C GRAVEL and SAND, some silt, (GM).

GRAIN SIZE DISTRIBUTION

Project [illegible]
Project No. [illegible] Date [illegible] Tested By [illegible] Reviewed By [illegible]

Golder Associates



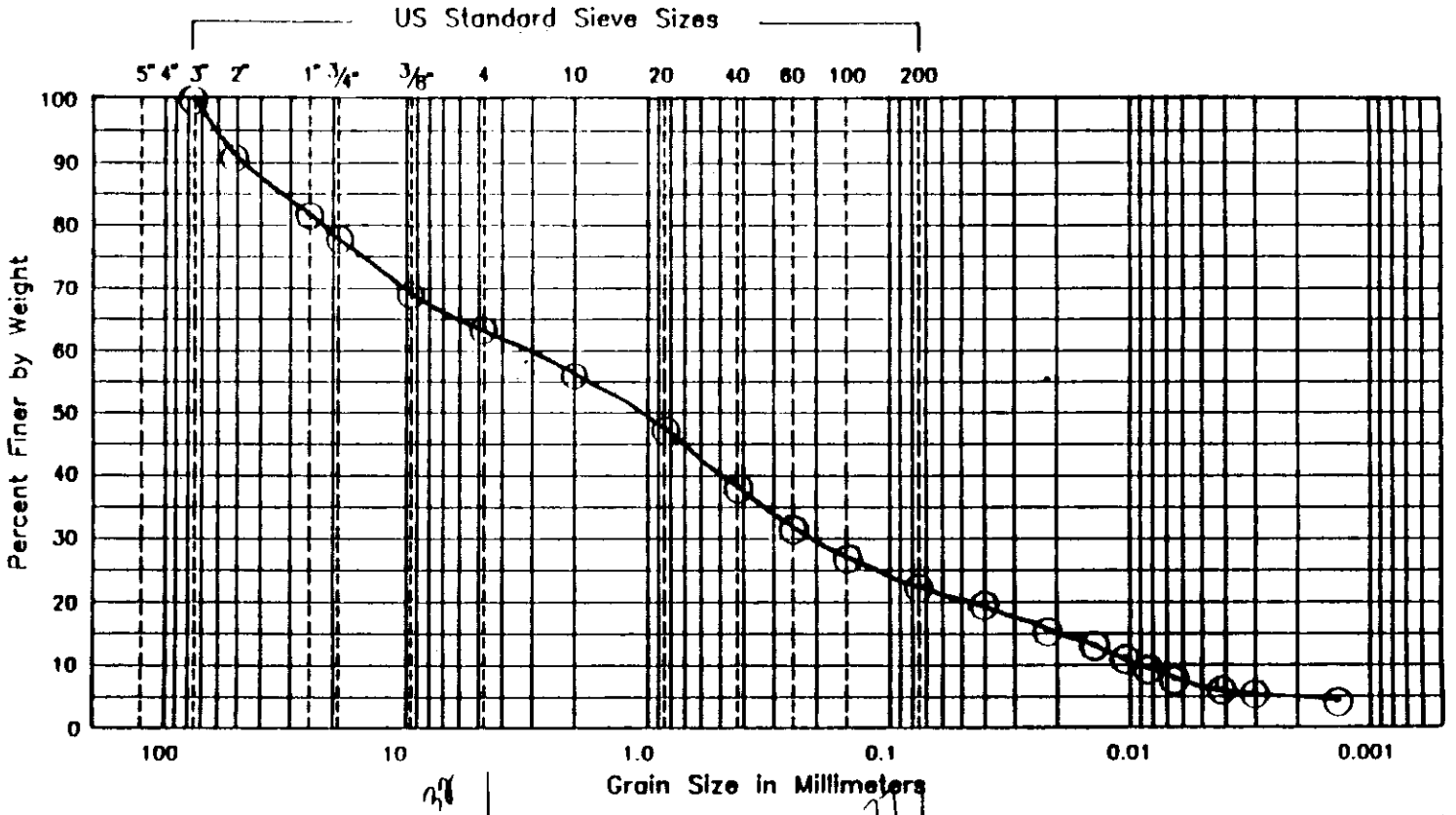
Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	21%		48%			31%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1009		2.9				Light olive grey, f-c SAND and GRAVEL, some silt, (SM).

2-14-90

GRAIN SIZE DISTRIBUTION

Project: [illegible]
Project No. [illegible] Date [illegible]
Logged by DAC Checked by [illegible]



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	%				46%	8.3%

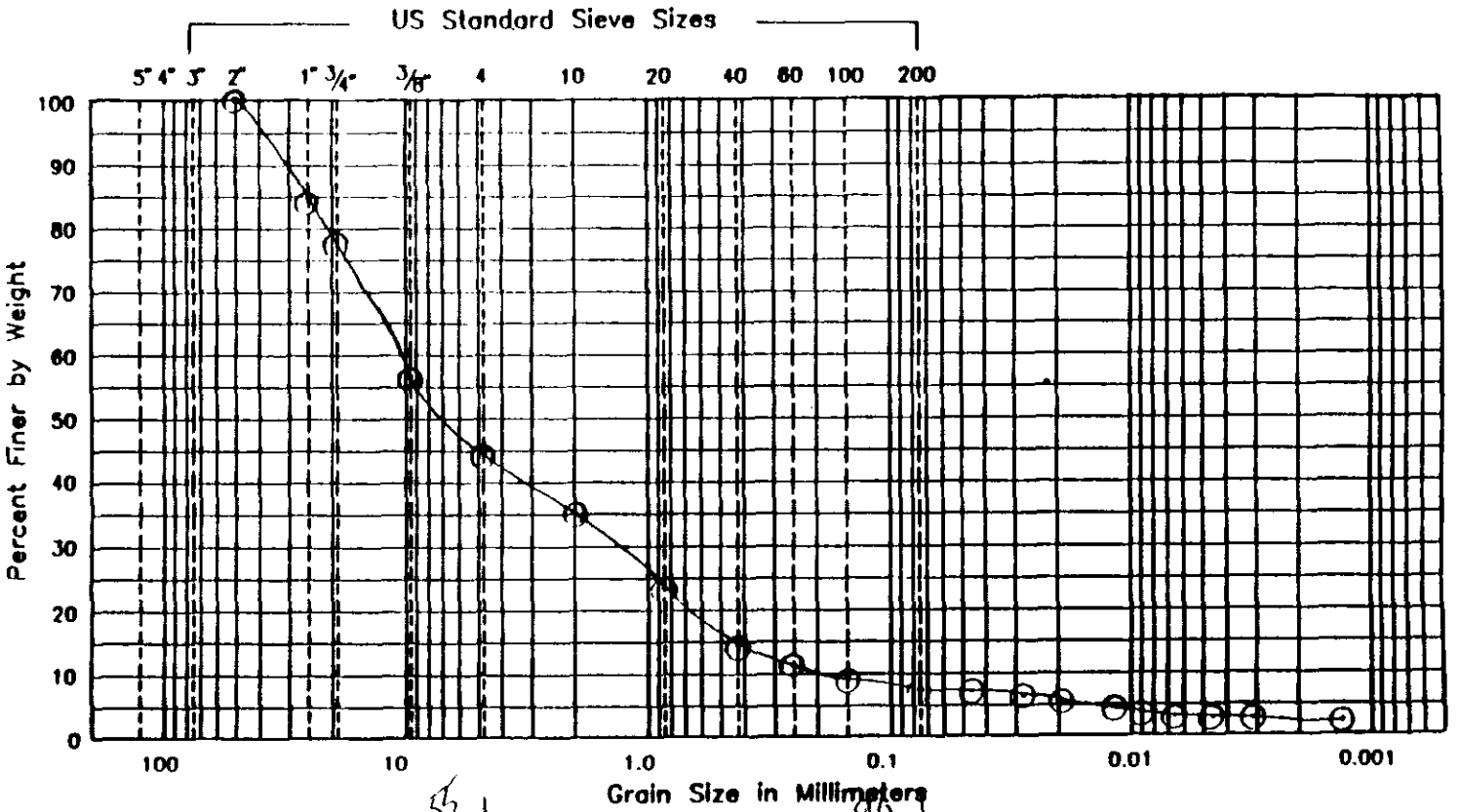
Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1Ø13		3.2				light olive grey, c-f SAND and GRAVEL, some silt, (SM).

Golder Associates

GRAIN SIZE DISTRIBUTION

Project: [illegible]
Project No. [illegible] Date [illegible] Tested By [illegible] Approved By [illegible]

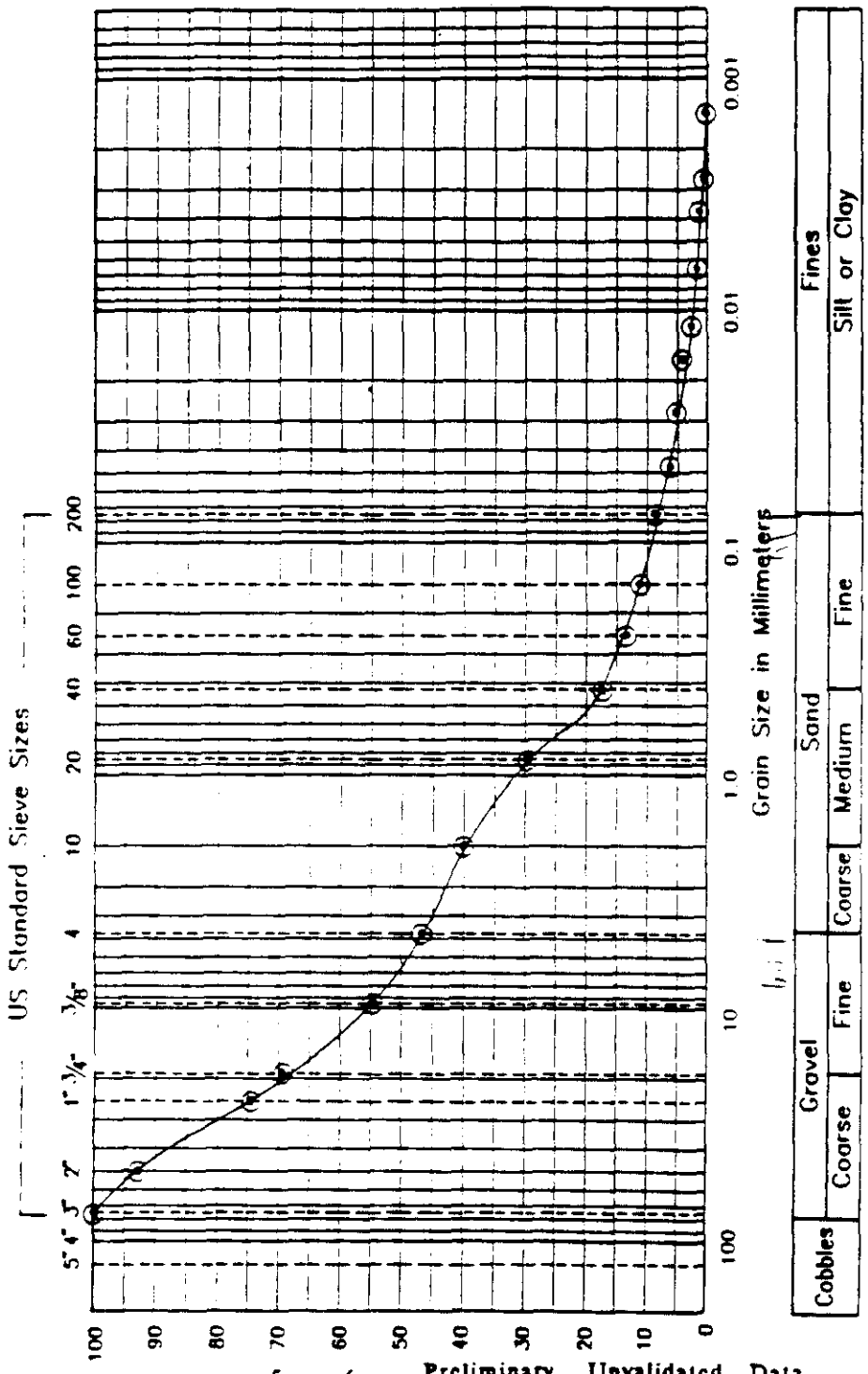
Golder Associates



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	65%			18%		17%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1015		2.3				Olive grey, f-c GRAVEL and SAND, little silt, (GM-GP).

2-15-90



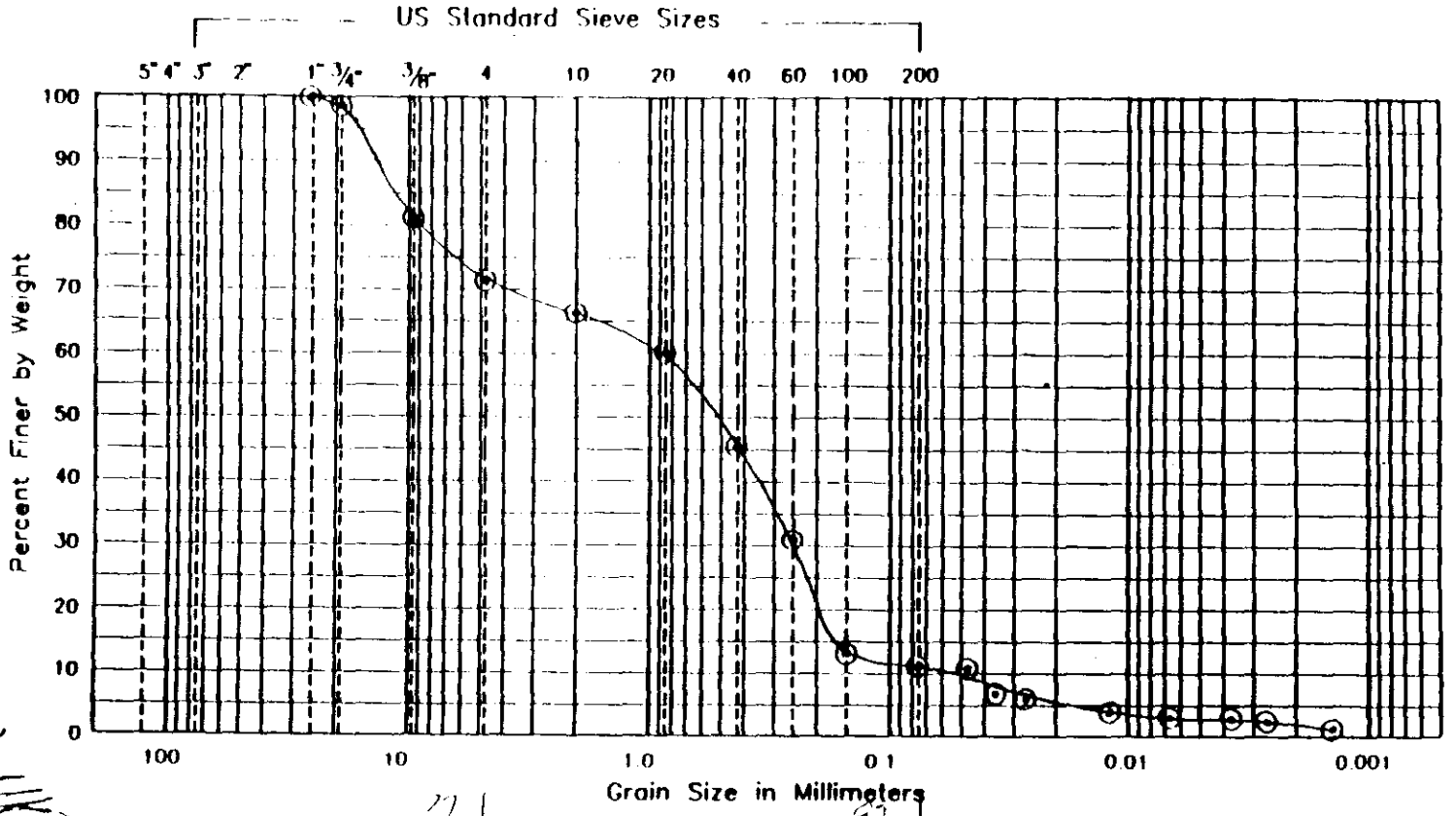
Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
DP4		2.7				Olive grey, c-f GRAVEL, and c-f SAND, little silt, (GP-GM).
A0412						

Preliminary, Unvalidated Data -- To Be Used by Cognizant Engineer Only

GRAIN SIZE DISTRIBUTION

Project WHC/1100-EM-1/WA
Project No 683-1754.201 Date 7/21/89 Plotted By [illegible] Approved By [illegible]

Golder Associates



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

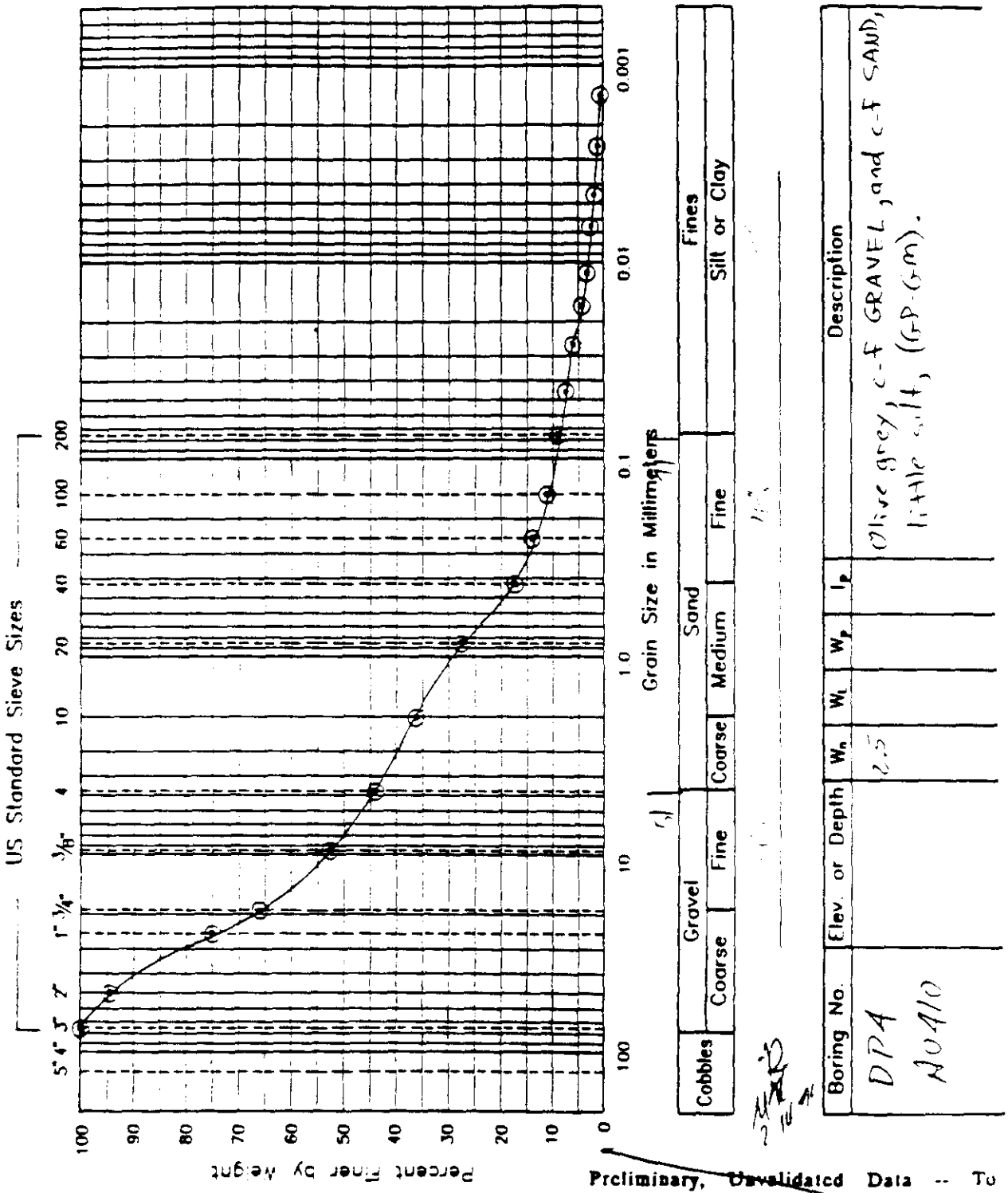
Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
DPA N0402		0.8				Olive grey, f-m SAND, some f gravel, little silt, (SW-SM).

Preliminary, Unvalidated Data -- To Be Used by Cognizant Engineer Only

GRAIN SIZE DISTRIBUTION

Project: WMC/1100-EM1/MW
Project No. 882-1254-201 Date 9/26/89 Tested By SK Approved By KLC

Golder Associates



Preliminary, Unvalidated Data -- To Be Used by Cognizant Engineer Only

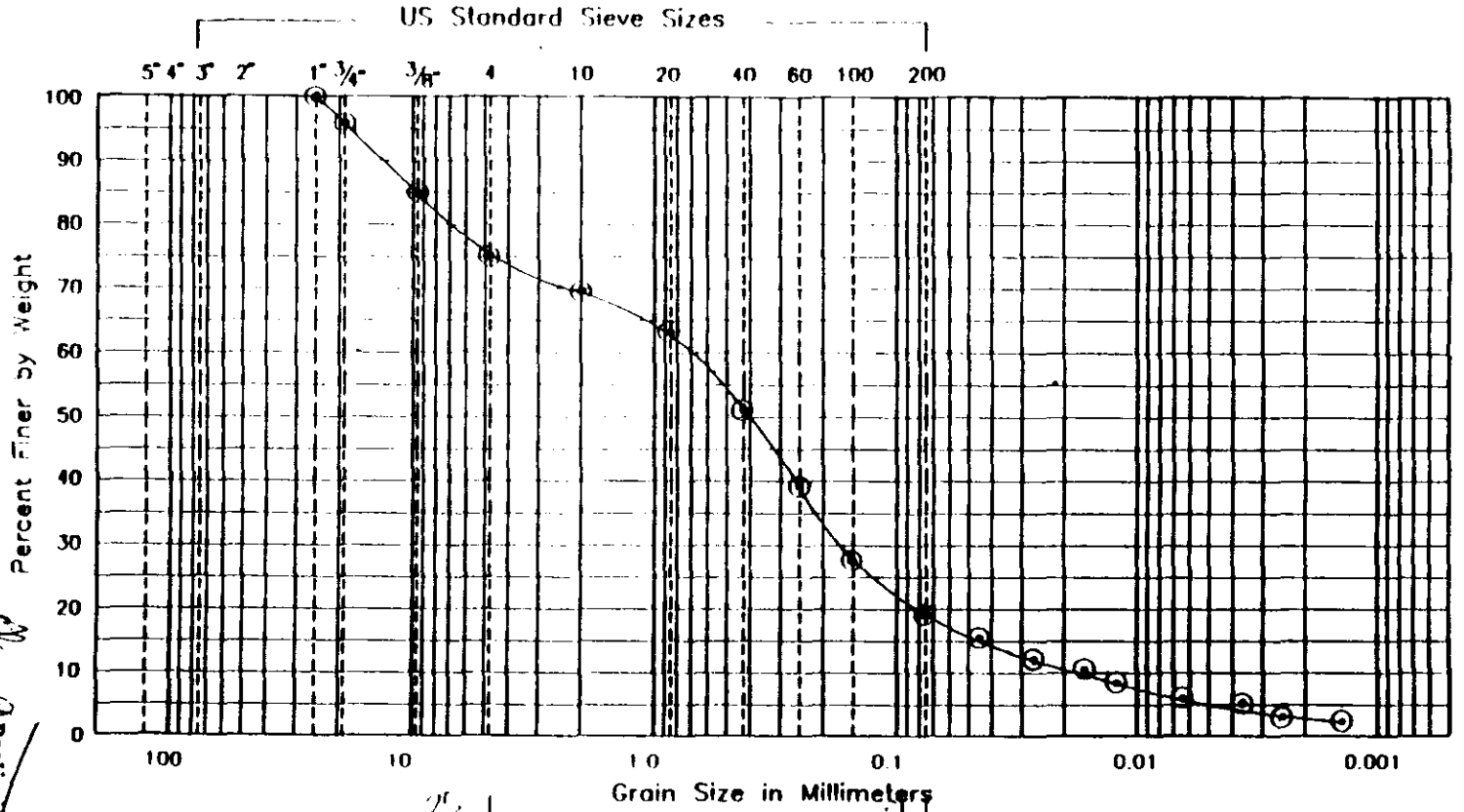
GRAIN SIZE DISTRIBUTION

Project: WHS/1100-EM-1/WN
Project No. 883-1754.001 Date 29 AUG 91 Drawn By Sw Approved By KKG

Golder Associates

GRAIN SIZE DISTRIBUTION

Project: 100-C/100-D-E01-1/HW
Project No. 883-1754 001 Date 02/16/89 Checked By: SM Approved By:



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	2%			86%		12%

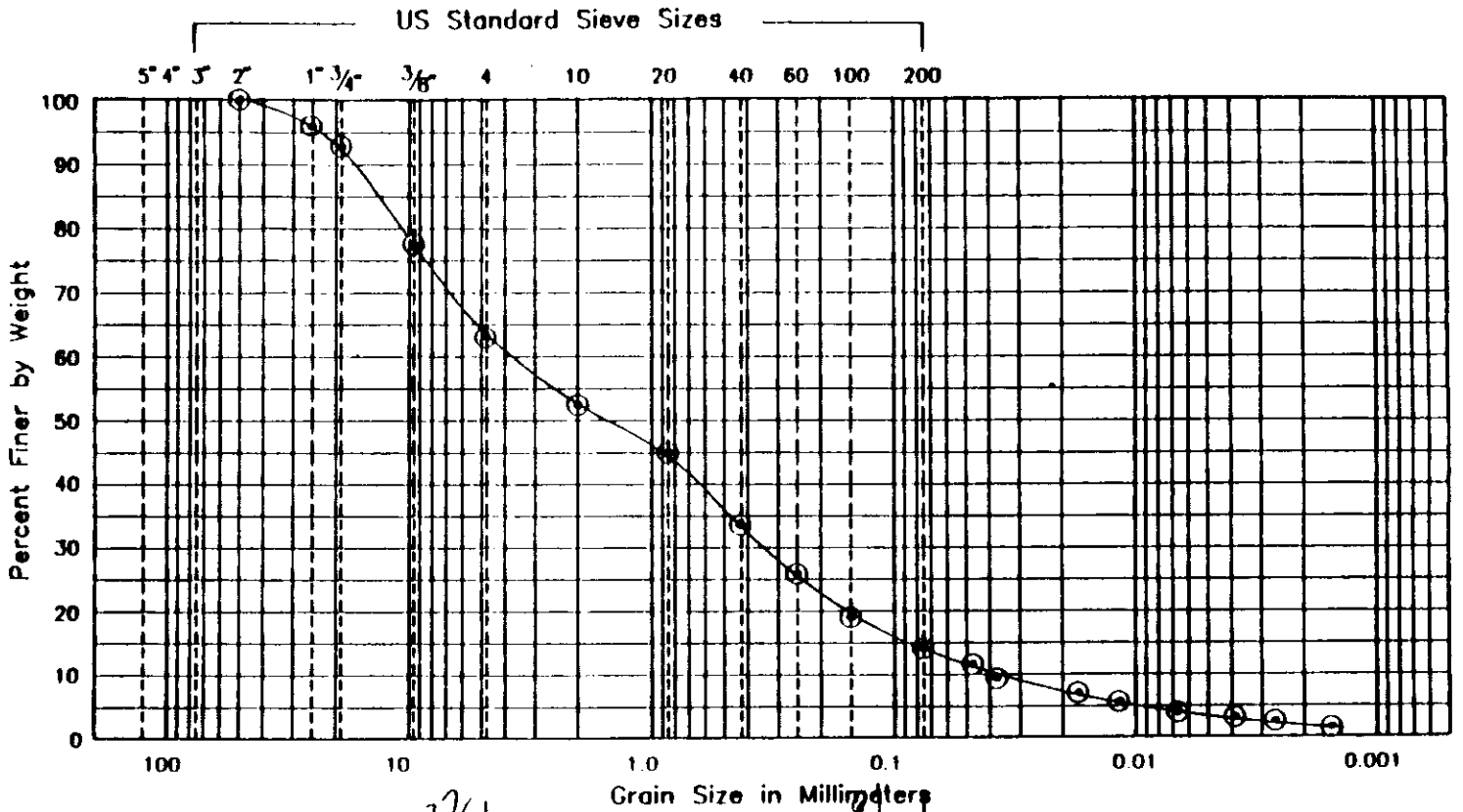
Boring No.	Elev or Depth	W_n	W_L	W_P	I_P	Description
DP4 A0404		32				Olive grey, f-c SAND, some f gravel, some silt, (SM).

Preliminary, Unvalidated Data – To Be Used by Cognizant Engineer Only

Golder Associates

GRAIN SIZE DISTRIBUTION

Project: 1944C/100-EM-1/WAG
Project No. E83-1354 OCI Date 1/19/91 Tested By: SKK Reviewed By: KMS



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

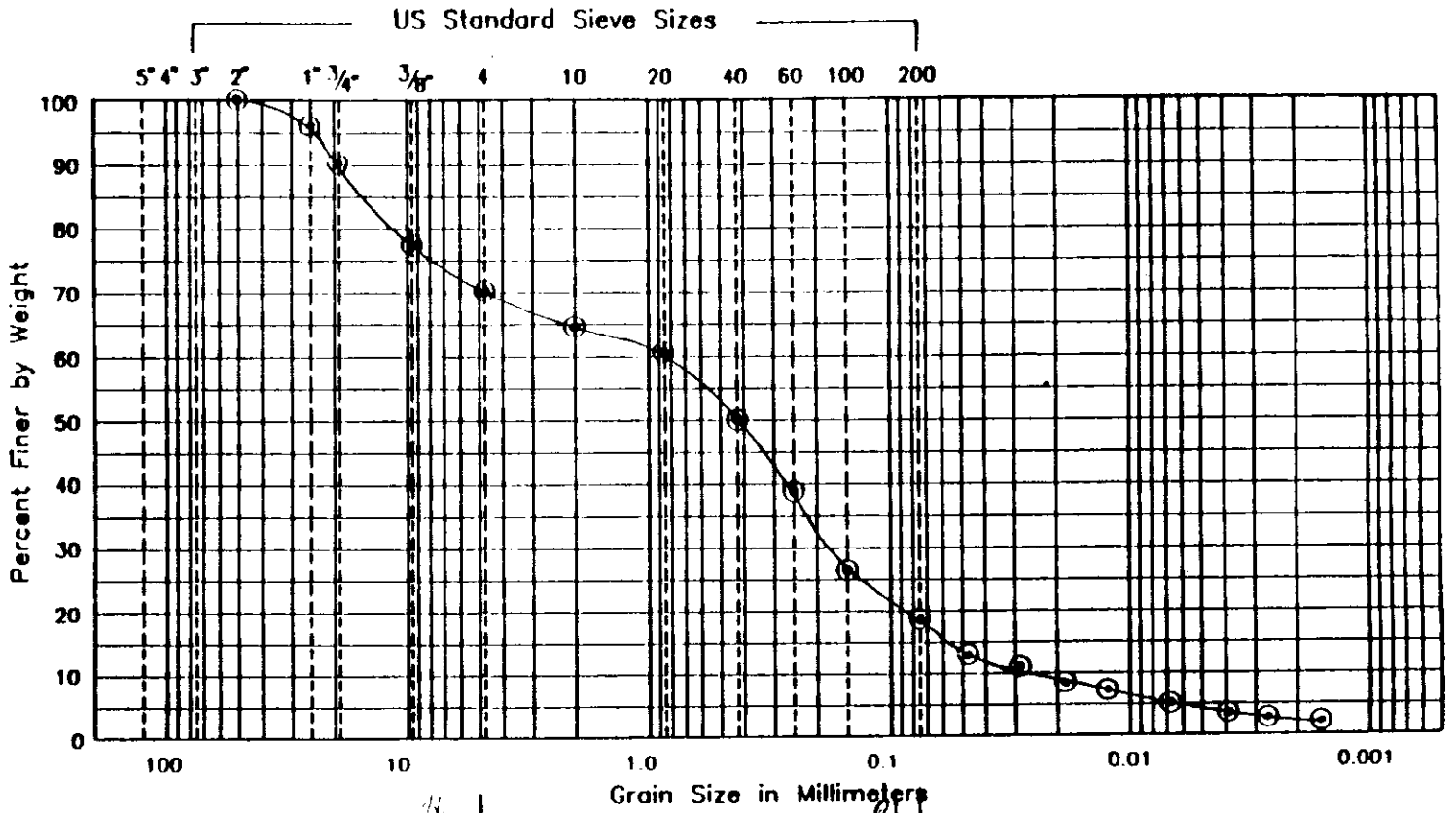
Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
DP-5		2.9				Dark yellowish brown, c-f SAND and GRAVEL, some silt, (SM).
A0503						

Golder Associates

GRAIN SIZE DISTRIBUTION

Project: UNC/1100-OPU-1/Wd
Project No. 89-1454.01 Date 12/AUG/89 Tested By: [illegible] Reviewed By: KKB

Golder Associates

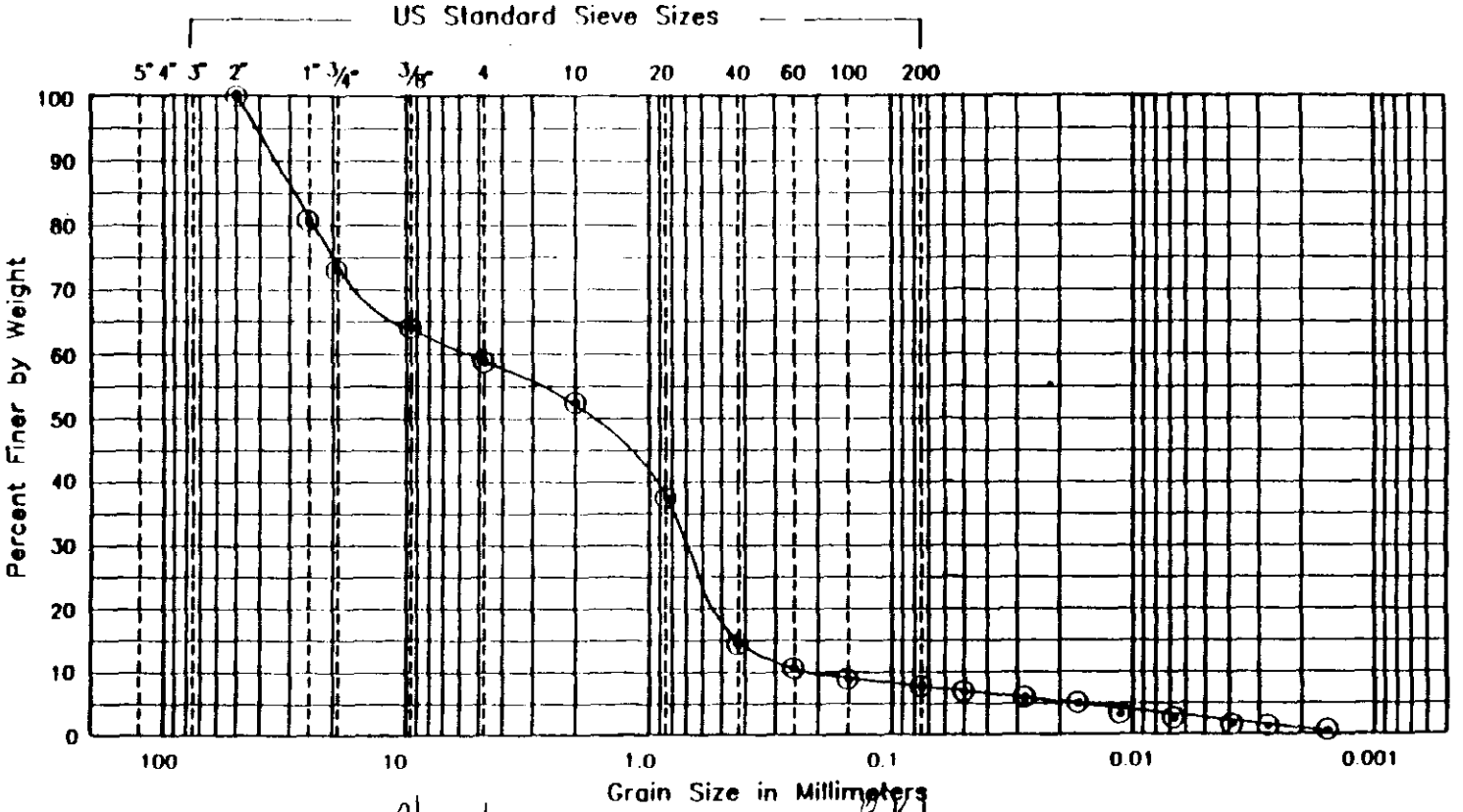


Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
					51%	19%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
DP-5 A05605		5.4				Dark yellowish brown, F-C SAND, some F-C GRAVEL, some silt, (SM).

GRAIN SIZE DISTRIBUTION

Project: WHC/1100-EM-1/WR
Project No. 863-1754.001 Date: 11/14/89 Tested By: SK Reviewed By: [illegible]



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

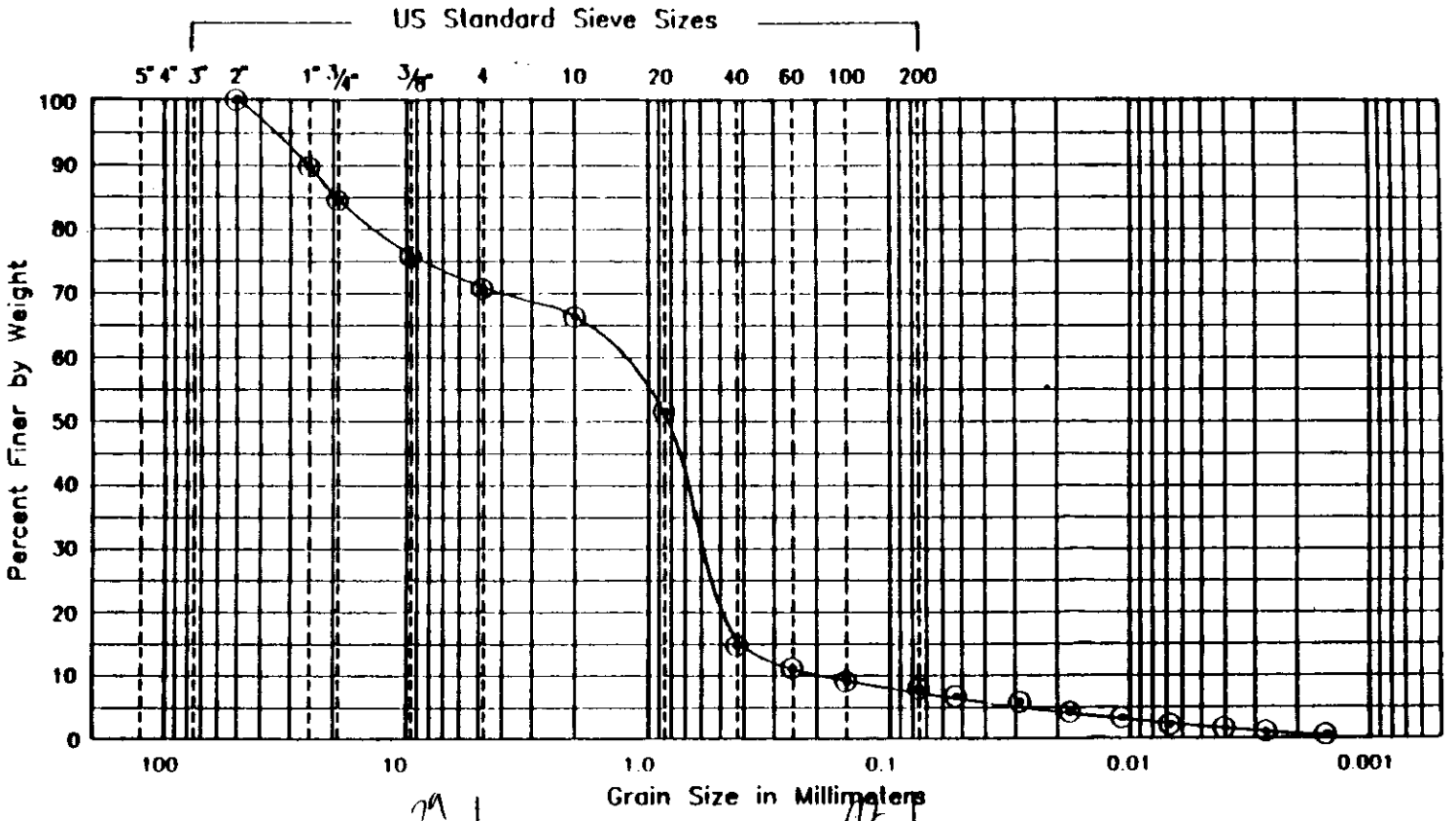
Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
DP-5 A0509		4.4				Dusky yellowish brown, c-f SAND and GRAVEL, little silt, (SP-SM).

Golder Associates

GRAIN SIZE DISTRIBUTION

Project: HWC/UNC-EPI-11/HA
Project No. 883-1754.001 Drawn By: Tested By: SKK Approved By: KHS

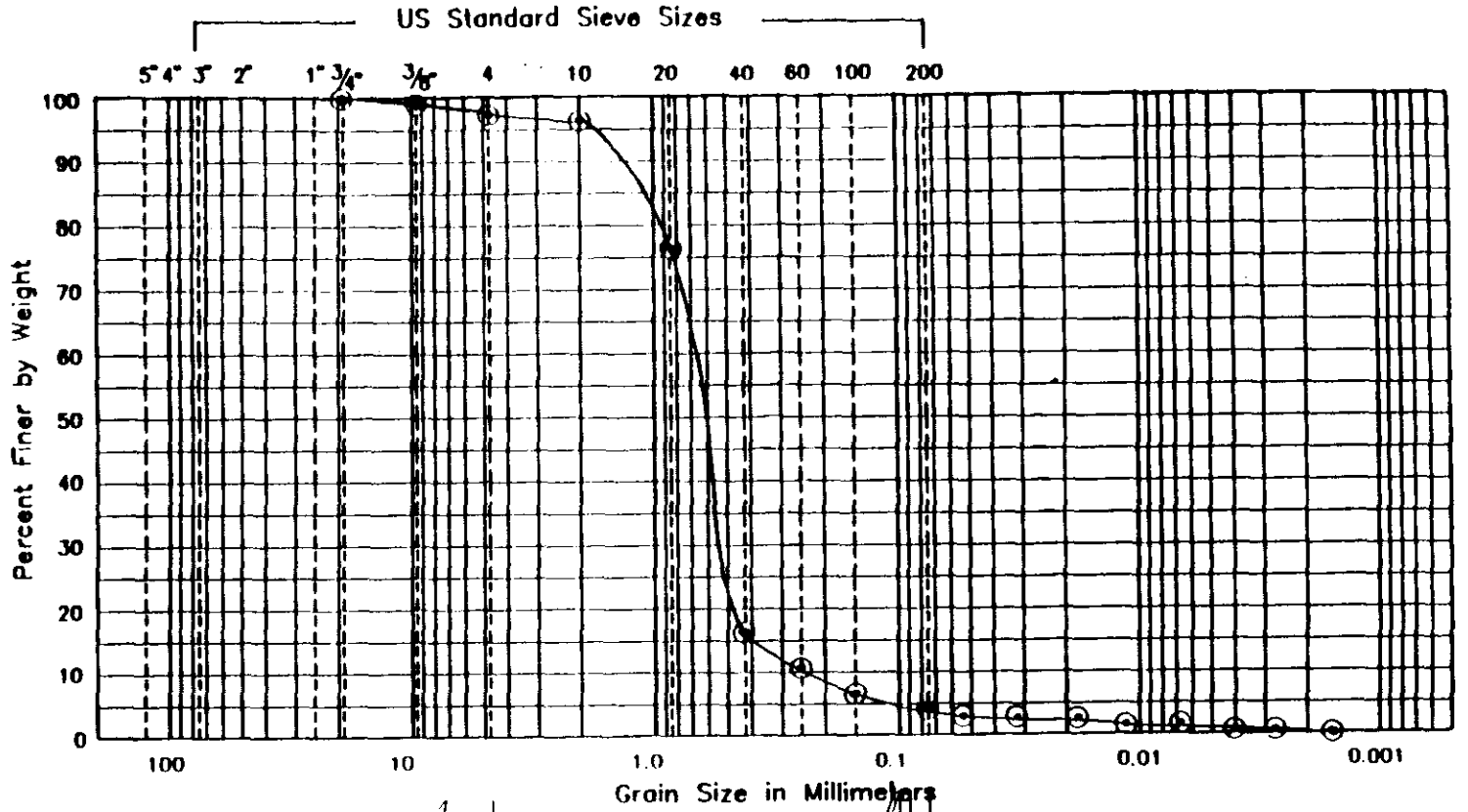
Golder Associates



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	29				65	6

2-16-90

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
DP-5 A0512		4.8				Dusky yellowish brown, m-f SAND, some f-c gravel, little silt, (SW-SM).



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
DP-5 A0513		4.2				Dusky yellowish brown, m-f SAND, trace f gravel, trace silt, (SP).

GRAIN SIZE DISTRIBUTION

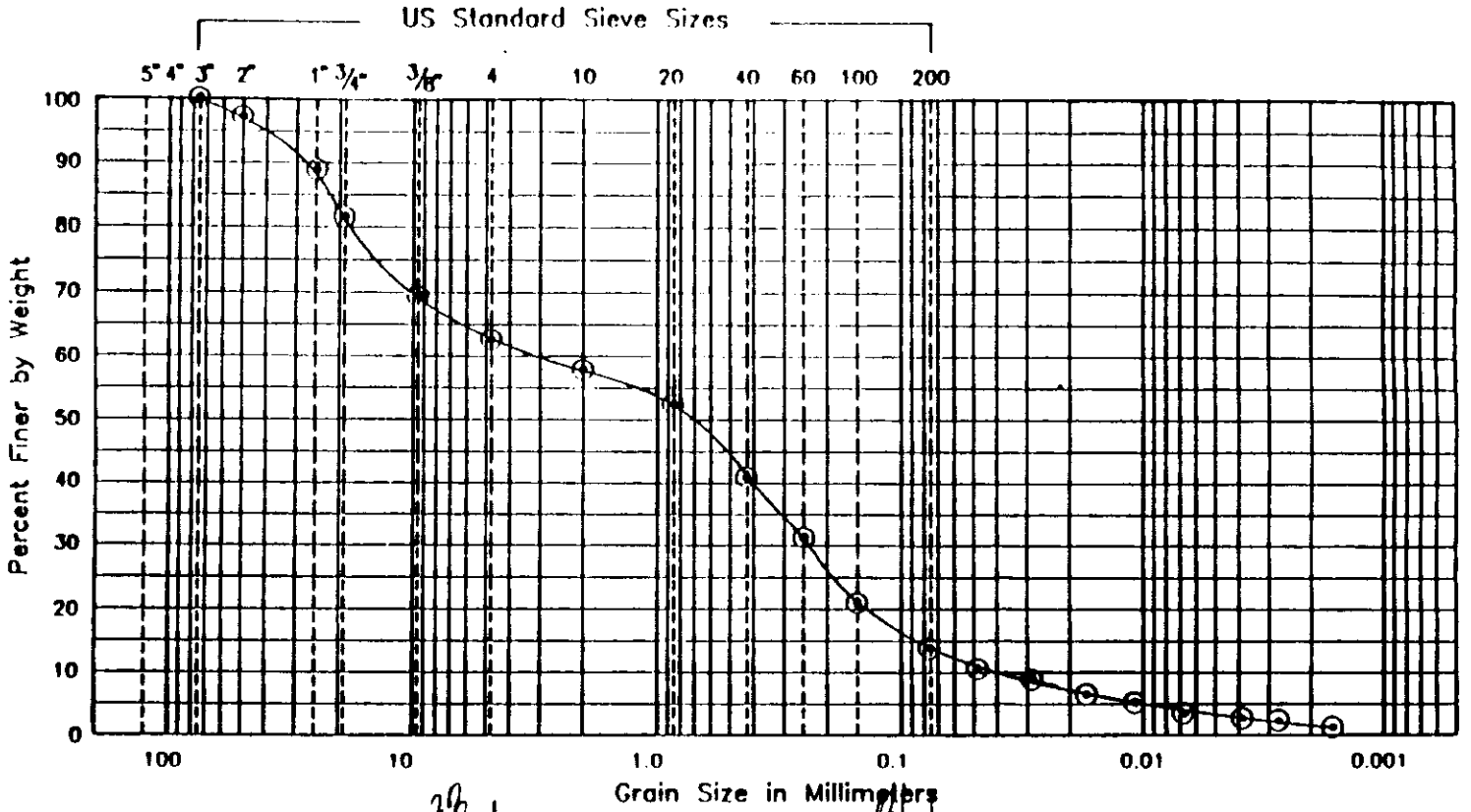
Project: WHC/HVR-EM-11/HLF
Project No. 882-1324.001 Drawn By: [illegible] Tested By: [illegible] Reviewed By: [illegible]

Golder Associates

GRAIN SIZE DISTRIBUTION

Project: WHC/UNE-EM-11/WM
Project No. 863-1354.001 Drawn by: [illegible] Tested by: [illegible] Reviewed by: [illegible]

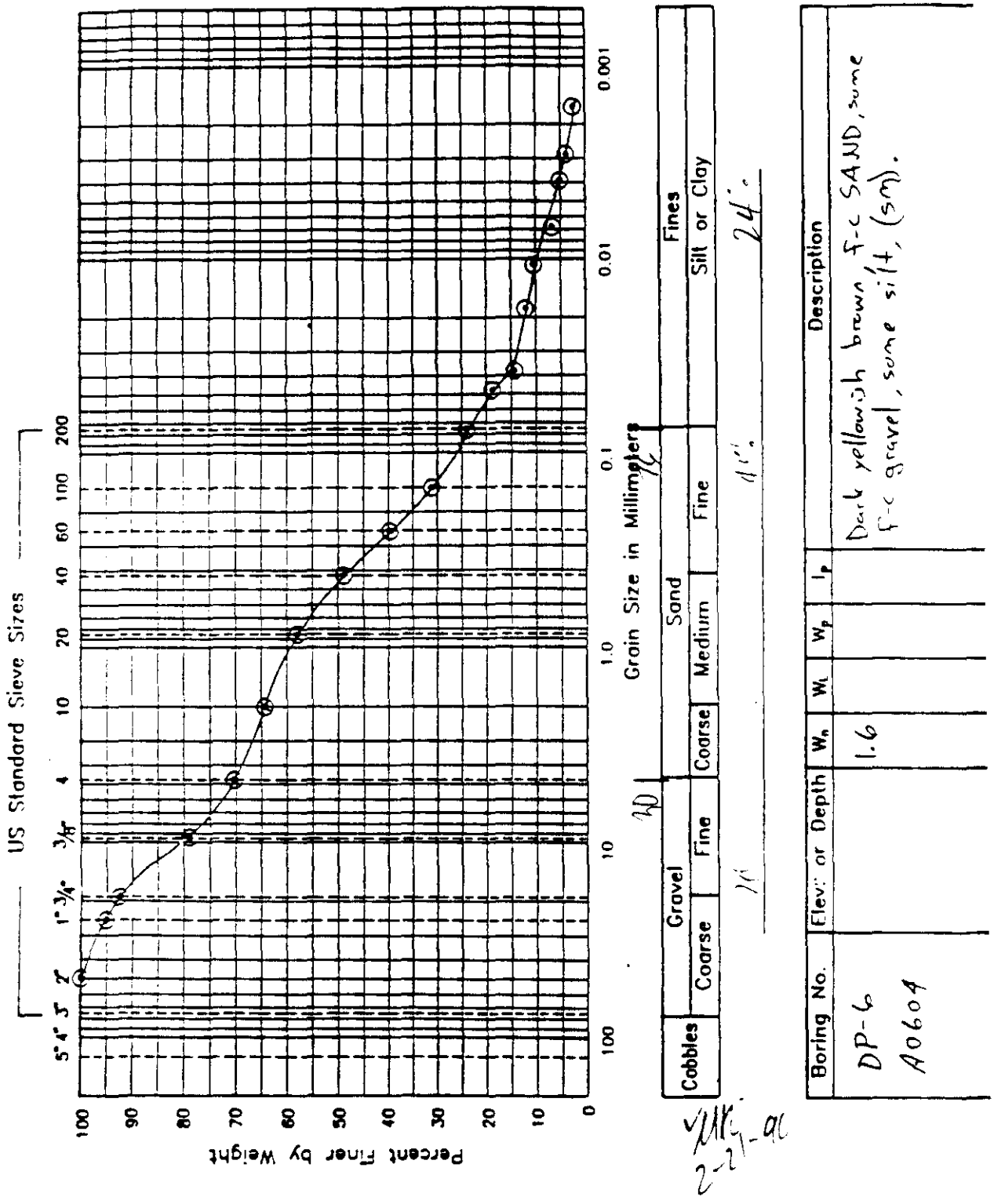
Golder Associates



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	38%				JPK	14%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
DP-6 A0603		1.2				Dark yellowish brown, F-C SAND and GRAVEL, some silt, (SM).

2-15-90



GRAIN SIZE DISTRIBUTION

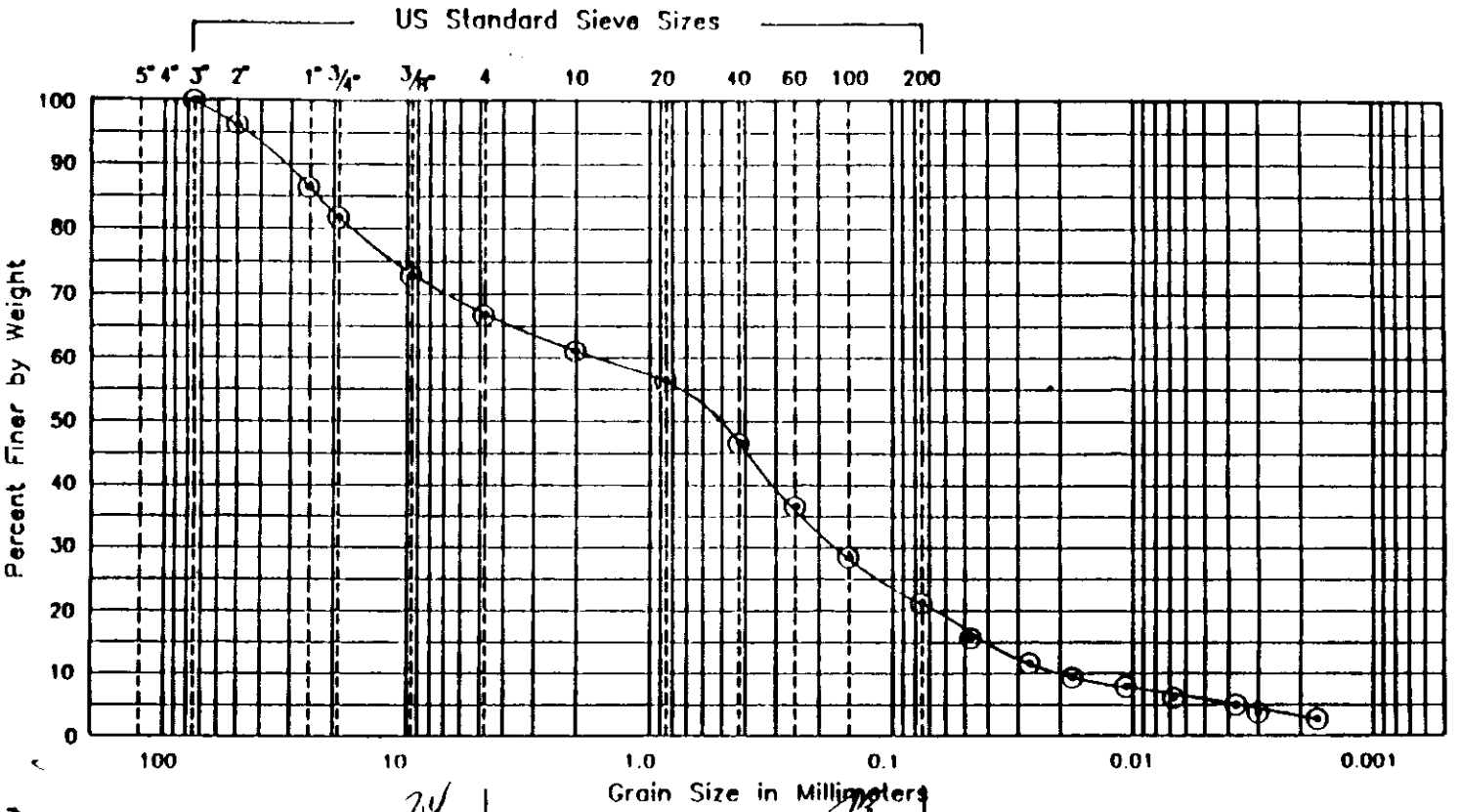
Project: WHC/IUC - EM-1/WA
Project No. 803-1754.001 Date 11/10/89 Tested By SH Approved By

Golder Associates

GRAIN SIZE DISTRIBUTION

Project: [illegible]
Project no. [illegible]
Drawn by [illegible]
Checked by [illegible]
Approved by [illegible]

Golder Associates



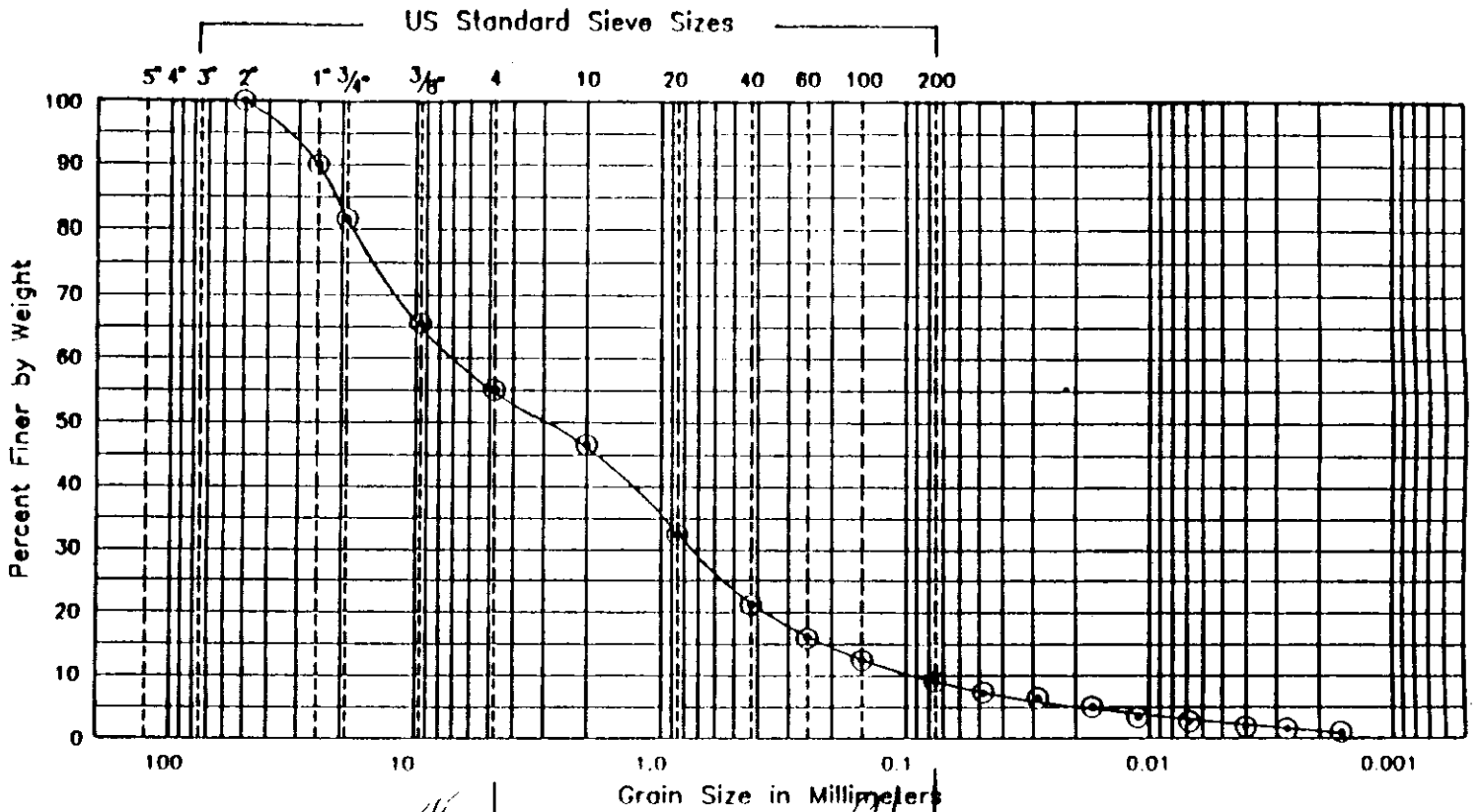
Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	34				78	
	41%				41%	12%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
DP-6 A0607		4.3				Dark yellowish brown, f-c SAND and GRAVEL, some silt, (SM).

GRAIN SIZE DISTRIBUTION

Project: HMC/HNC - EM-11/WMP
Project No. 893-1754 (c)
Drawn By: [illegible]
Checked By: [illegible]
Approved By: [illegible]

Golder Associates



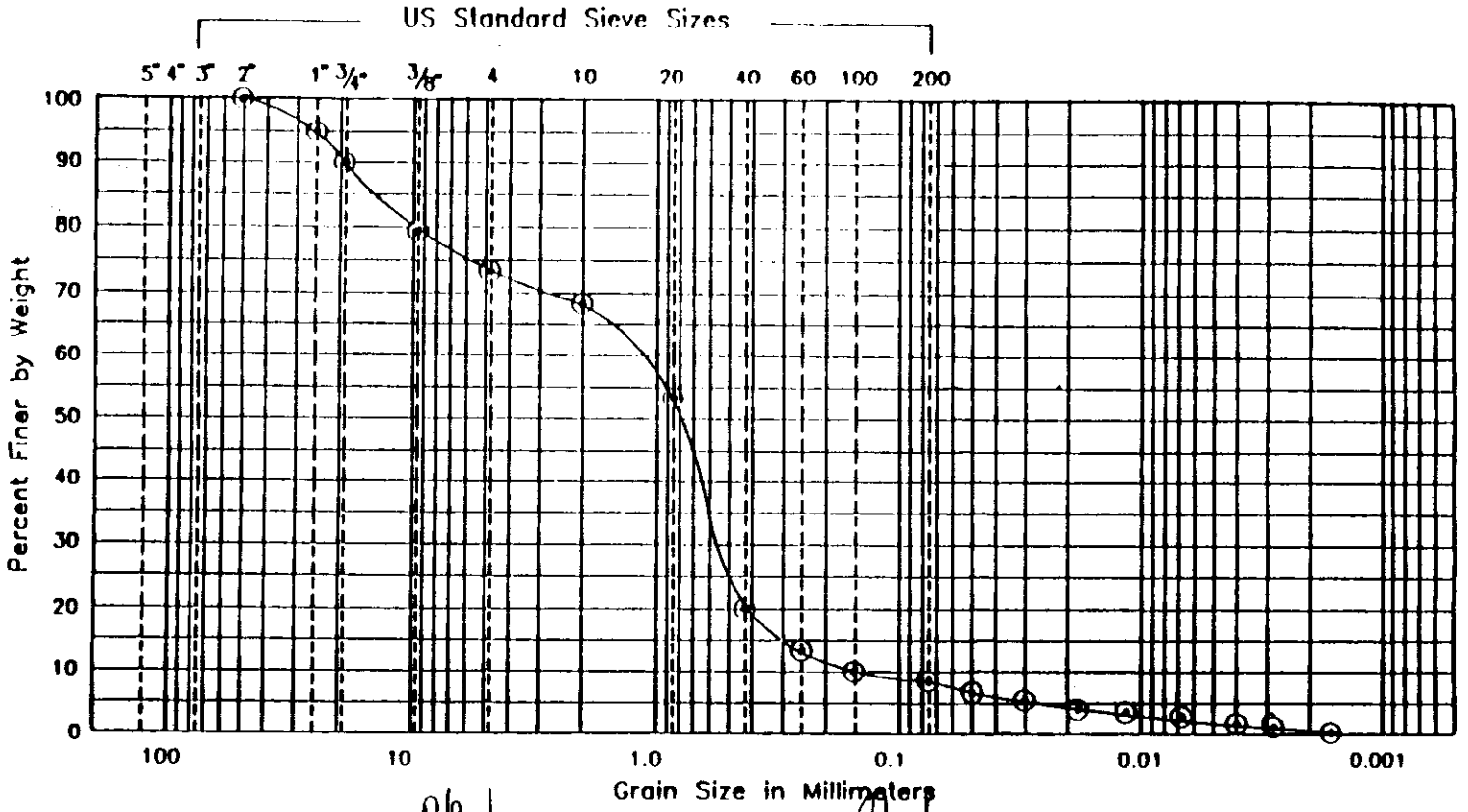
Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	11%				16%	9%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
DP-6 A0609		2.3				Dusky yellowish brown, F-C SAND and GRAVEL, little silt, (SP-SM).

GRAIN SIZE DISTRIBUTION

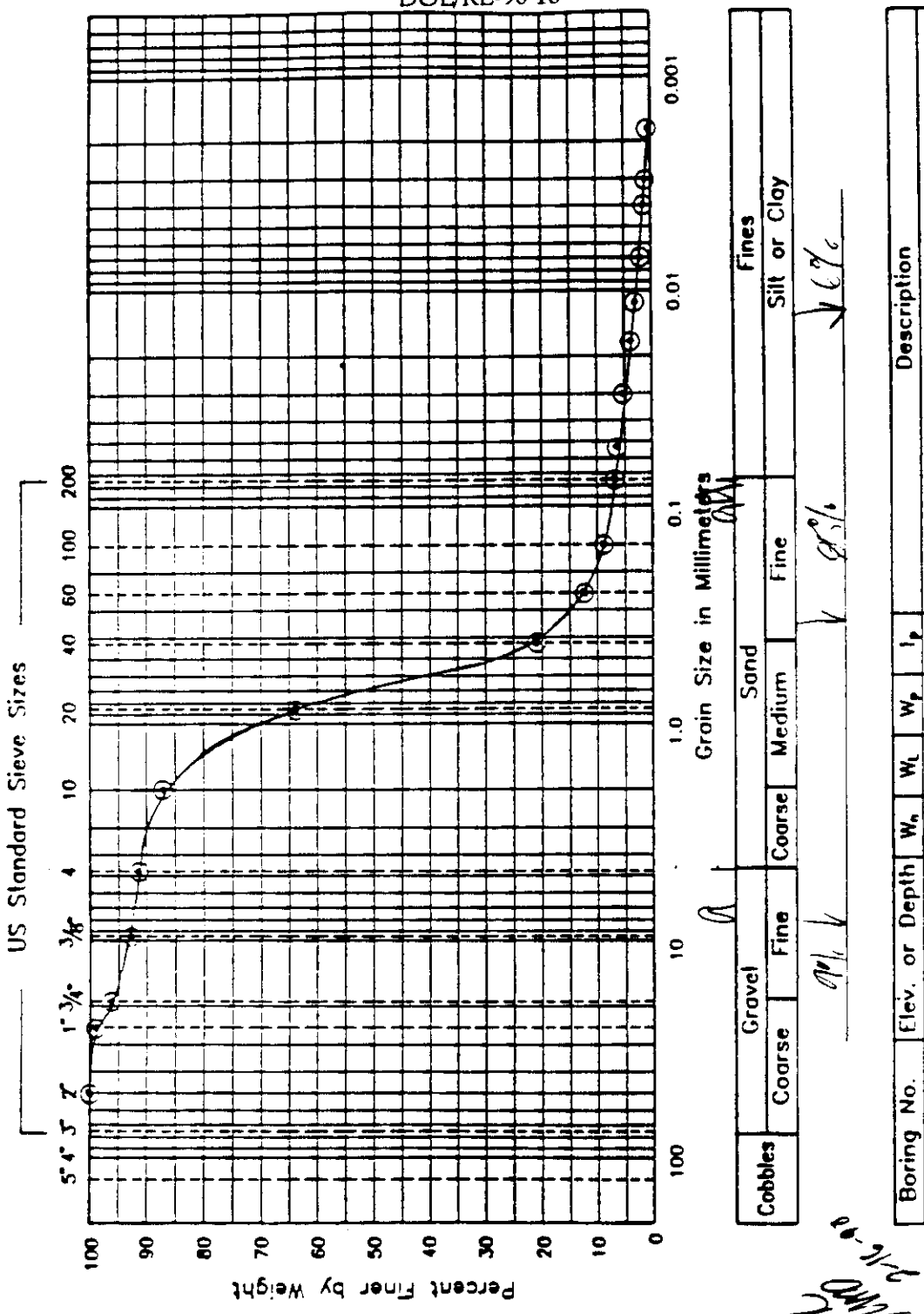
Project: WHC/100-EM-1/WA
Project No. 863-1754 001 Drilled/Visit Taken By: SHL Approved By: [illegible]

Golder Associates



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	26%				65%	9%

Boring No.	Elev. or Depth	W_n	W_L	W_p	I_p	Description
DP-6 A0611		3.2				Dusky yellowish brown, m-f SAND, some f-c gravel, little silt, (SW-SM).



Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
DP-6 A0614		3.2				Dusky yellowish brown, m-f SAND, little f-c gravel, little silt, (SP-SM).

GRAIN SIZE DISTRIBUTION

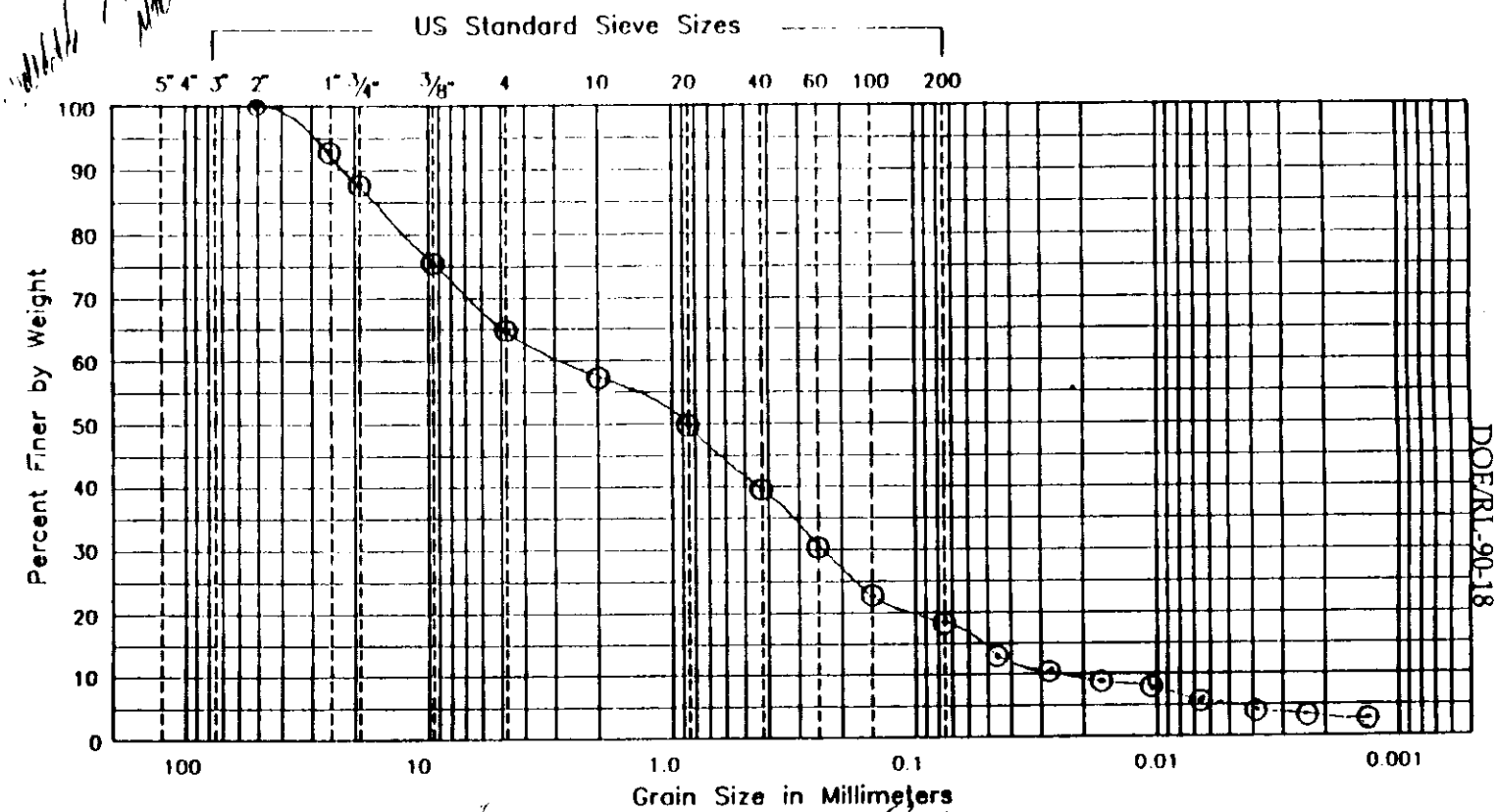
Project: WNC/IUC-EM-1/WA
Project No. 863-1754.001 Date 11/1/89 Tested By SH Approved By KKD

Golder Associates

GRAIN SIZE DISTRIBUTION

Project: [illegible] Project No. [illegible] Date [illegible] Tested By [illegible] Approved By [illegible]

Golder Associates

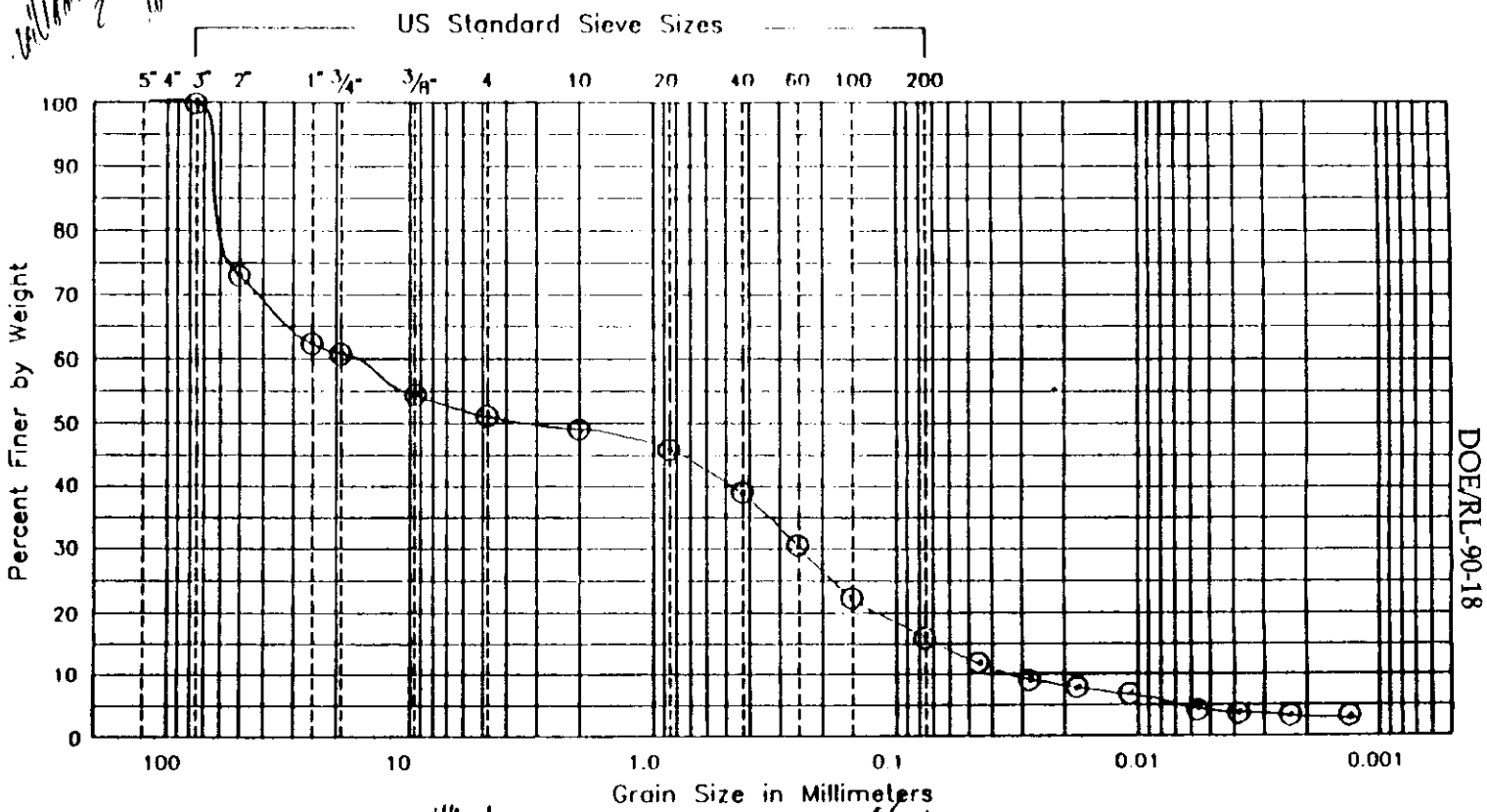


Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	2%			11%		1.0%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A-11Ø2		2.6				Pale yellowish brown, c-f SAND and GRAVEL, some silt, (SM).

GRAIN SIZE DISTRIBUTION

Project: 100 Area - Fill WA
Project No. 8-3-135U Date 10/22/92 Tested By SC Approved By [illegible]



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	11%			26%		14%

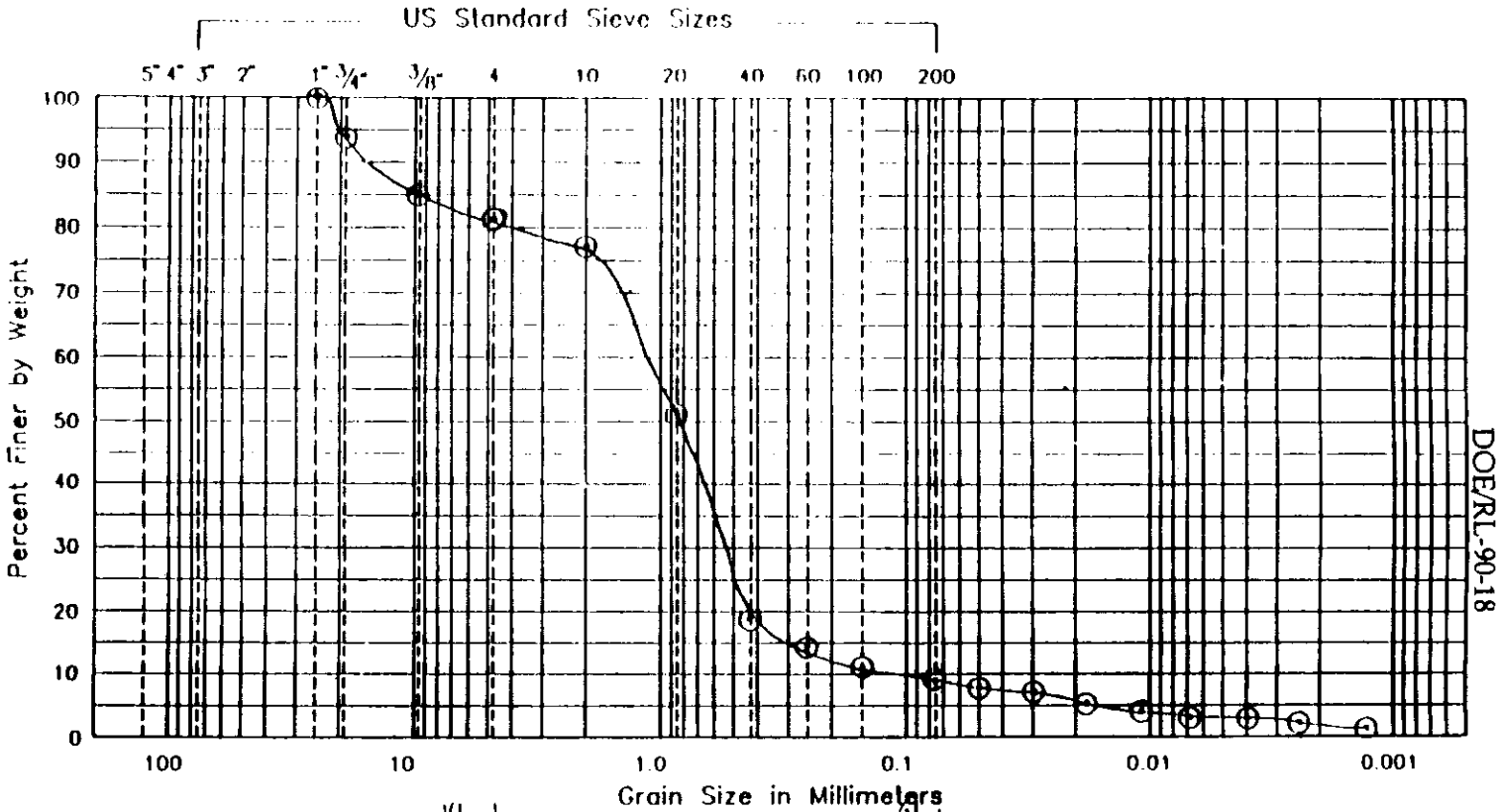
Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A-1104		7.2				Moderate brown, c-f GRAVEL and m-f SAND, some silt, (GM).

Golder Associates

GRAIN SIZE DISTRIBUTION

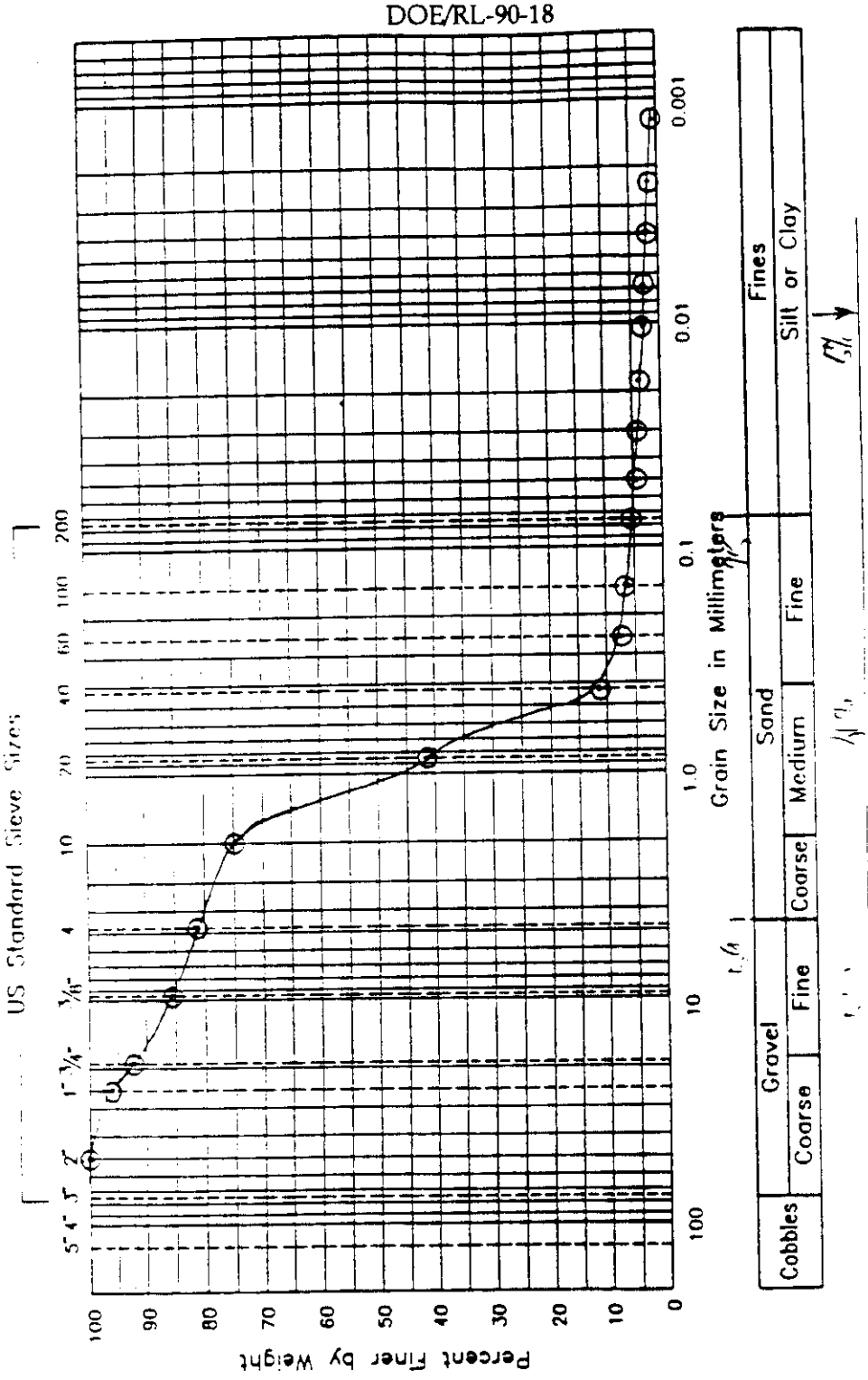
Project: WHC (1100-EM-1) WA
Project No. 913-1750 Date 12/13/90 Tested By DPO
Approved By [illegible]

Golder Associates



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	14%		77%			9%

Boring No.	Elev. or Depth	W_n	W_L	W_p	I_p	Description
A-1108		3.8				Olive black, m-f SAND, some gravel, little silt. (SM-SW).



GRAIN SIZE DISTRIBUTION

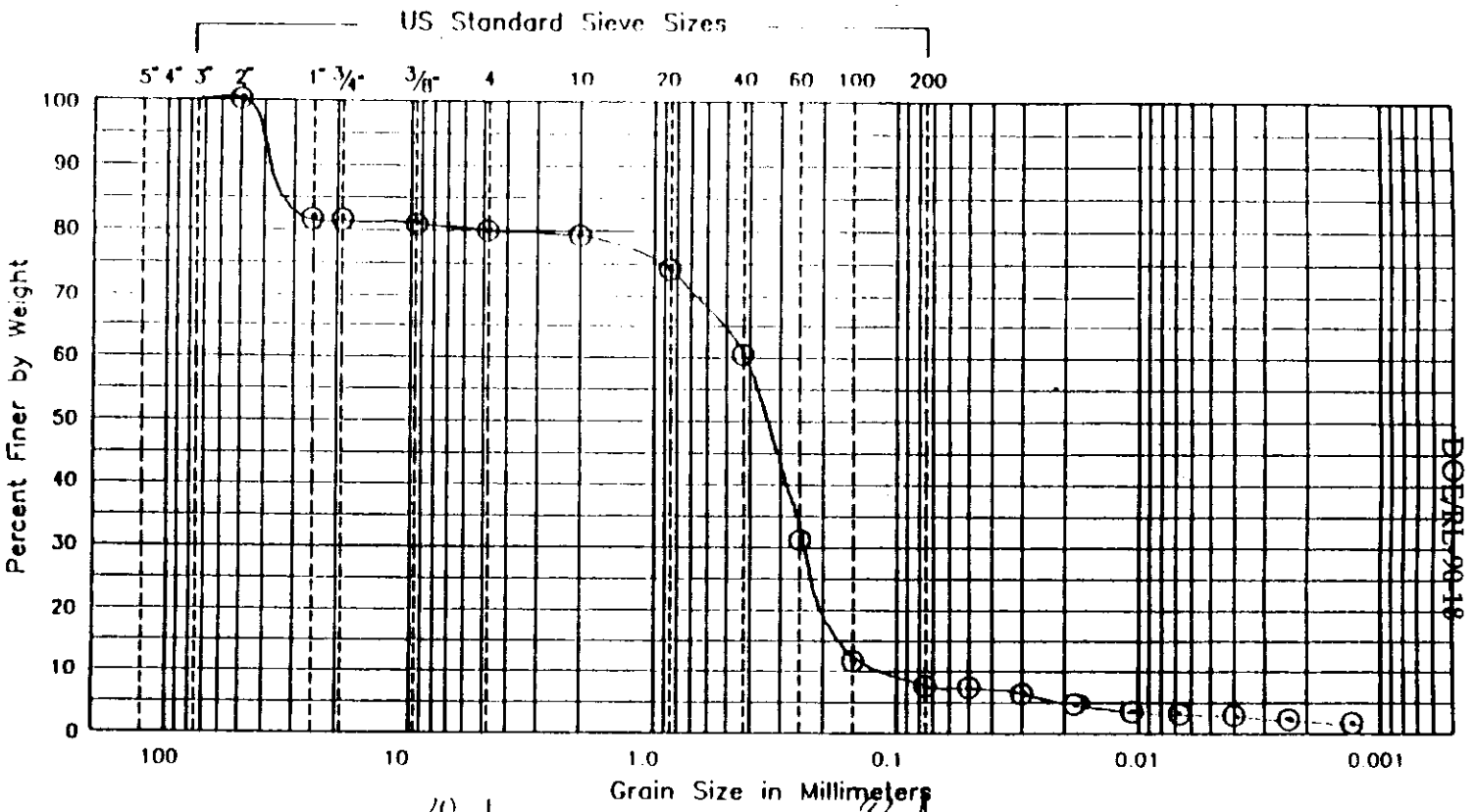
Project WMC / 1100 - EM - 1 / WA
Project No. 9-3-175 UA / Date 10/23/94 Tested By DPL Approved By KRB

Golder Associat

GRAIN SIZE DISTRIBUTION

Project: 300 Area - 618-11 WA
Project No. 903-1750 Date 10-23-90 Tested By DPC Approved By [illegible]

Golder Associates

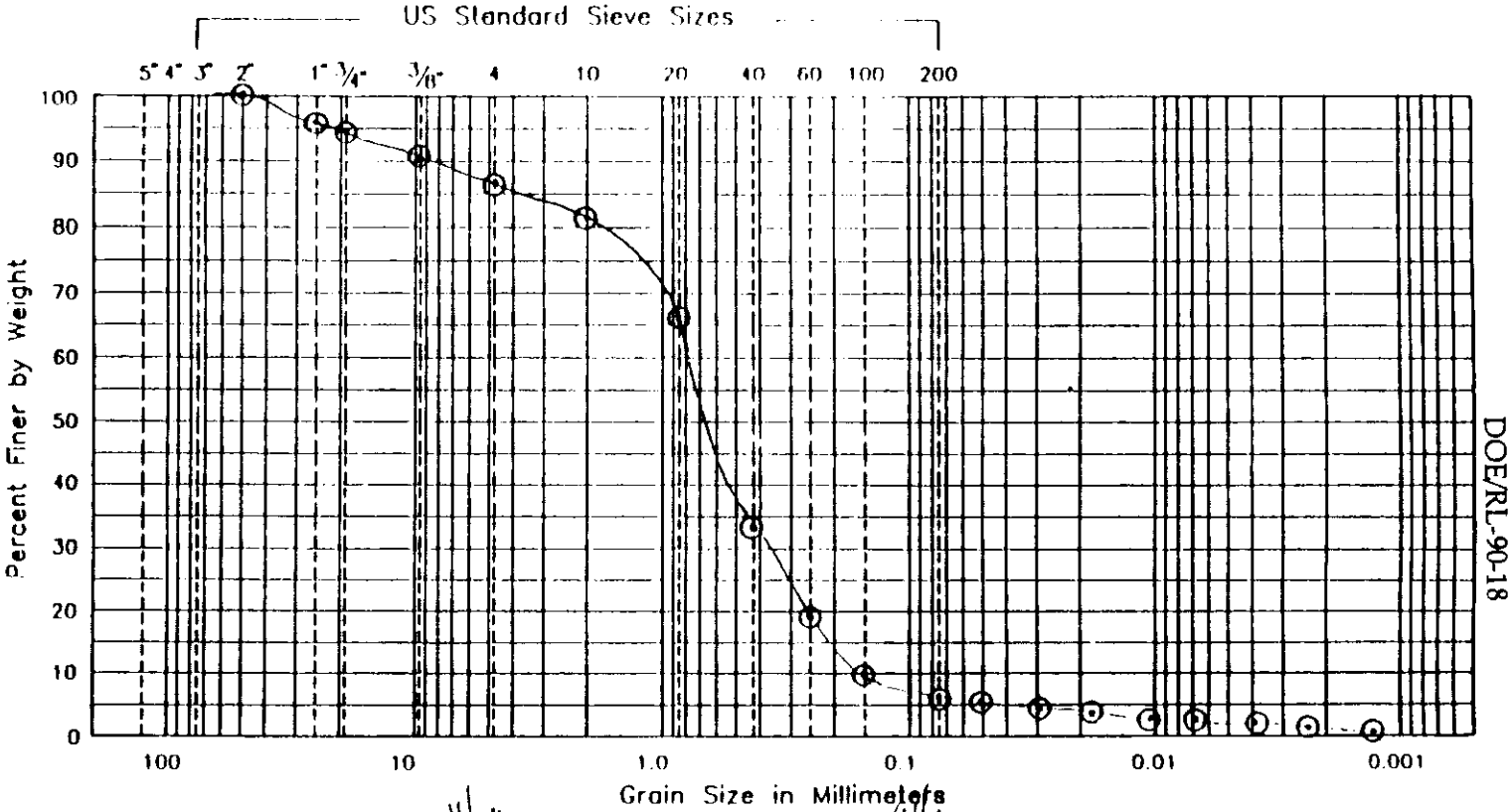


Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
		10%			17%	0%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A-111Φ		10.8				Dark yellowish brown, m-f SAND, some gravel, little silt, (SM-SP).

GRAIN SIZE DISTRIBUTION

Project: [illegible]
Project No. [illegible] Date [illegible] Tested By [illegible] Approved By [illegible]



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

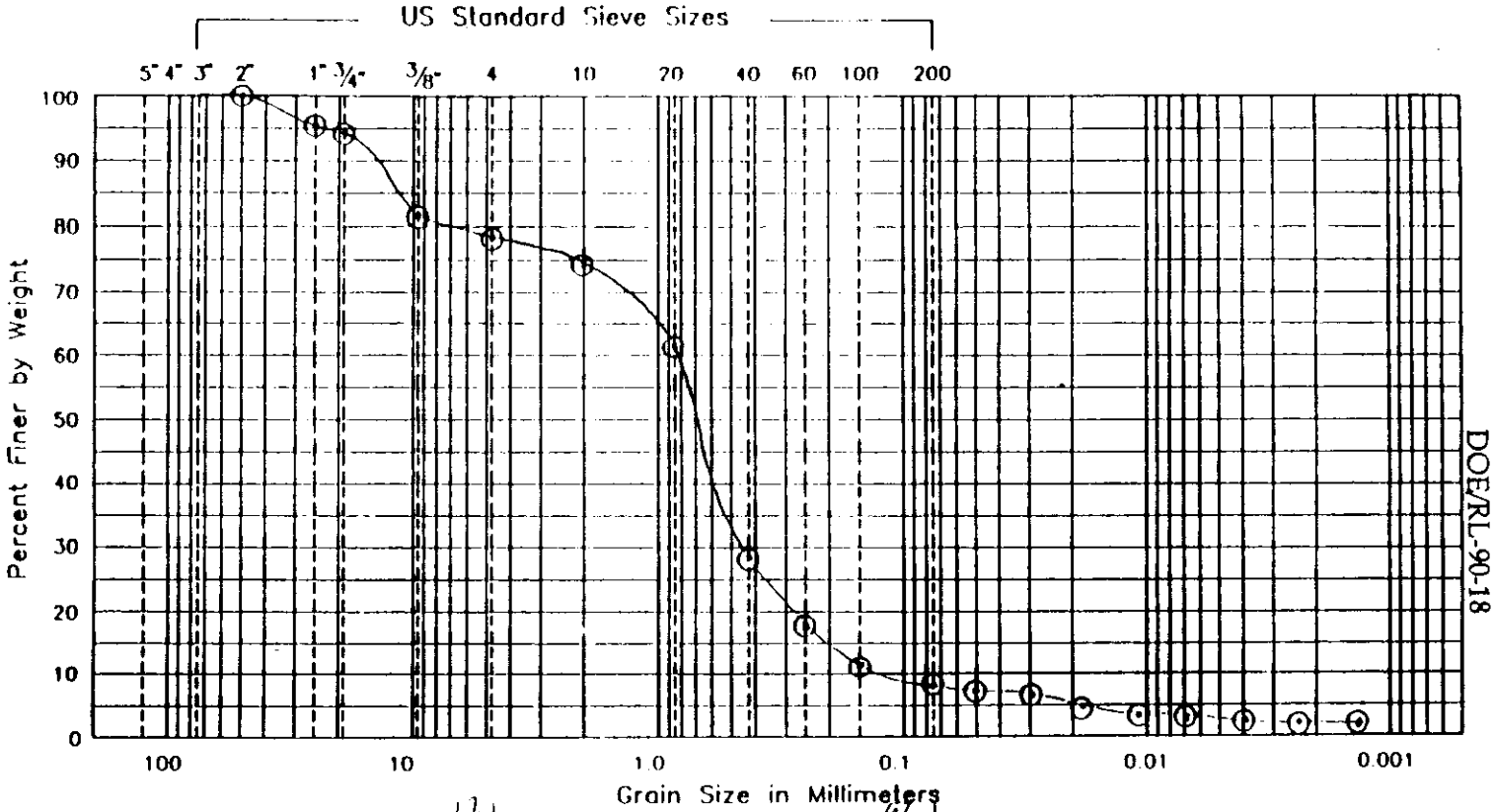
Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A-1112		4.6				Olive black, m.f SAND, some c.f gravel, little silt, (SM-GP).

Golder Associates

GRAIN SIZE DISTRIBUTION

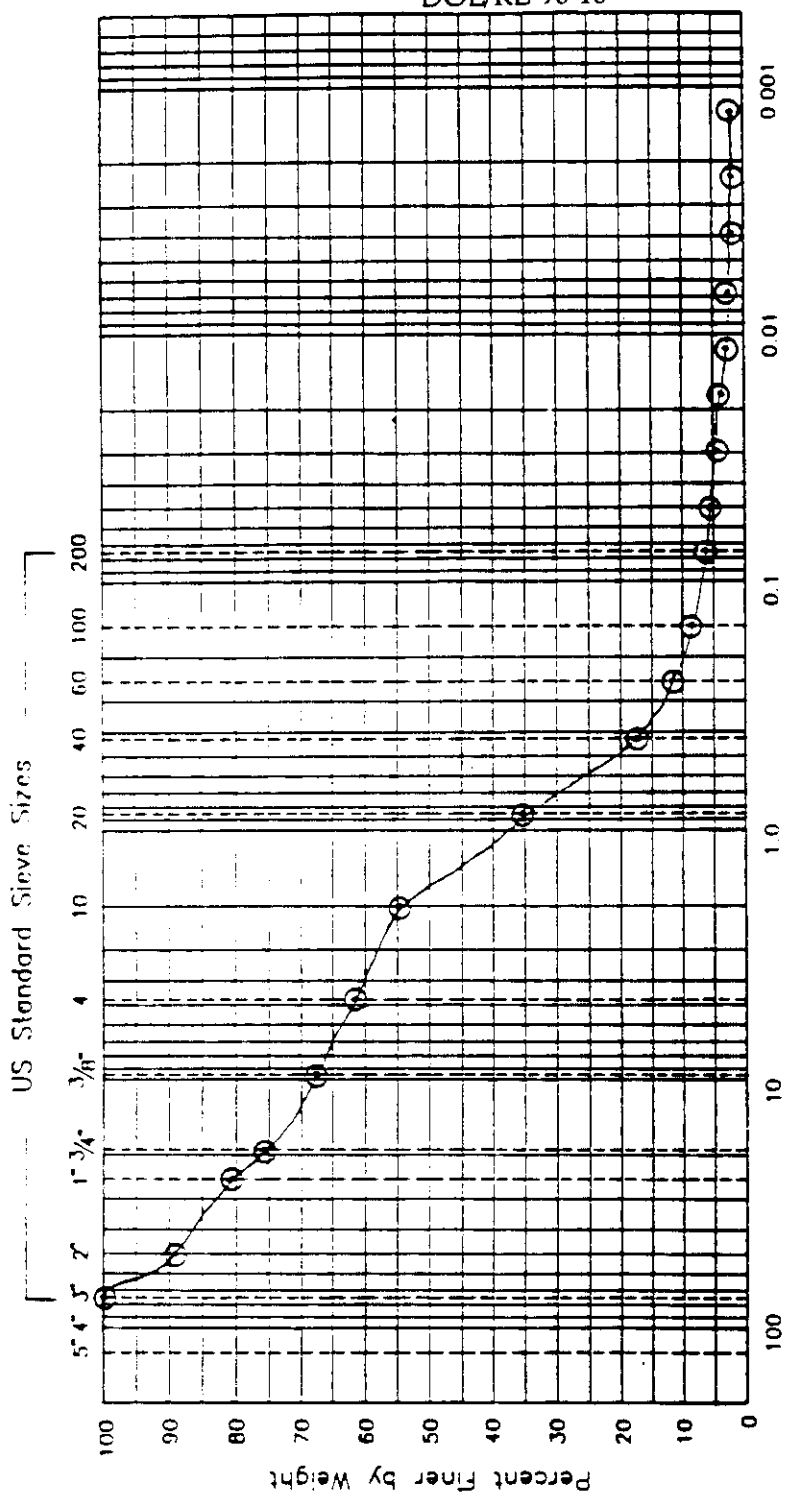
Project: [illegible] WA
Project No. 843-1350 Date 10/23/84 Tested By DPC Approved By [illegible]

Golder Associates



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	11%		19%			6%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A-1113		4.0				Olive black, m-f SAND, some c-f gravel, little silt, (SM-SW).

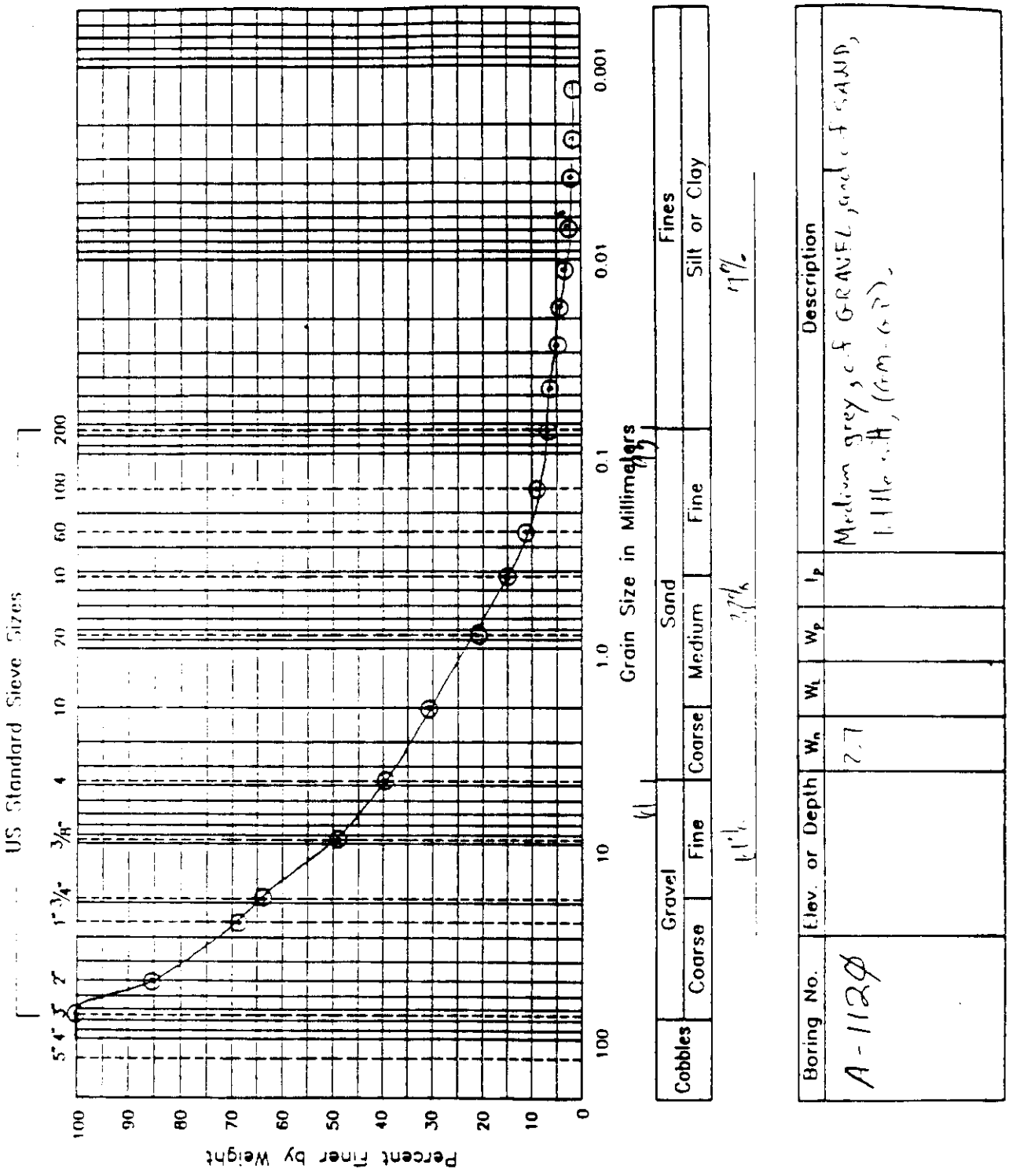


Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A-1117		3.0				Olive gray, f SAND and GRAVEL, trace silt (SM-GP)

GRAIN SIZE DISTRIBUTION

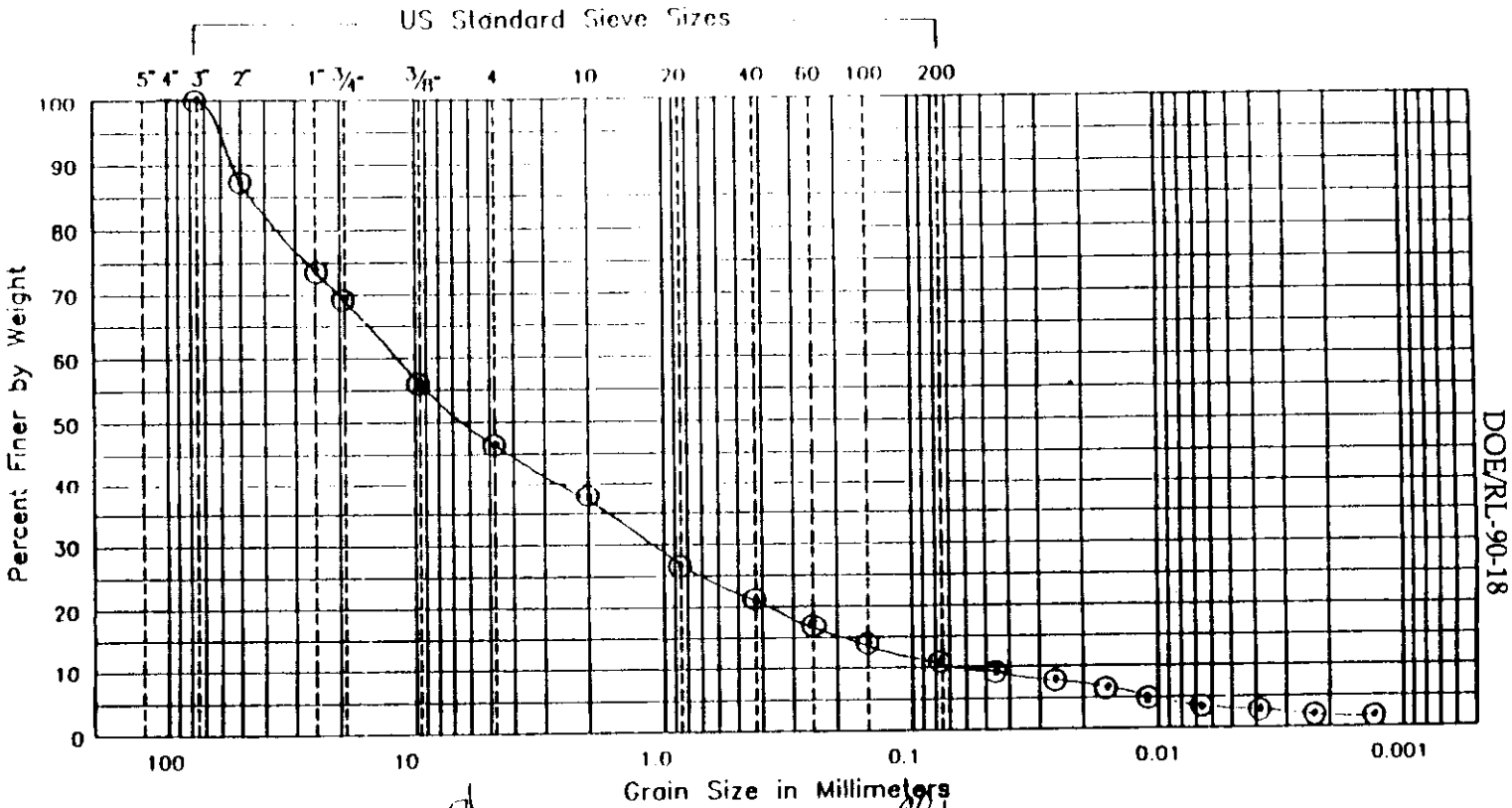
Project: WMC / 1100-EM-1 / WA
Project No. 923-12500 Date 10/23/92 Tested By DPC Approved By KKT

Golder Associates



GRAIN SIZE DISTRIBUTION

Project: WMC / 1100 - EM - 1 / WA
Project No. 9-3-175 / Date 10/23/90 Tested By DPO Approved By KHB Golder Associates



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	0%		88%			12%

Boring No.	Elev. or Depth	W_n	W_l	W_p	I_p	Description
A-1122		2.5				Medium gray, c-f GRAVEL and c-f SAND, little silt (GM-GW).

GRAIN SIZE DISTRIBUTION

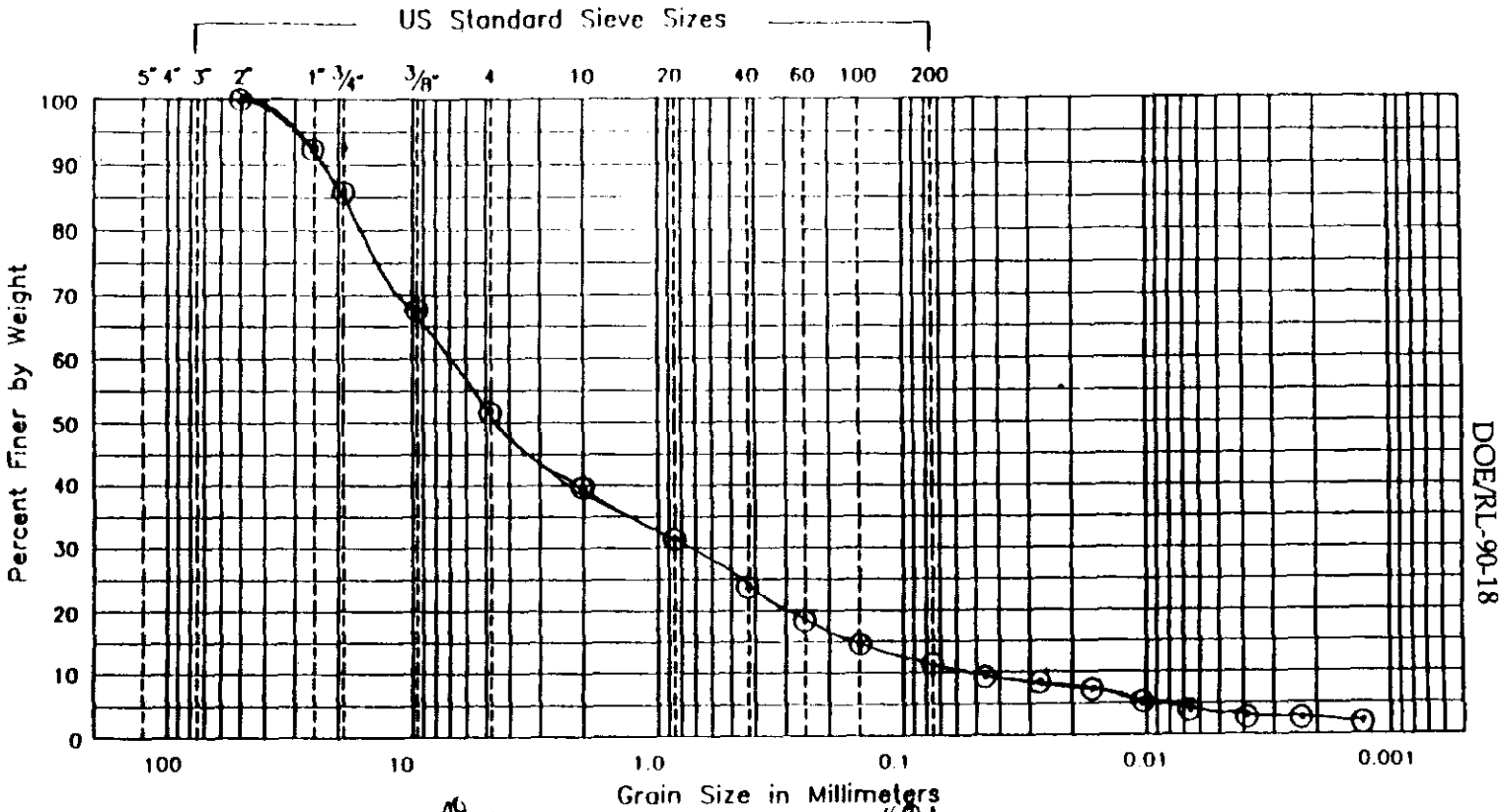
Project: EMC Hole - Sampling
Project No. 883-1250 Date 11/23/86 Tested by DPC Reviewed by [illegible]

Golder Associat

GRAIN SIZE DISTRIBUTION

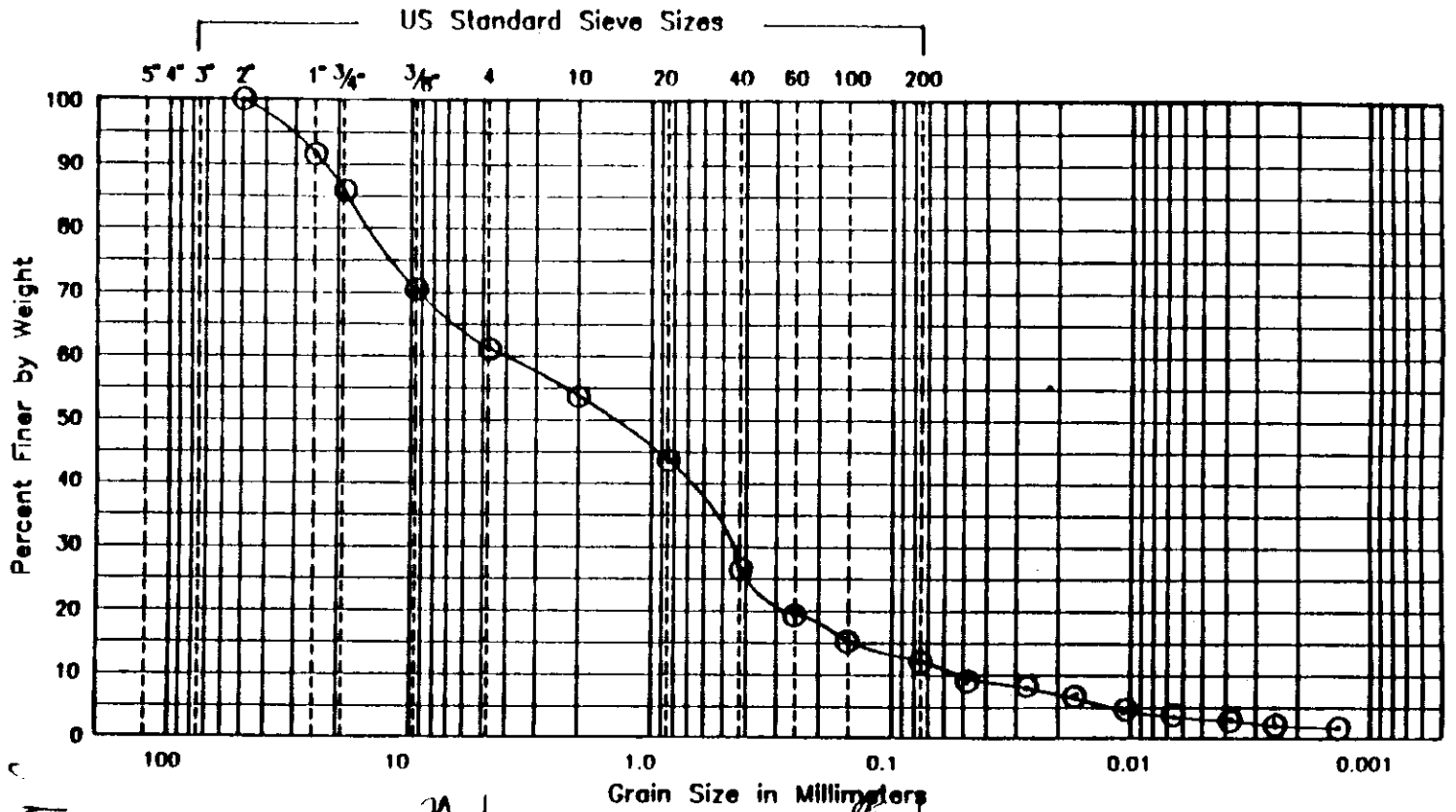
Project: 300 MC / 1100 - EM - 1 / WA
Project No. 843-1350 Date 10/23/90 Tested By DRC Approved By

Golder Associates



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	18%			28%		12%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A-1124		3.7				Olive grey, c-f GRAVEL and c-f SAND, little silt, (GM-GW).



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A09Ø2		2.5				Olive grey, f-c SAND and GRAVEL, little silt, (SM-SW).

GRAIN SIZE DISTRIBUTION

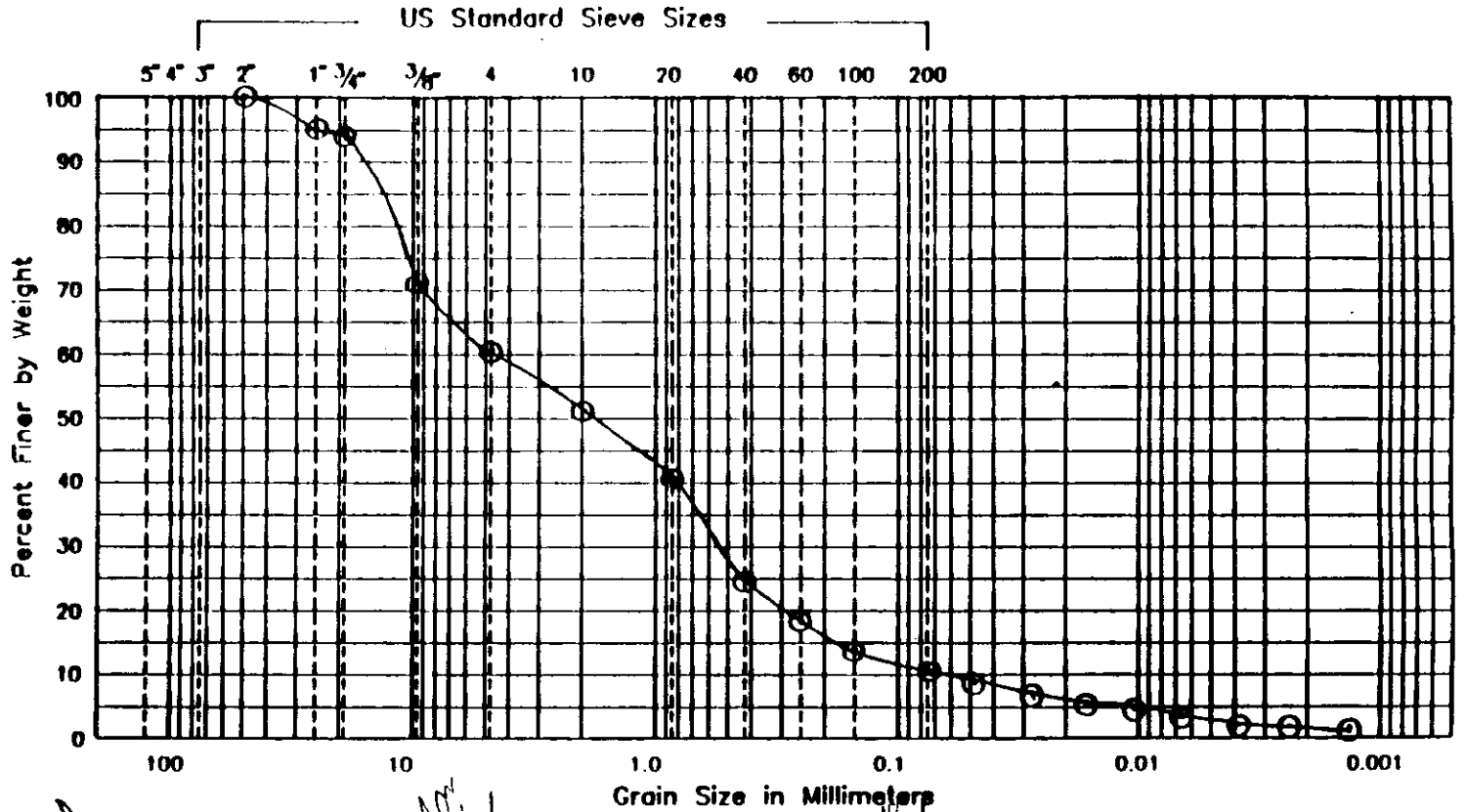
Project WHC/UDD-EM-1/WA
Project No. 183-1354 Date 9-1-91 Drawn by DRC Approved by

Golder Associates

GRAIN SIZE DISTRIBUTION

Project WHC/UPDO - EPI-1/WA
Project No. 883-1354 Date 9-1-90 Drawn By DPC Approved By

Golder Associates

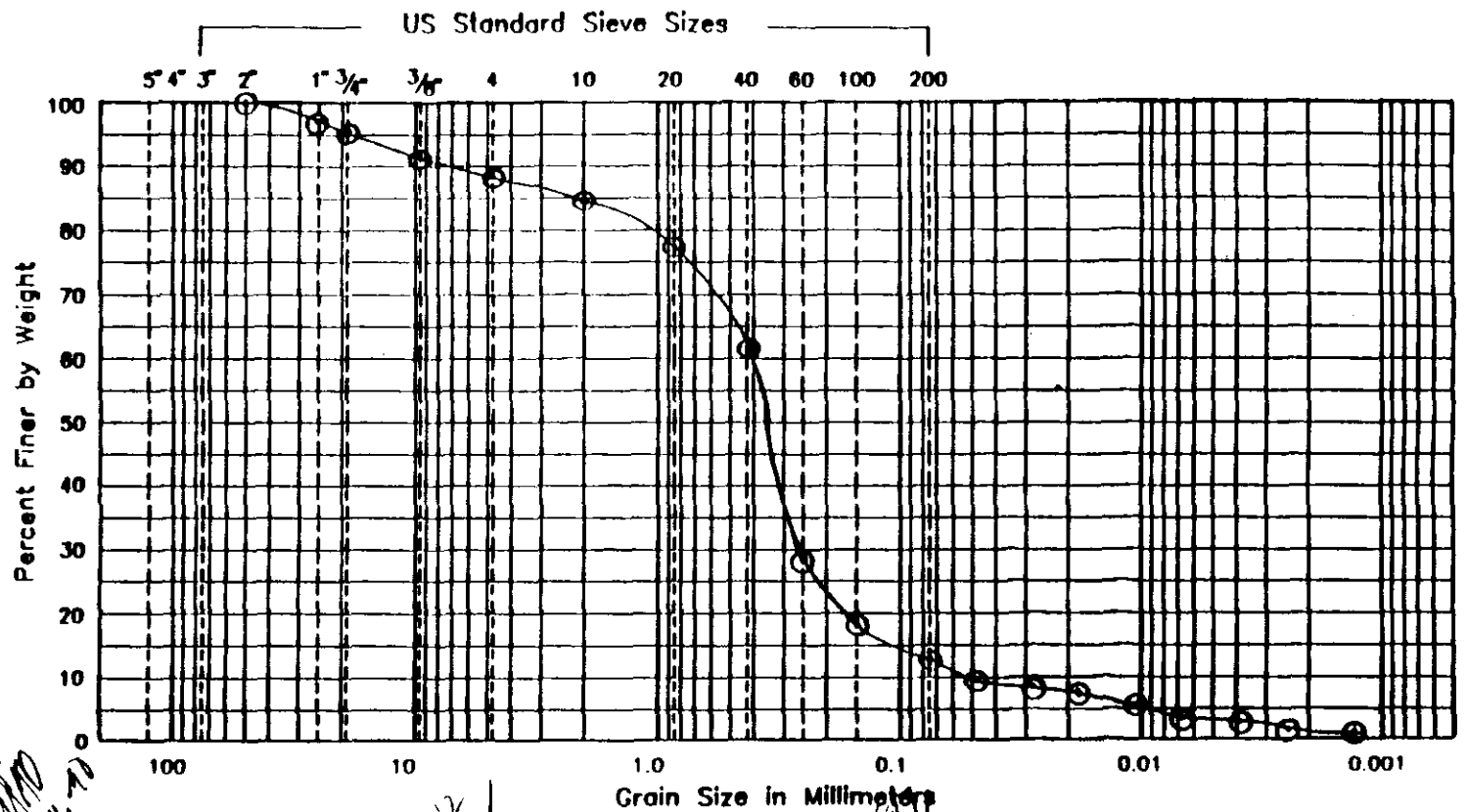


Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	10%			70%		20%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A0905		2.4				Olive grey, f-c SAND and GRAVEL, little silt, (SM-SW).

GRAIN SIZE DISTRIBUTION

Project WHC/HDP-EPA-1/WA
Project No. 883-1334 Date 9-1-[illegible]
Tested By [illegible] Reviewed By [illegible]



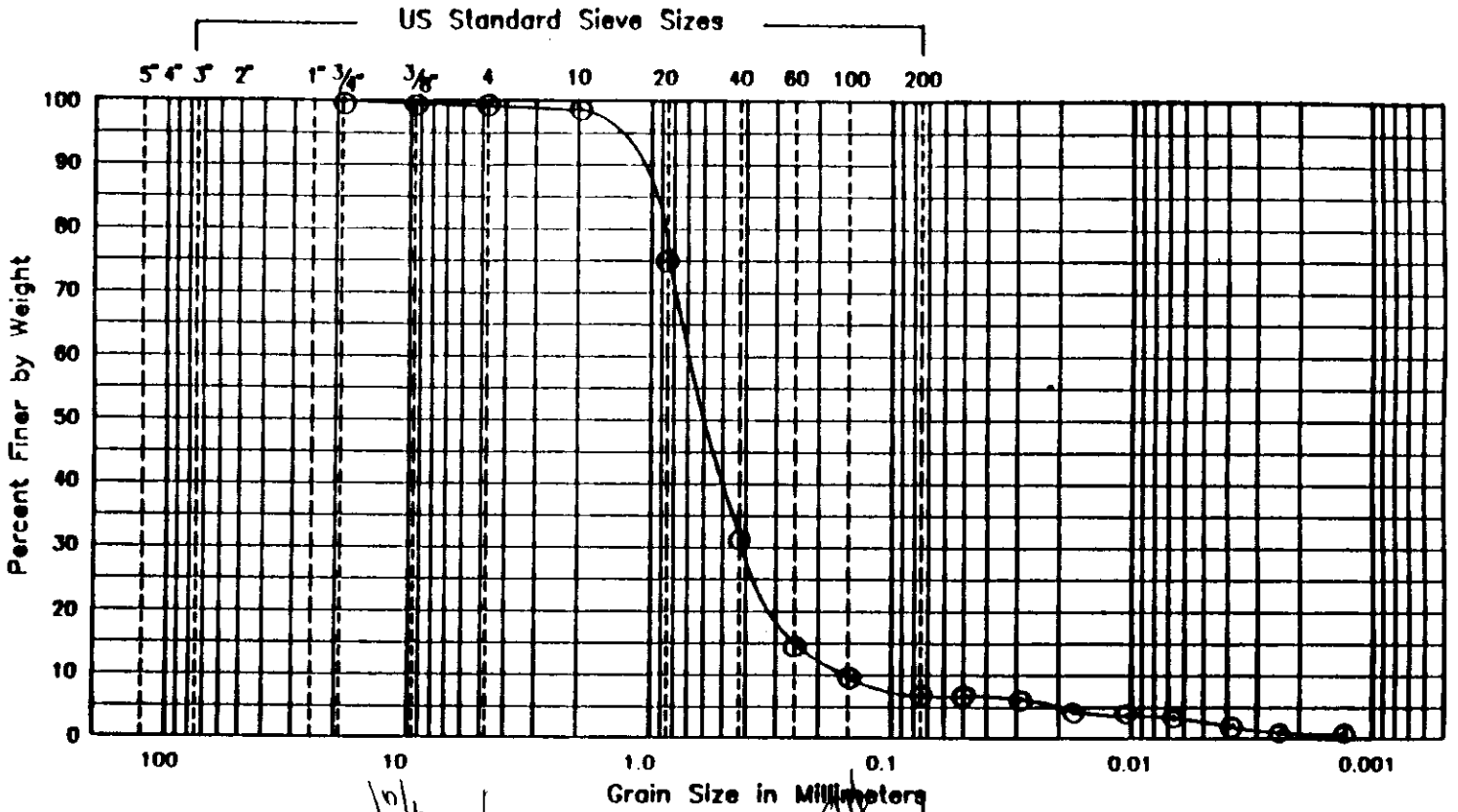
Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	12%			15%		13%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A0908		4.9				Dusky yellowish brown, f-m SAND, some gravel, some silt, (SM).

Golder Associates

GRAIN SIZE DISTRIBUTION

Project WHC/UDQ - EPI-1/WA
Project No. 883-1384 Date 9-1-91 Tested By DPO Approved By [illegible]



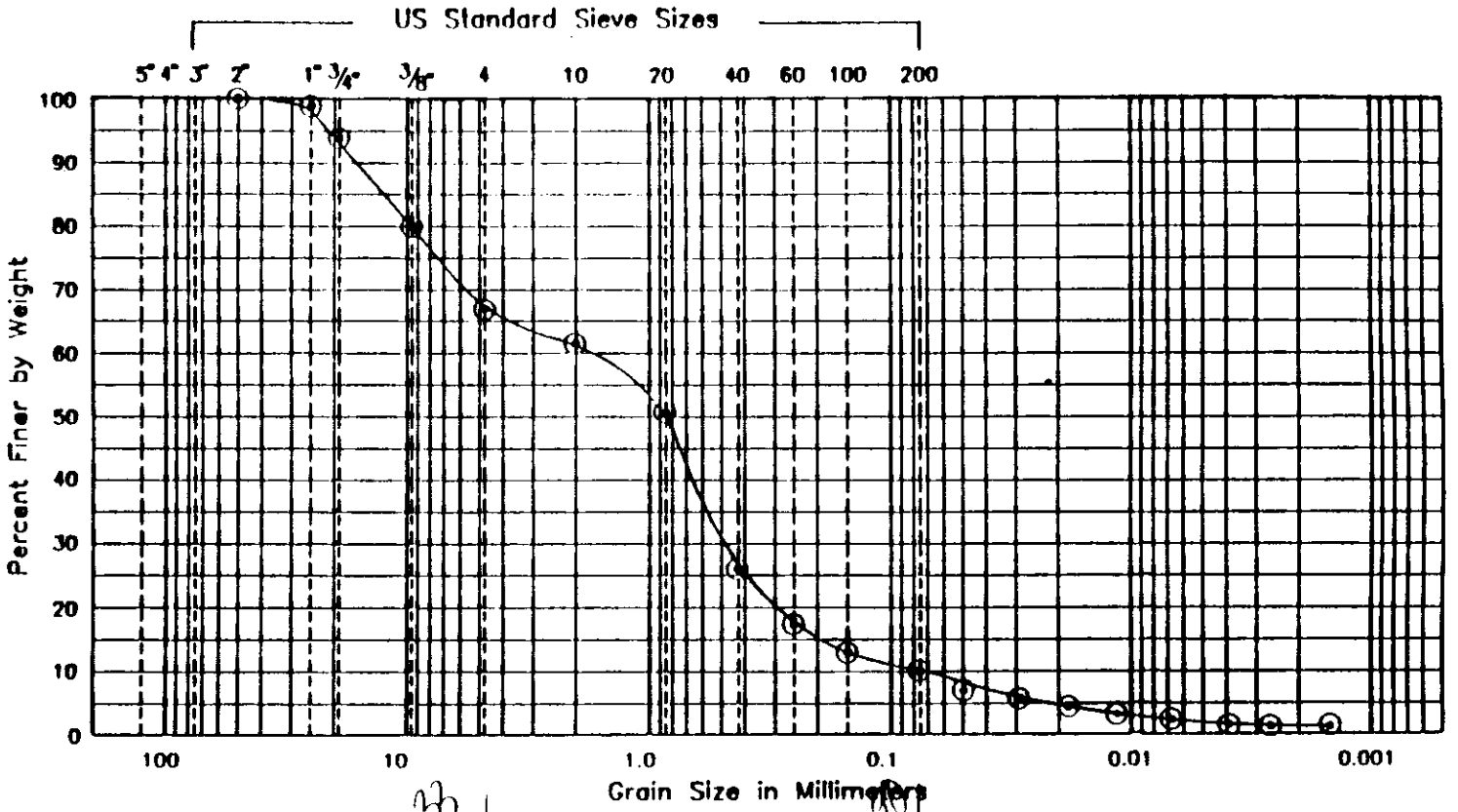
Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
		1%			93%	6%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
AØ911		5.8				Dusky yellowish brown, m-f SAND, little silt, trace f gravel, (SM-SP).

Golder Associates

GRAIN SIZE DISTRIBUTION

Project: WHC/1100-EM-1/WA
Project No. 4532-1354-001 Date: 13AUG89 Tested By: [illegible] Reviewed By: [illegible]



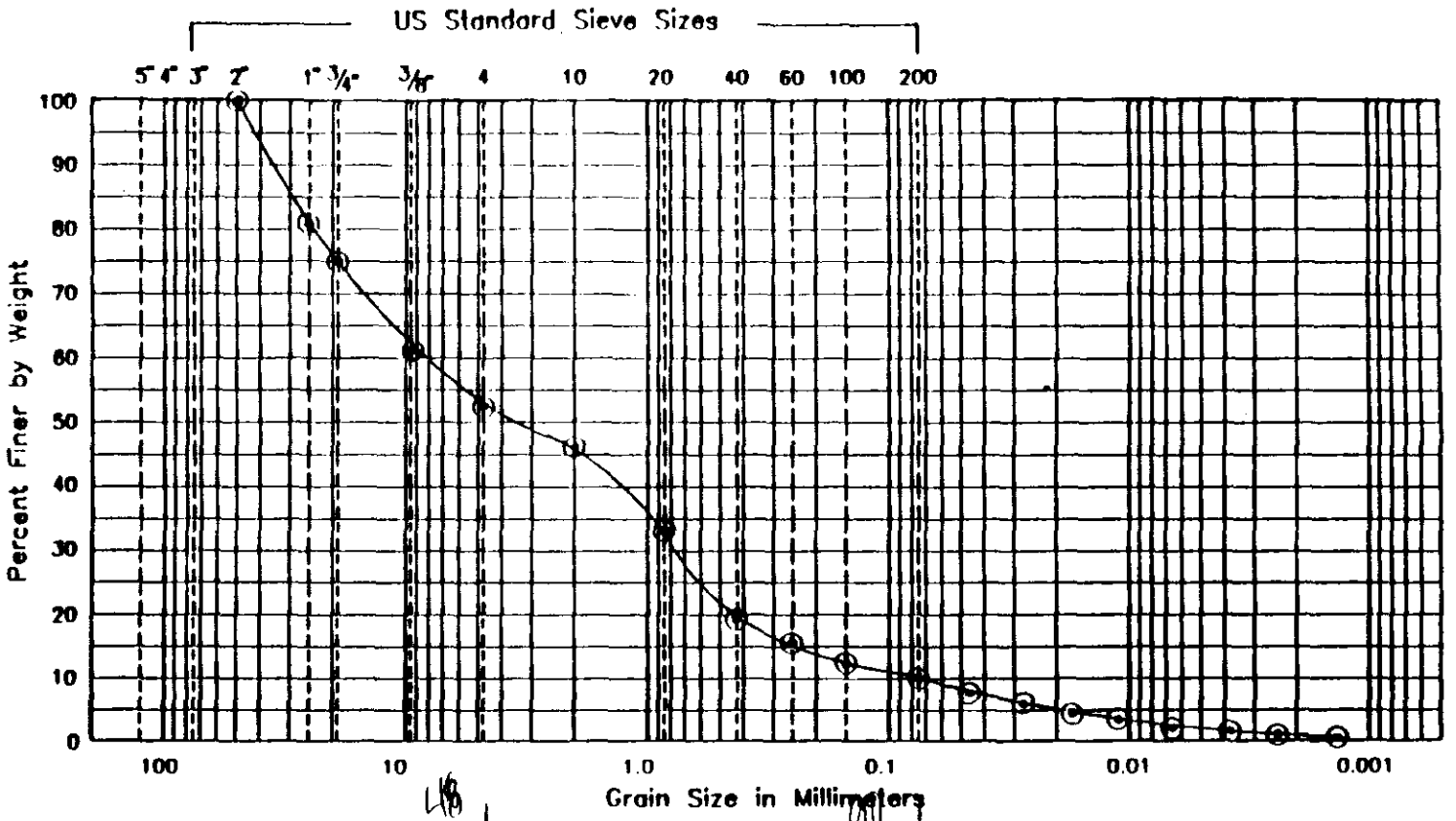
Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	1%			1.1%		1%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
DP-2 A0802		1.3				Dusky yellowish brown, m-f SAND and f. gravel, little silt, (SM-SW).

Golder Associates

GRAIN SIZE DISTRIBUTION

Project: WHC/1100-EDR-1/WA
Project No. 893-1954-01 Date: 12/20/90 Tested By: [illegible] Approved By: [illegible]



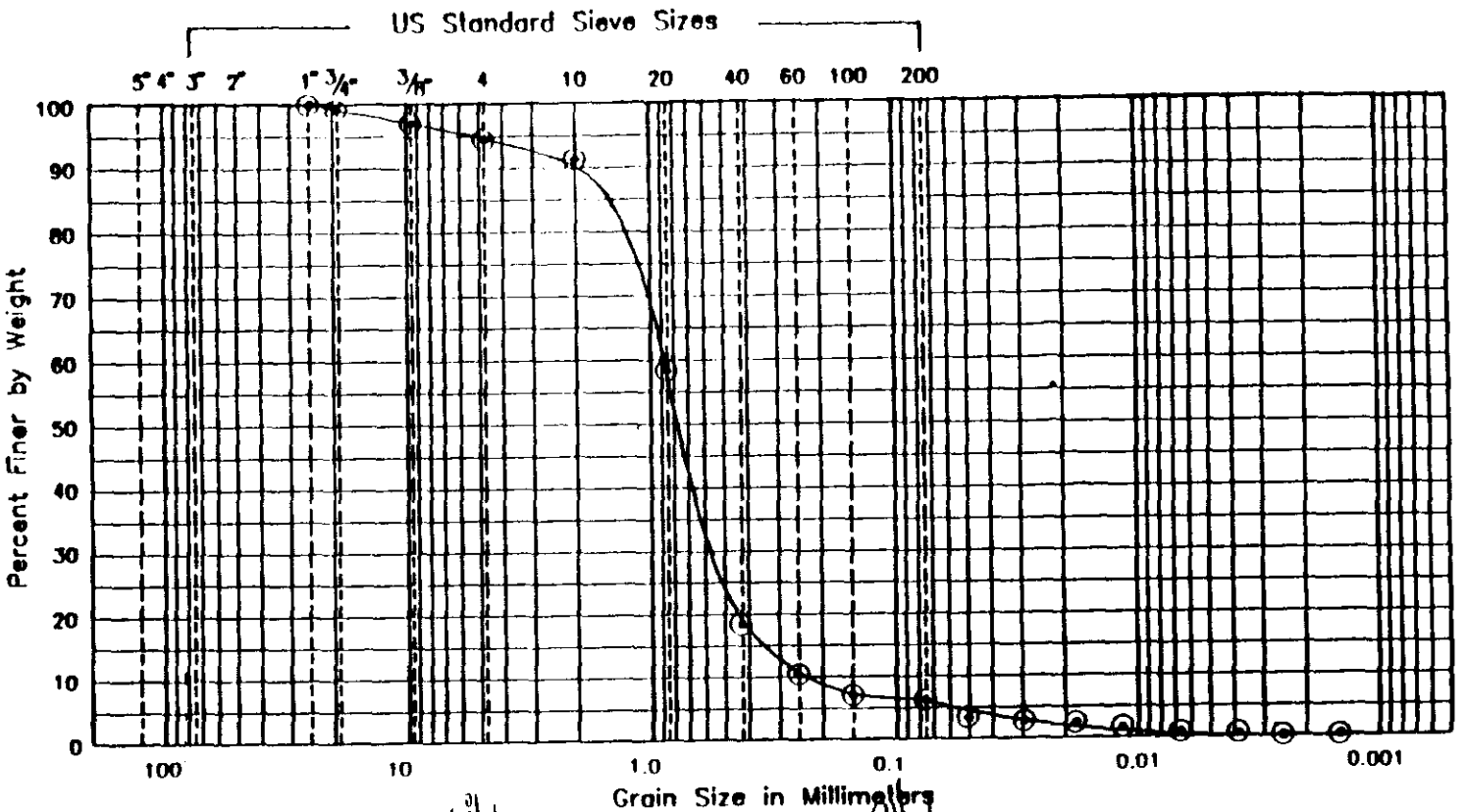
Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
DP-2 A0804		2.7				Olive black, f-c GRAVEL and SAND, little silt, (GM-GP).

Golder Associates

GRAIN SIZE DISTRIBUTION

Project WHC/HPC-EM-17 WH
Project No. 89-135-01 Date 11/08/89 Drawn By [illegible] Approved By [illegible]
Golder Associ



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	0%				94%	6%

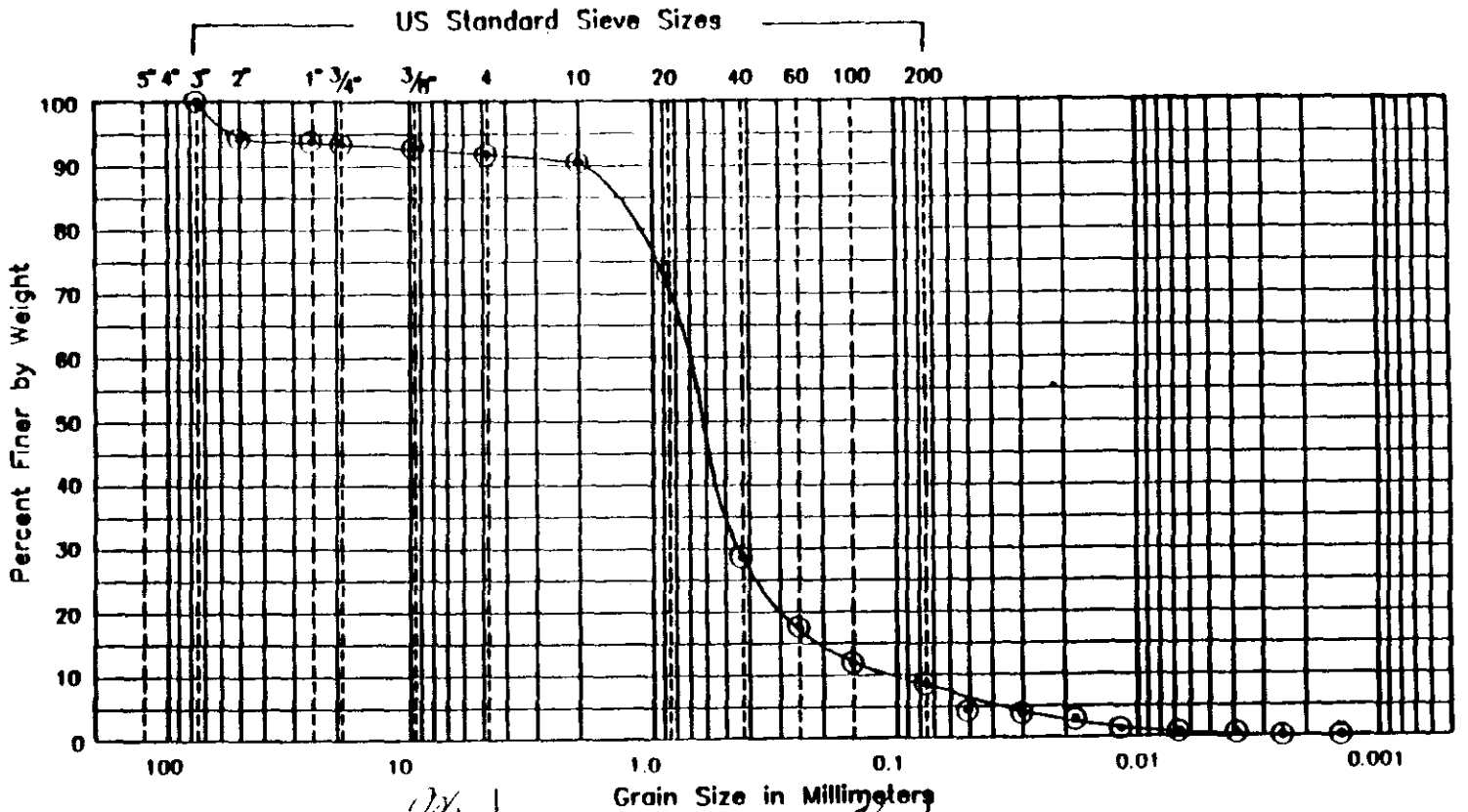
Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
DP-2		3.8				Olive black, m-f SAND, little f. gravel, little silt, (SM-SP).
AU806						

SK 2-14-90

GRAIN SIZE DISTRIBUTION

Project: 1100-EM-1 WK
Project No. 893-1752 001 Date: 8/20/90 Tested By: [illegible] Reviewed By: [illegible]

Golder Associates



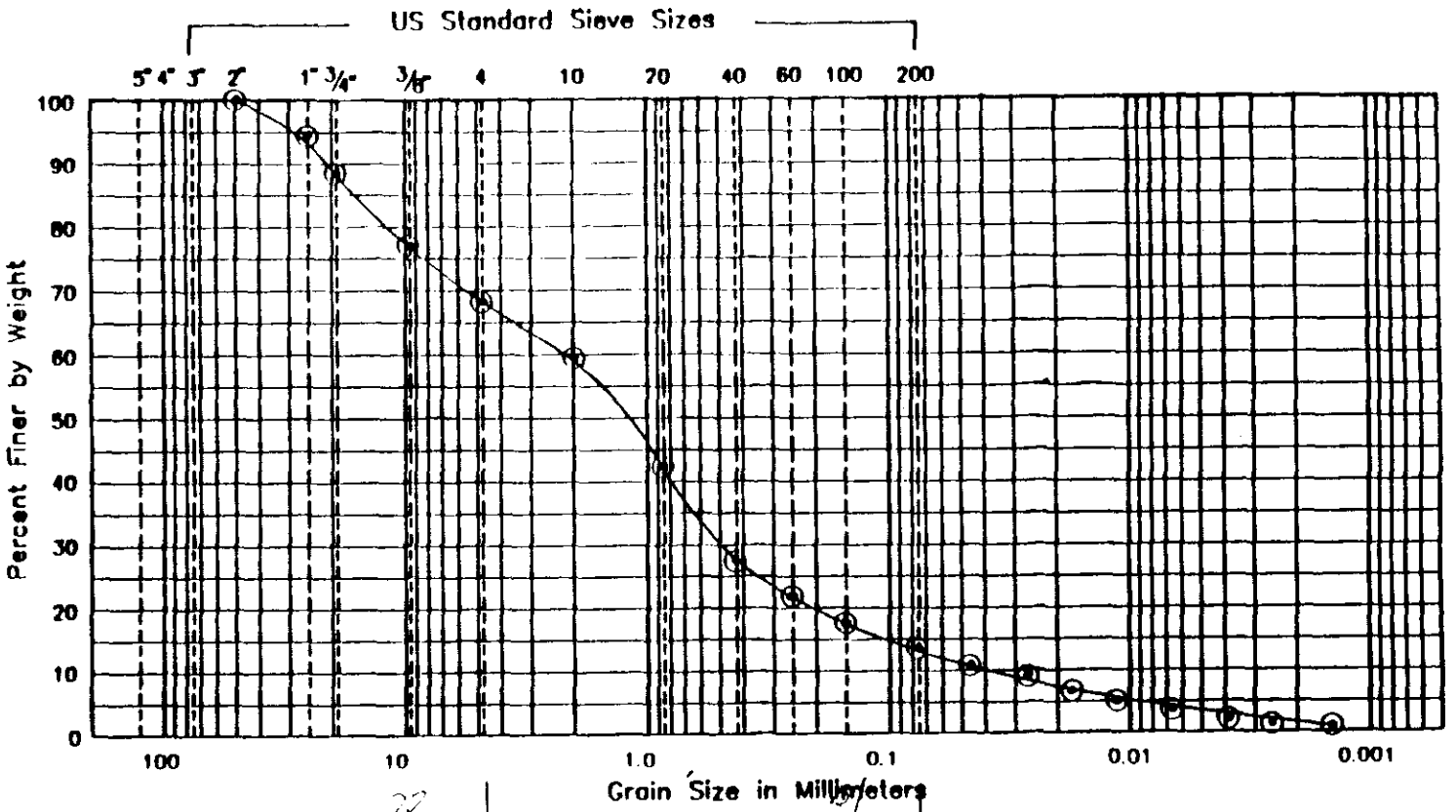
Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	0%			91%		9%

Boring No.	Elev. or Depth	W_n	W_L	W_p	I_p	Description
DP-2 A0807		3.9				Greyish black, m-f SAND, little silt, little c-f gravel, (SM-SW).

GRAIN SIZE DISTRIBUTION

Project: WHC/HPC-EM-17 WK
Project No. 933-1352-001 Date: 2/16/90 Tested By: [illegible] Reviewed By: [illegible]

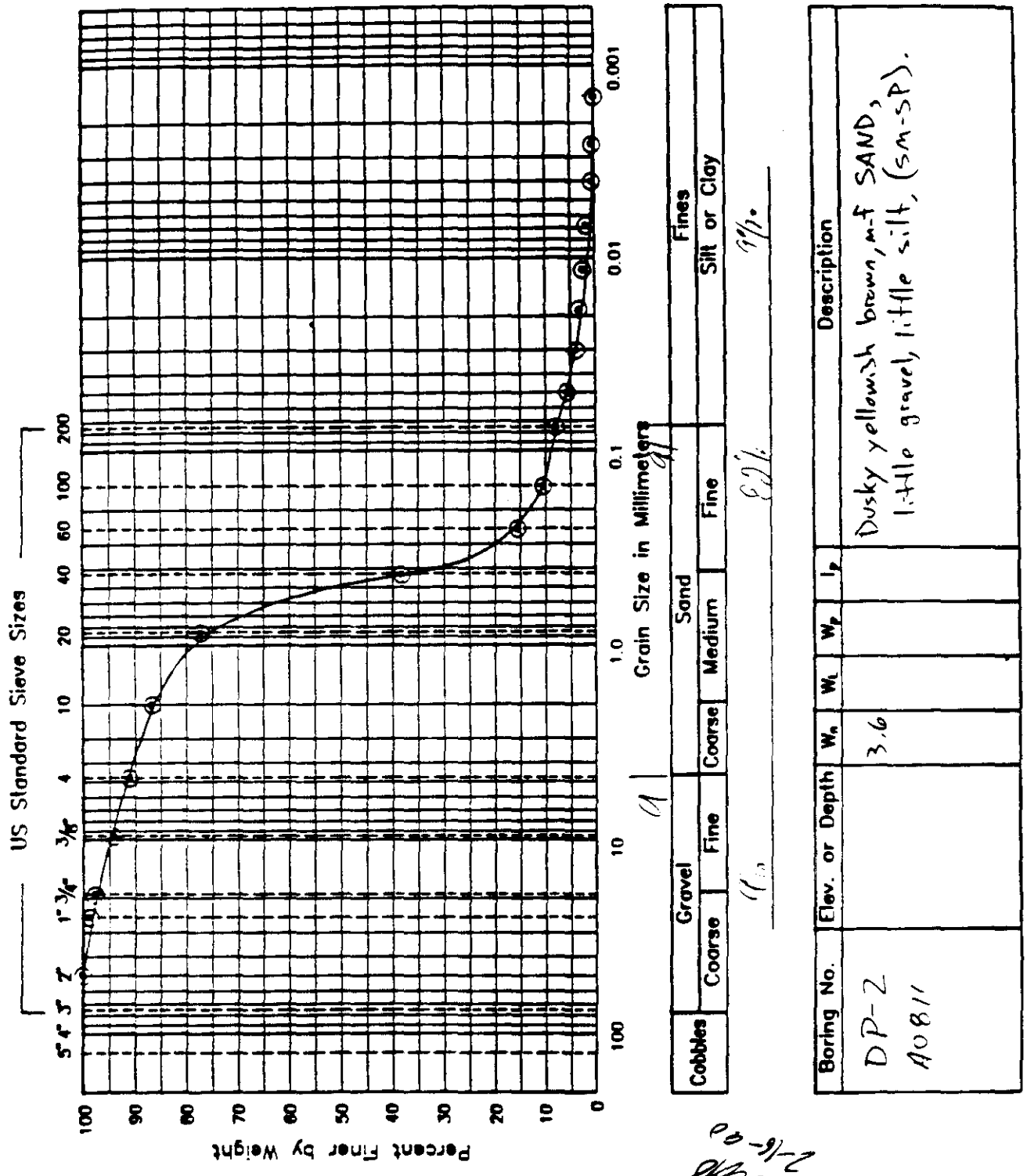
Golder Associat



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	28			69%		19%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
DP-2 A0809		2.8				Brownish black, silty f-c SAND and GRAVEL, (SM).

JR NRO 2-16-90

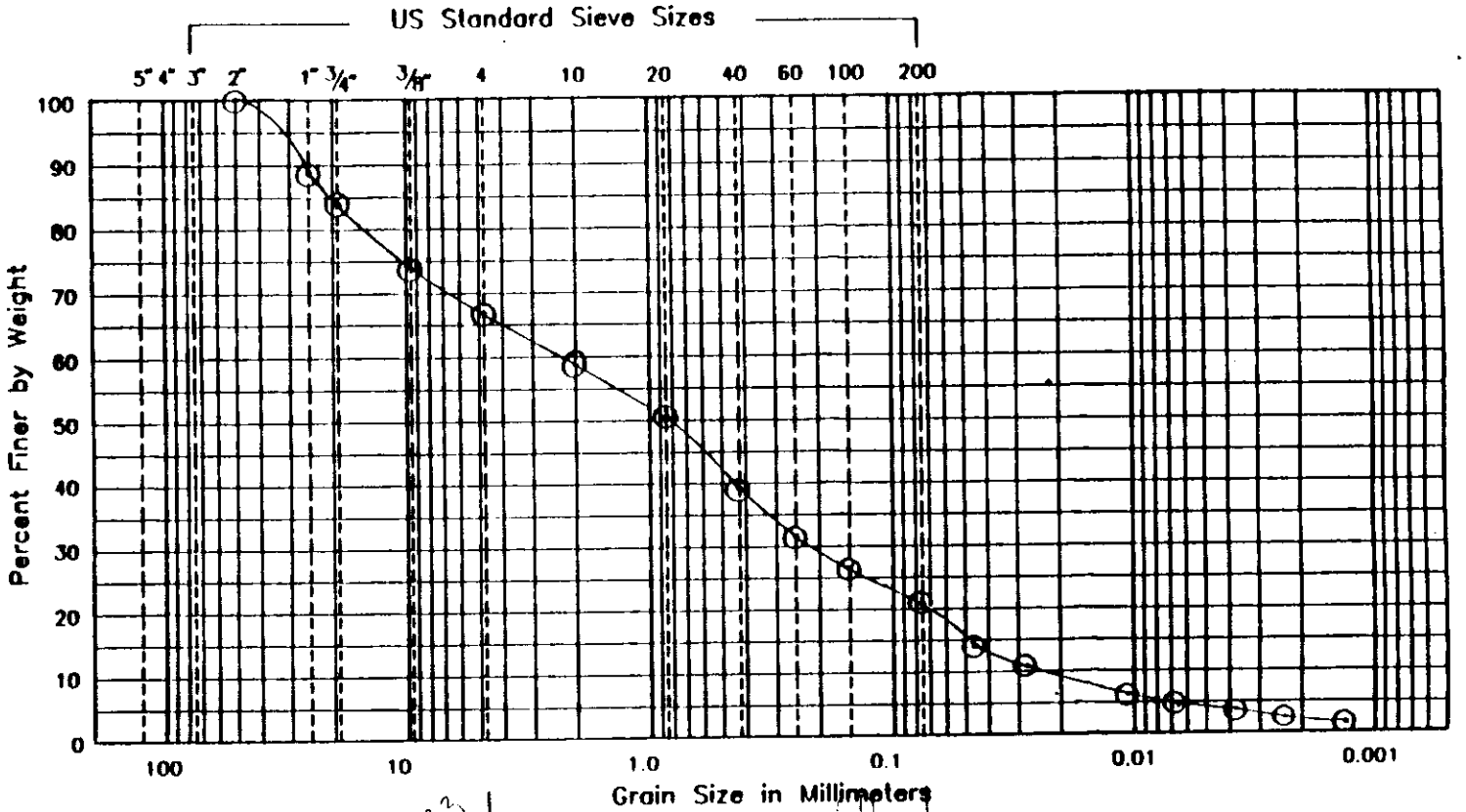


GRAIN SIZE DISTRIBUTION

Project WHC/1100-EM-1/WA
Project No. 863-1754.001 Date 13AUG89 Tested By SH Approved By KH
Golder Associates

GRAIN SIZE DISTRIBUTION

Project: 446/1100-DP-1/WA
Project No. 883-1254.001 Date: 10/11/89 Taken By: SKF Approved By: [illegible]



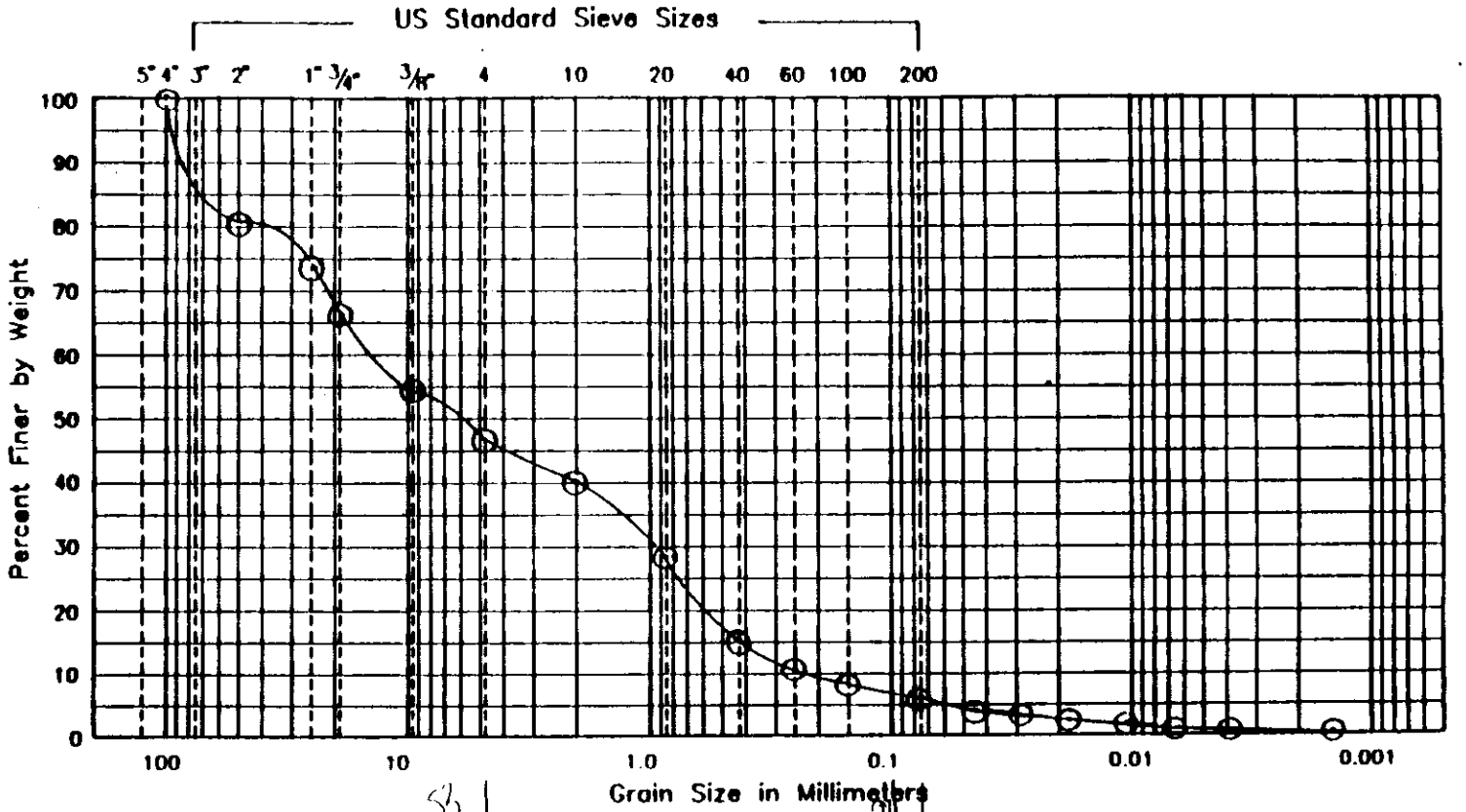
Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	15%			15%		70%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
DP-3 A07Ø3		1.5				Dark yellowish brown, silty f-c SAND and GRAVEL, (SM).

Golder Associates

GRAIN SIZE DISTRIBUTION

Project: 100D-GW-1/WB
Project No. 883-1254.001 Date: 10/01/89 Tested By: [illegible] Approved By: [illegible]



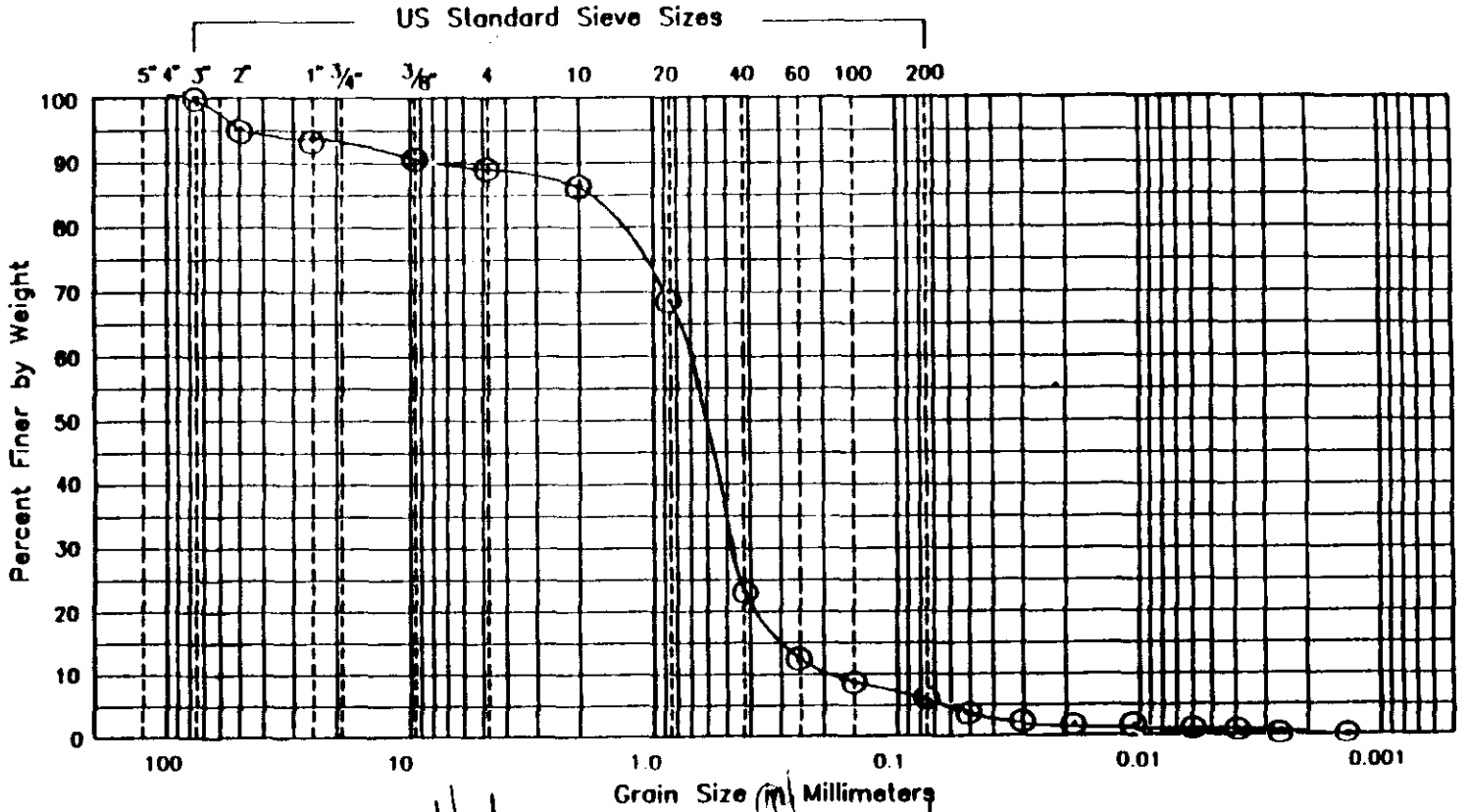
Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
					11 %	0 %

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
DP-3 A07Ø5		2.5				Dusky yellowish brown, F-C SAND and GRAVEL, some cobbles, little silt, (GM-GP)

Golder Associates

GRAIN SIZE DISTRIBUTION

Project EKS 1100-Ø7-1/WA
Project No. 883-1254.001 Date 10/19/89 Tested By SHC Reviewed By [illegible]



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
		11%			9%	1%

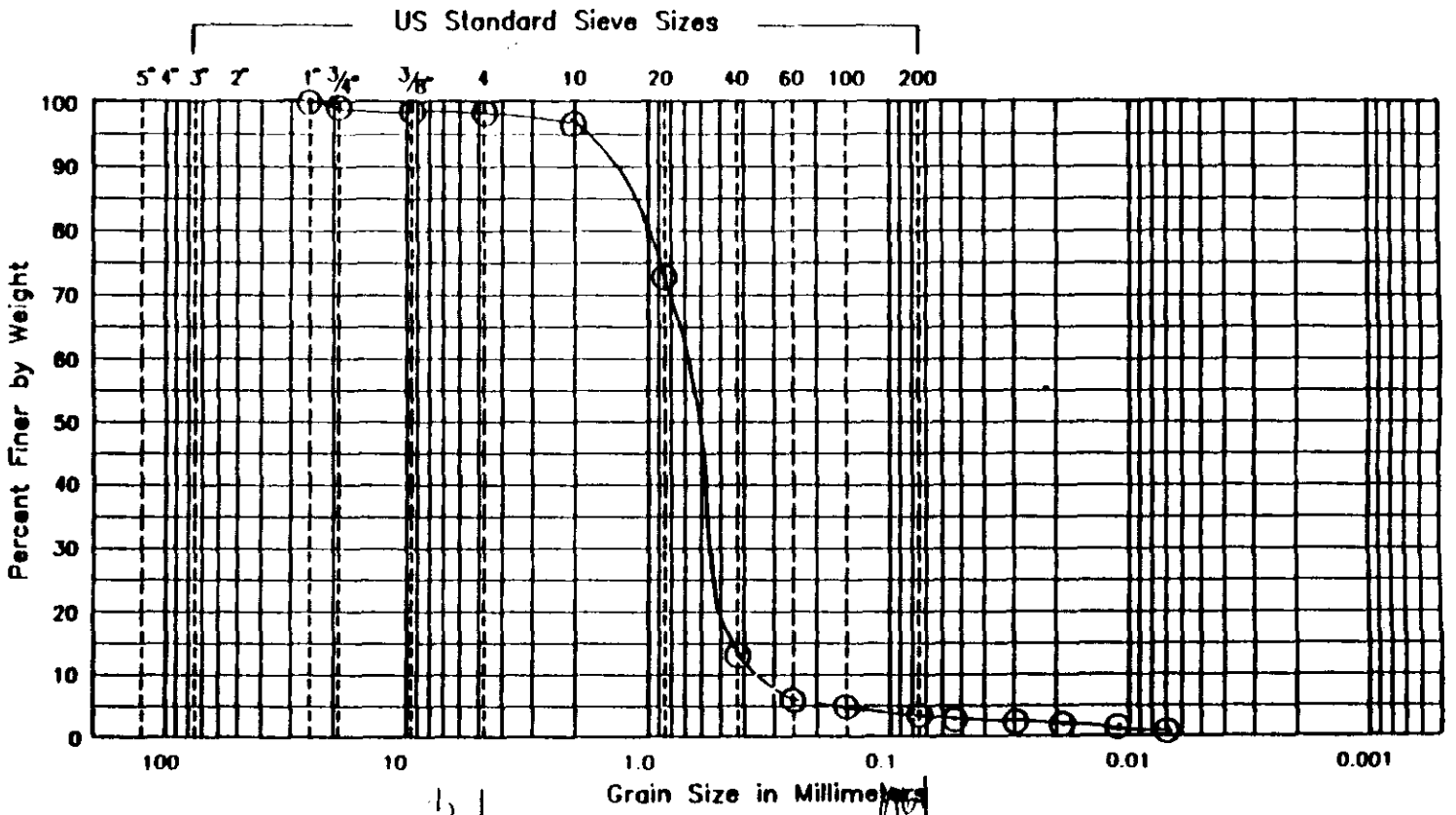
Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
DP-3 A07Ø7		4.4				Olive black, m-f SAND, little c-f gravel, little silt, (SM-SP).

Golder Associat

GRAIN SIZE DISTRIBUTION

Project 100-BC-1/WA
Project No. 883-1254.301 Date 8/14/89 Tested By SK Approved By

Golder Associates

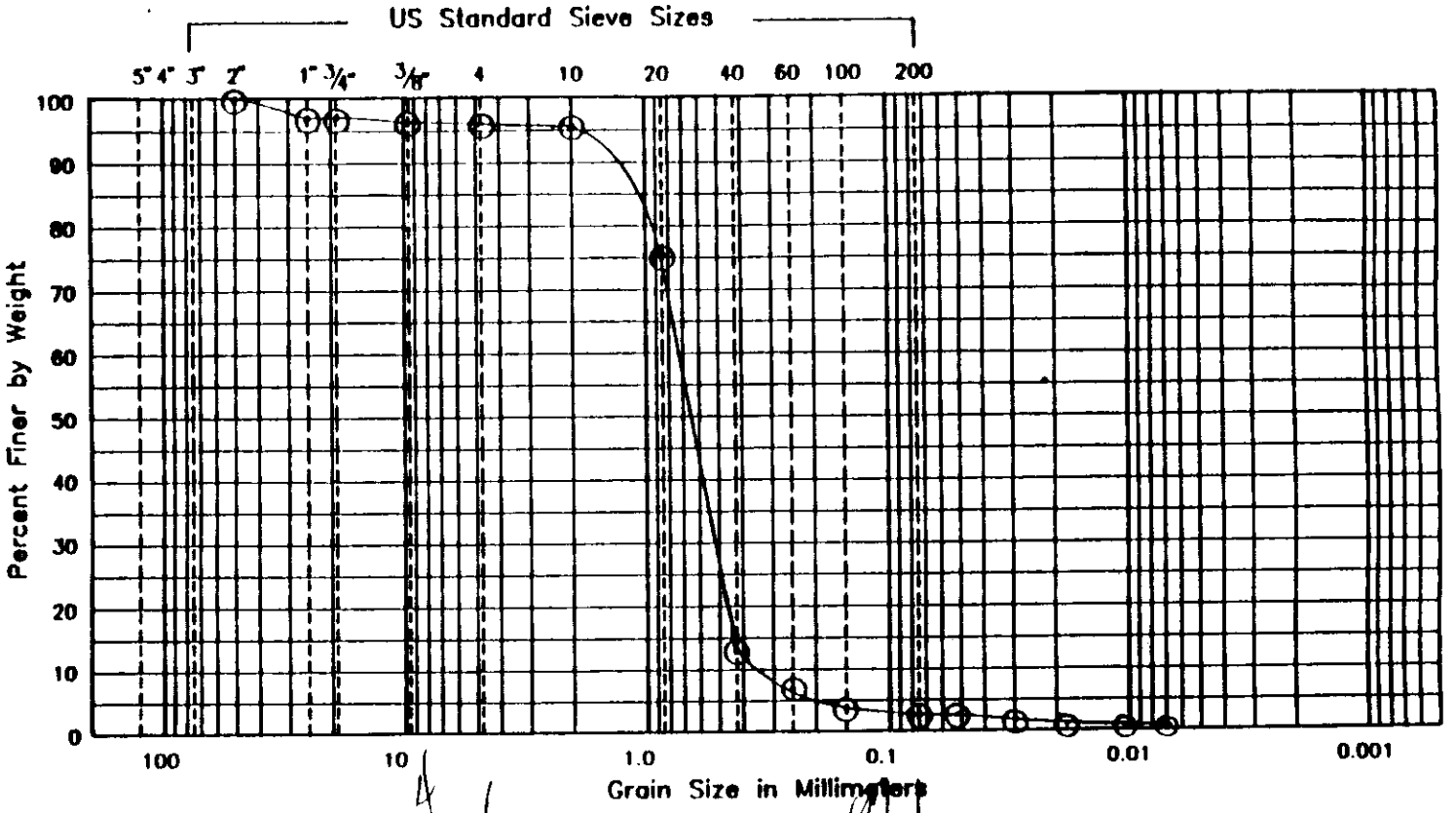


Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
		1%			99%	1%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
DP-3 A0710		3.7				Dusky yellowish brown, m. SAND, trace silt, trace gravel, (SP).

GRAIN SIZE DISTRIBUTION

Project 200-UP-1 OU
Project No. 883-1254.001 Date 11/15/89 Tested By SAK Reviewed By [illegible]



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	1%			97%		2%

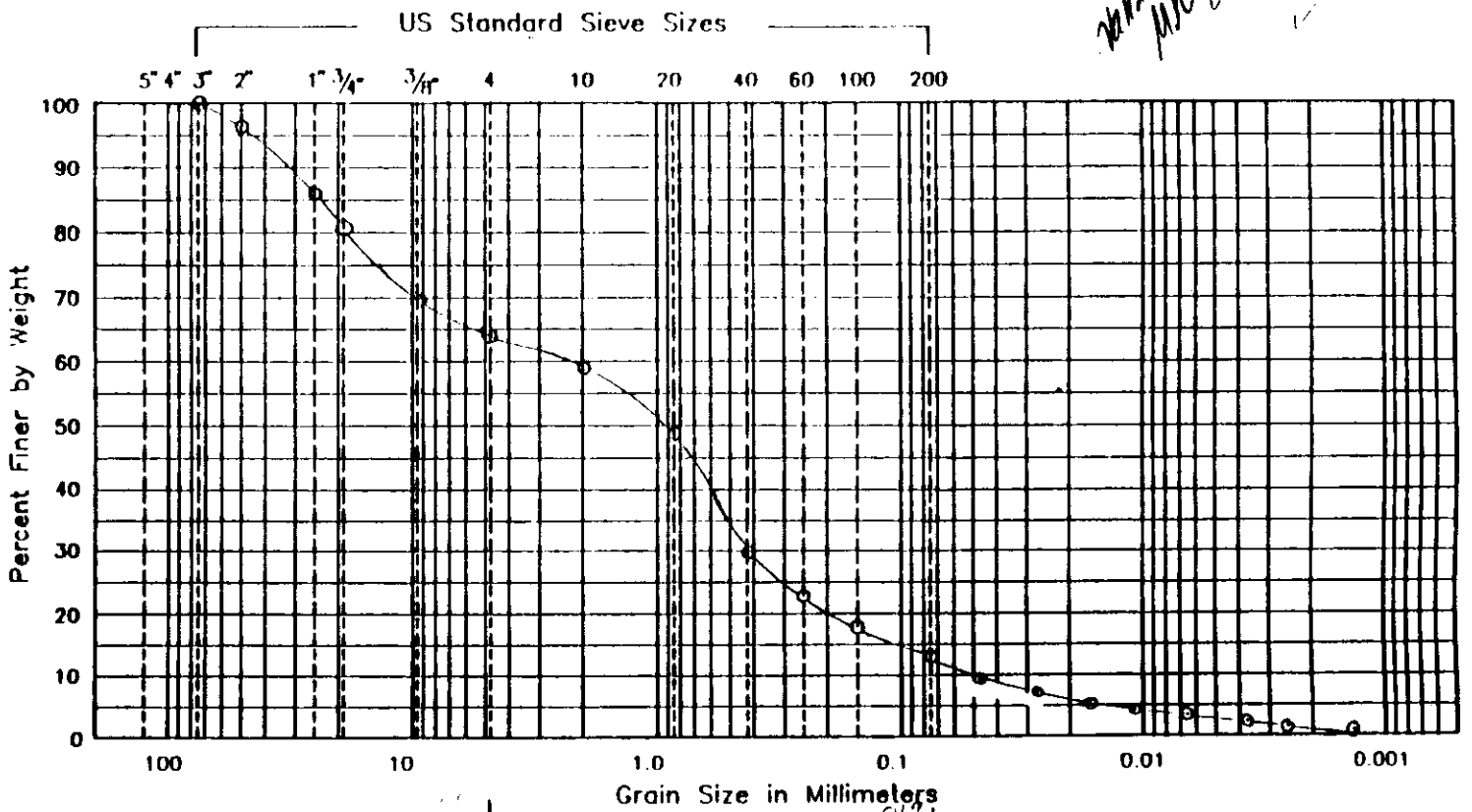
Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
DP-3 A0711		3.9				Brownish black, m. SAND, trace gravel, trace silt, (SP).

Golder Associates

GRAIN SIZE DISTRIBUTION

Project: [illegible]
Project No. [illegible] Date [illegible] Tested By [illegible] Approved By [illegible]

Golder Associates



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
						1%

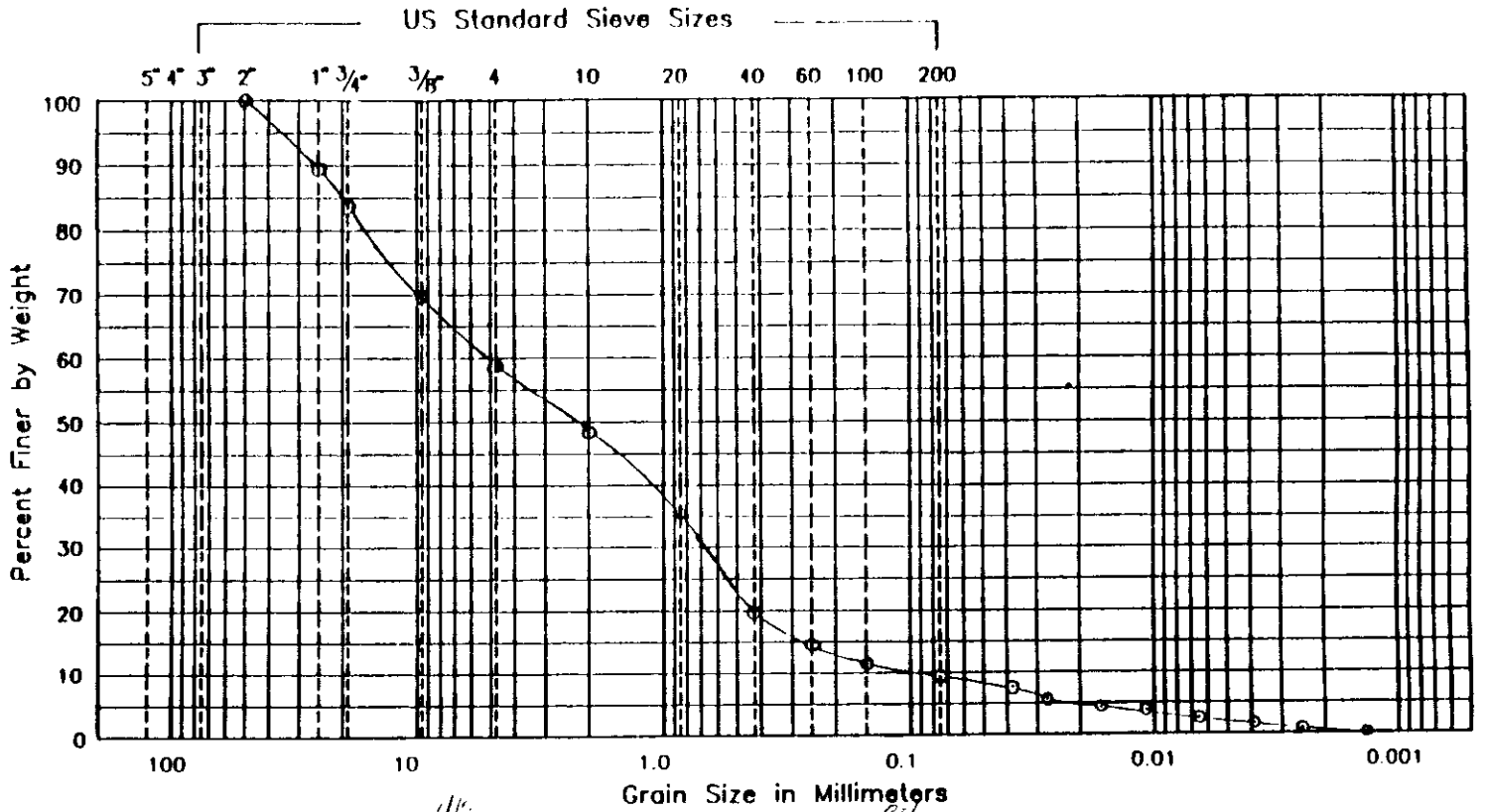
Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A 12.02		1.5				Lt. Olive grey, m-f SAND and c-f GRAVEL some silt (SM)

$C_u = \frac{2.25}{.05} = 45$ $C_c = \frac{.43^2}{2.25(.05)} = 1.6$

GRAIN SIZE DISTRIBUTION

Project: WPPSS-[illegible] PINA
Project No. EE: 2254.00 Date: [illegible] Tested By: [illegible] Approved By: [illegible]

Golder Associates



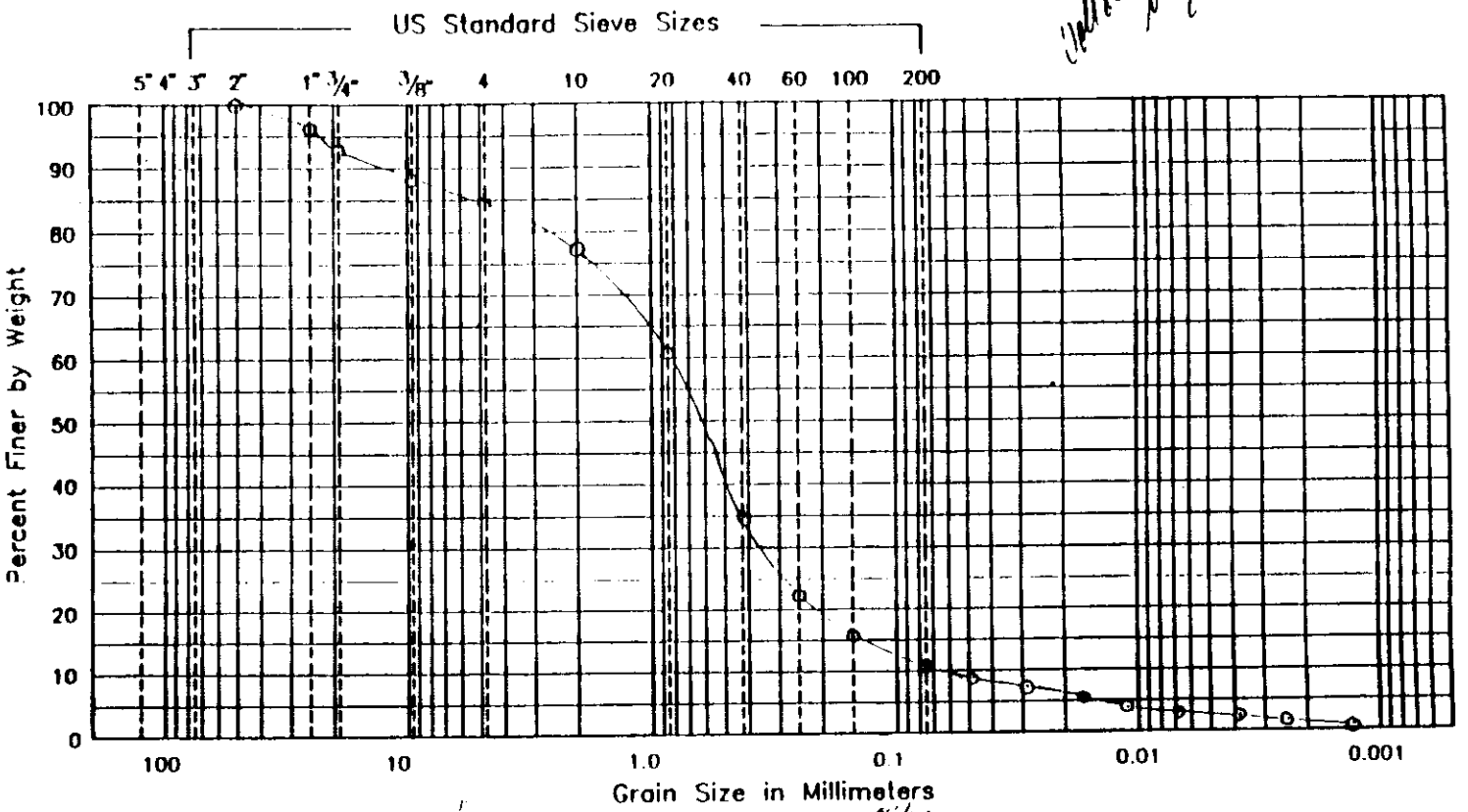
Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	11%			80%		9%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1207		2.1				Med. lt. grey, c-m-f SAND and c-f GRAVEL little silt (SP-SM)

GRAIN SIZE DISTRIBUTION

Project: WPS 1100-EPA-1 / UNA
Project No. EE3-2546.00v Date 4/23/88 Tested By: BEW Approved By: [illegible]

Golder Associates

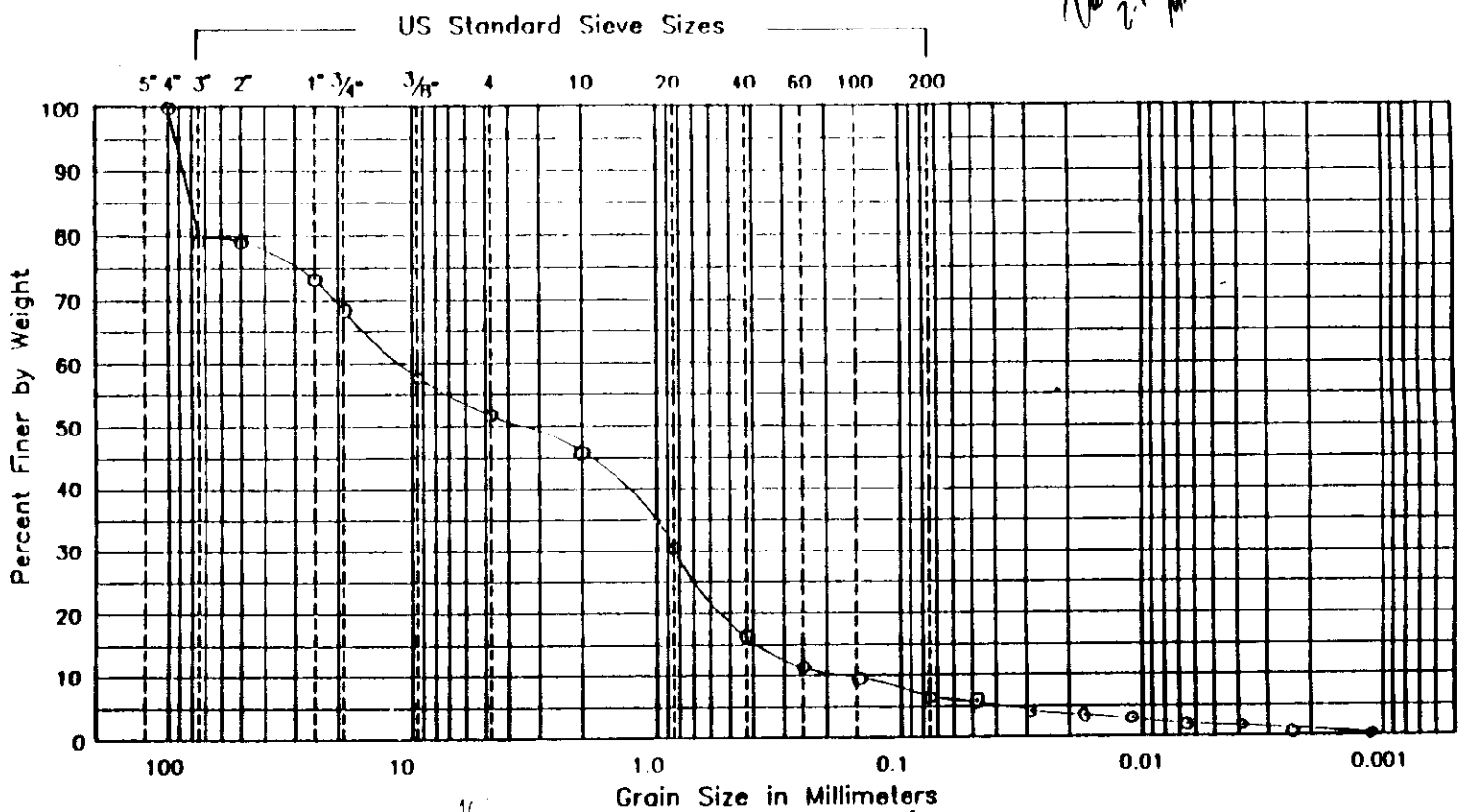


Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1209		3.6				Olive grey, gravely, m-f SAND, little silt (SW - SM) $C_u = \frac{.85}{.065} = 13$ $C_z = \frac{.332}{.85(.065)} = 2.5$

GRAIN SIZE DISTRIBUTION

Project: WRS/HPS-EHW/UNA
Project No. 883-7706-300 Date 8/27/90 Tested By: BFW Approved By: KLB



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A12/2		2.0				lt. olive grey to med. grey, m-f SAND and GRAVEL, little silt. (SP-SM)

Validated 2-15-91 MPO

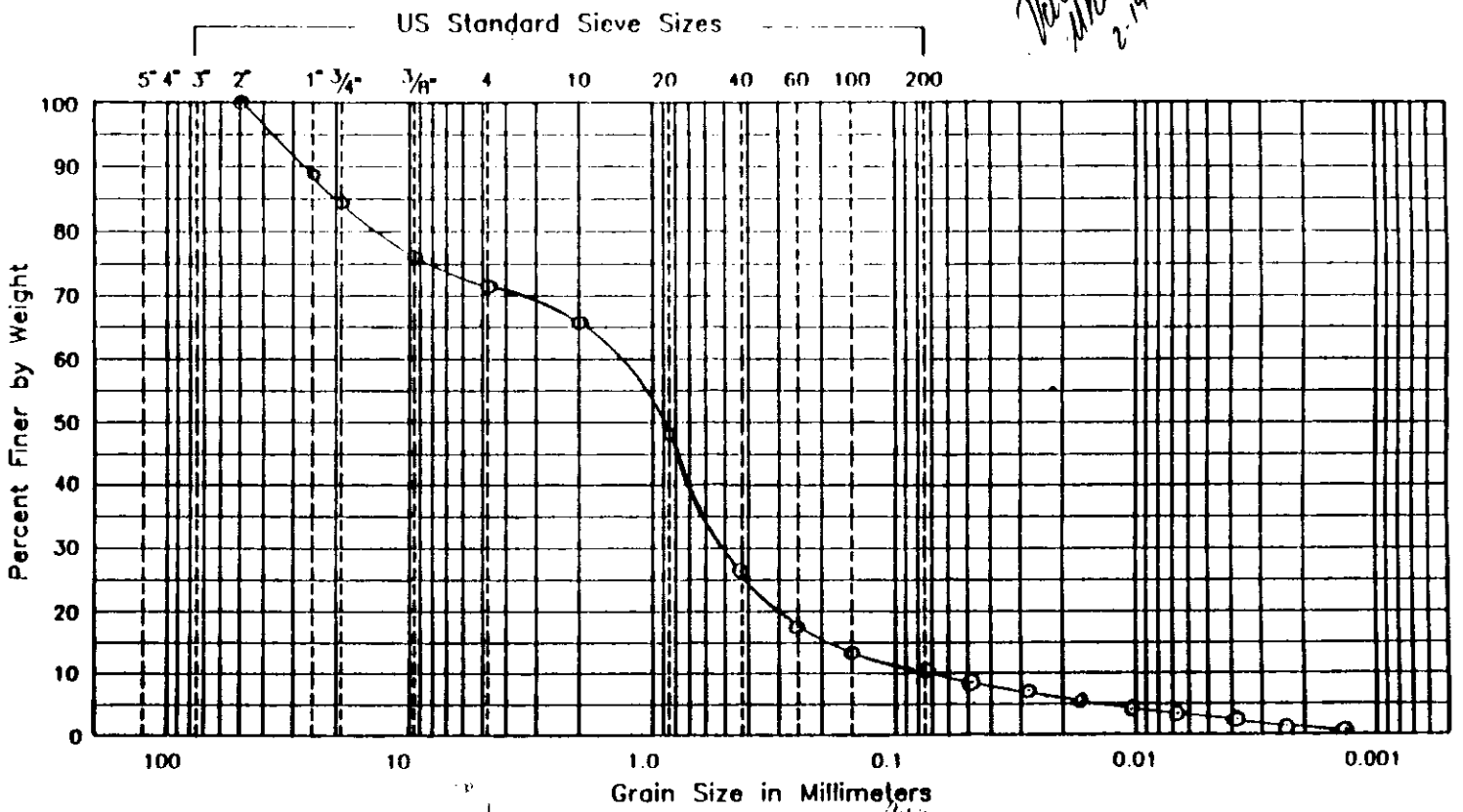
Golder Associates

Verified NMD 2-14-90

GRAIN SIZE DISTRIBUTION

Project: [illegible]
Project No. [illegible] Date [illegible] Tested By [illegible] Approved By [illegible]

Golder Associates



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

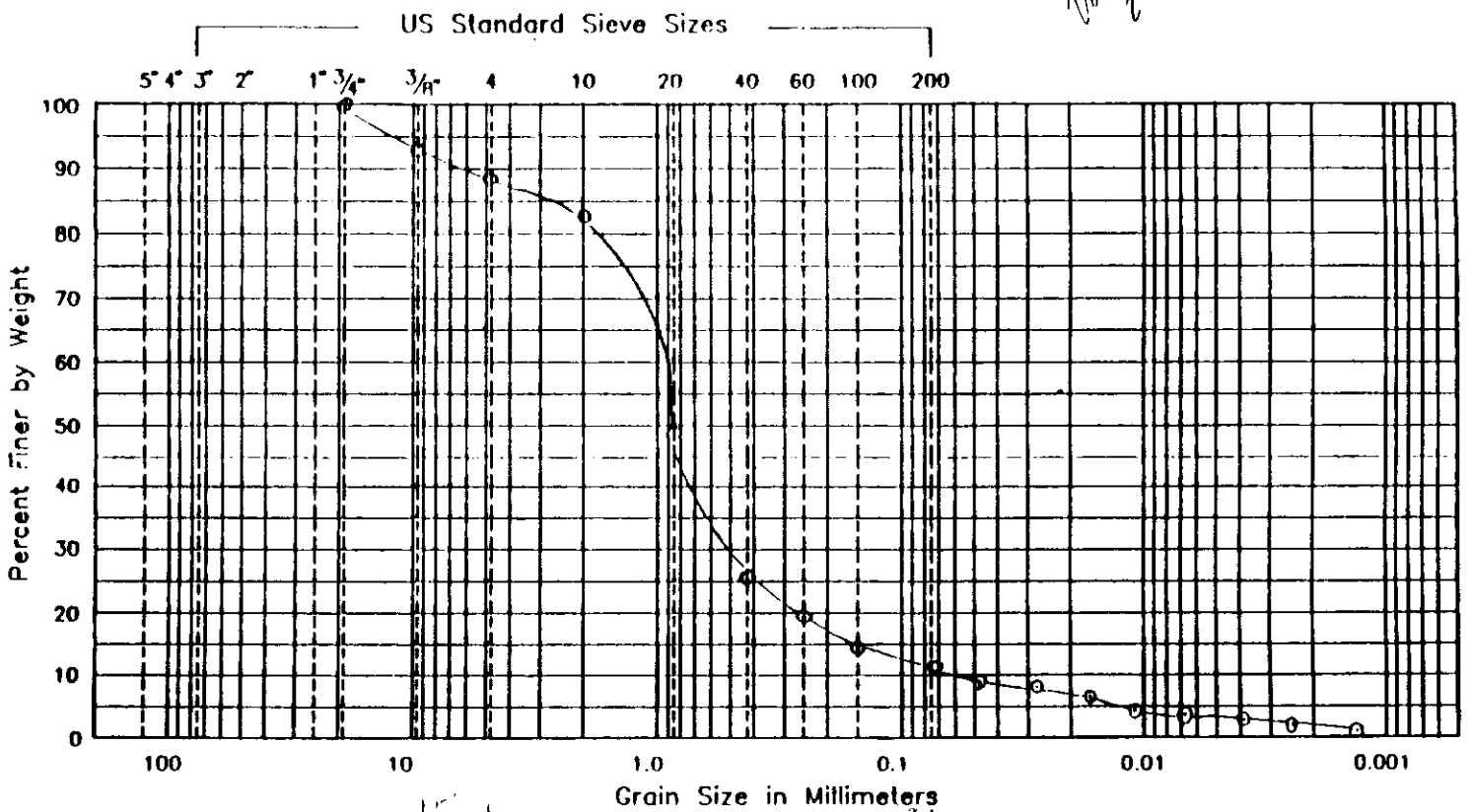
$C_u = \frac{1.45}{.072} = 20.14$ $C_c = \frac{.51^2}{1.45(.072)} = 2.5$

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A 1214		3.1				olive grey, c-f gravely, m-f SAND, little silt (SW-SM)

Validated 2-15-90 MPD

GRAIN SIZE DISTRIBUTION

Project: WPS-1100-ENG-100A
Project No. 883-2-2-100 Date 8/23/89 Tested By: B.Kim Approved By: [illegible]



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

$C_u = \frac{.9}{.062} = 14.5$ $C_z = \frac{.52^2}{.9(.062)} = 4.9$

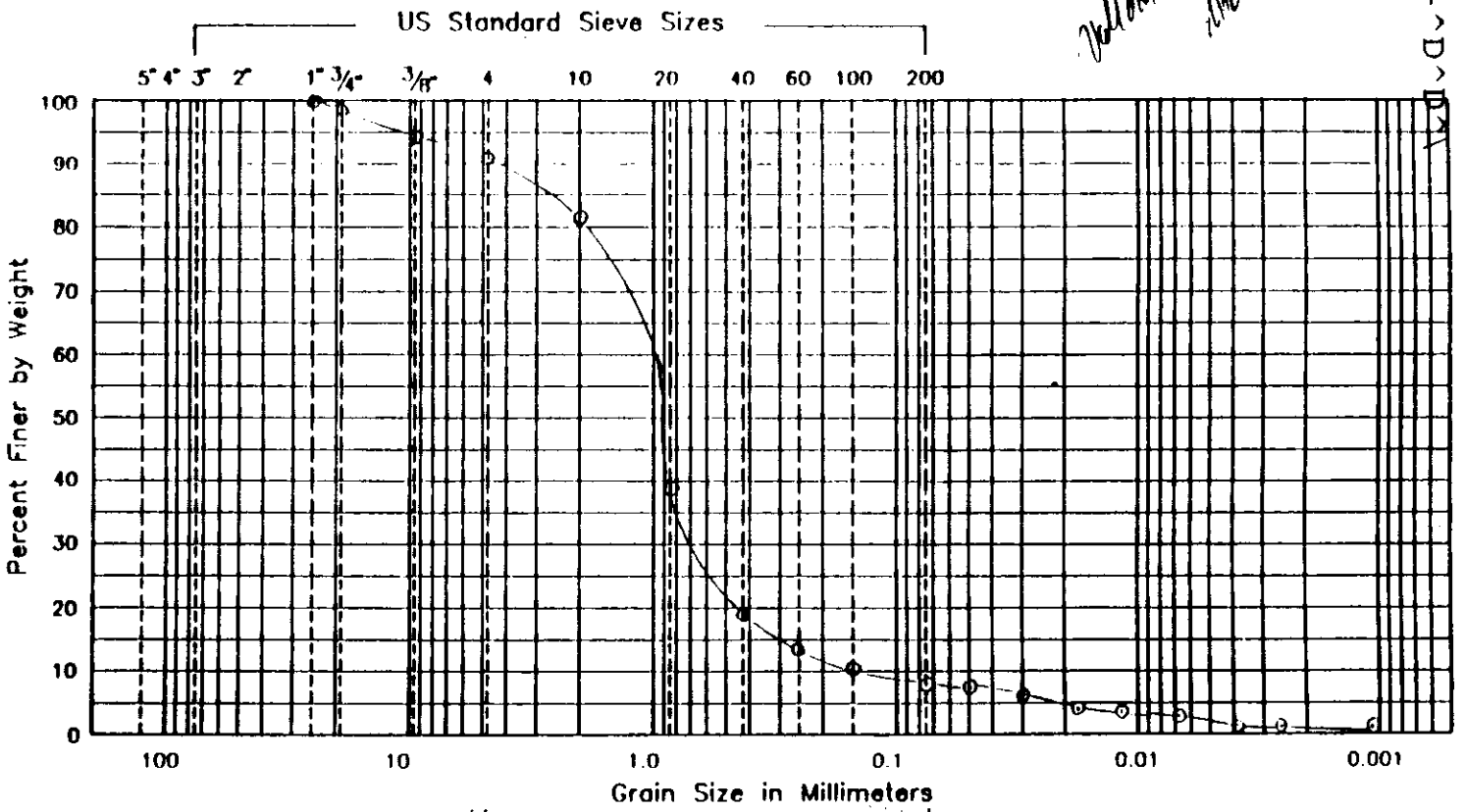
Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1215		2.5				Olive gray, f gravelly m-f SAND, little silt (SP-SM)

Golder Associates

GRAIN SIZE DISTRIBUTION

Project: WRF/UMB "FEN" LINE
Project No. 883-3246.000 Date: 8/27/89 Tested By: BFW Approved By: [illegible]

Golder Associates



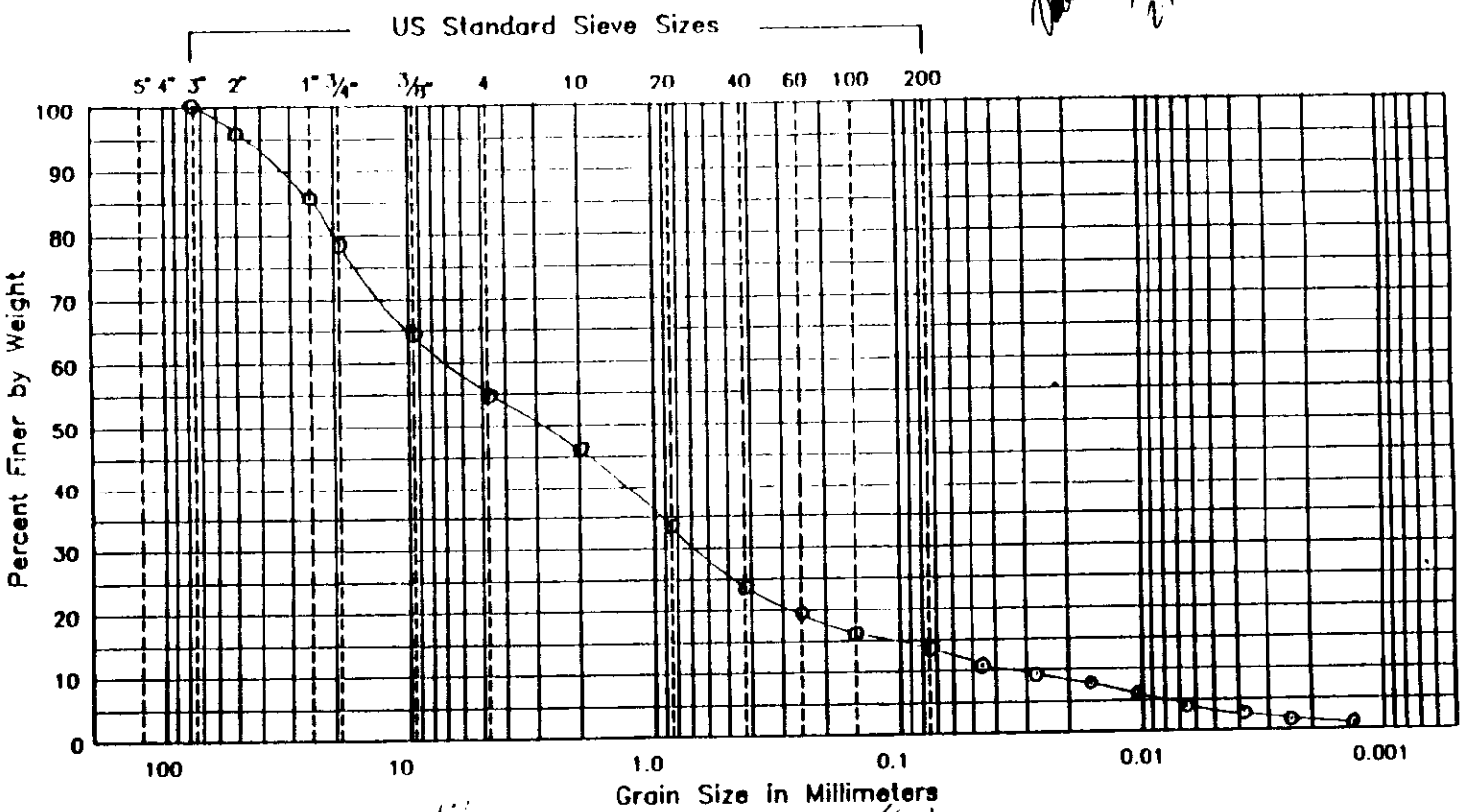
Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A 12 16		3.0				Olive black, m-f SAND, little f gravel, little silt (SP-SM) $C_u = \frac{1}{.19} = 5.3$ $C_z = \frac{.7^2}{1(.19)} = 2.6$

GRAIN SIZE DISTRIBUTION

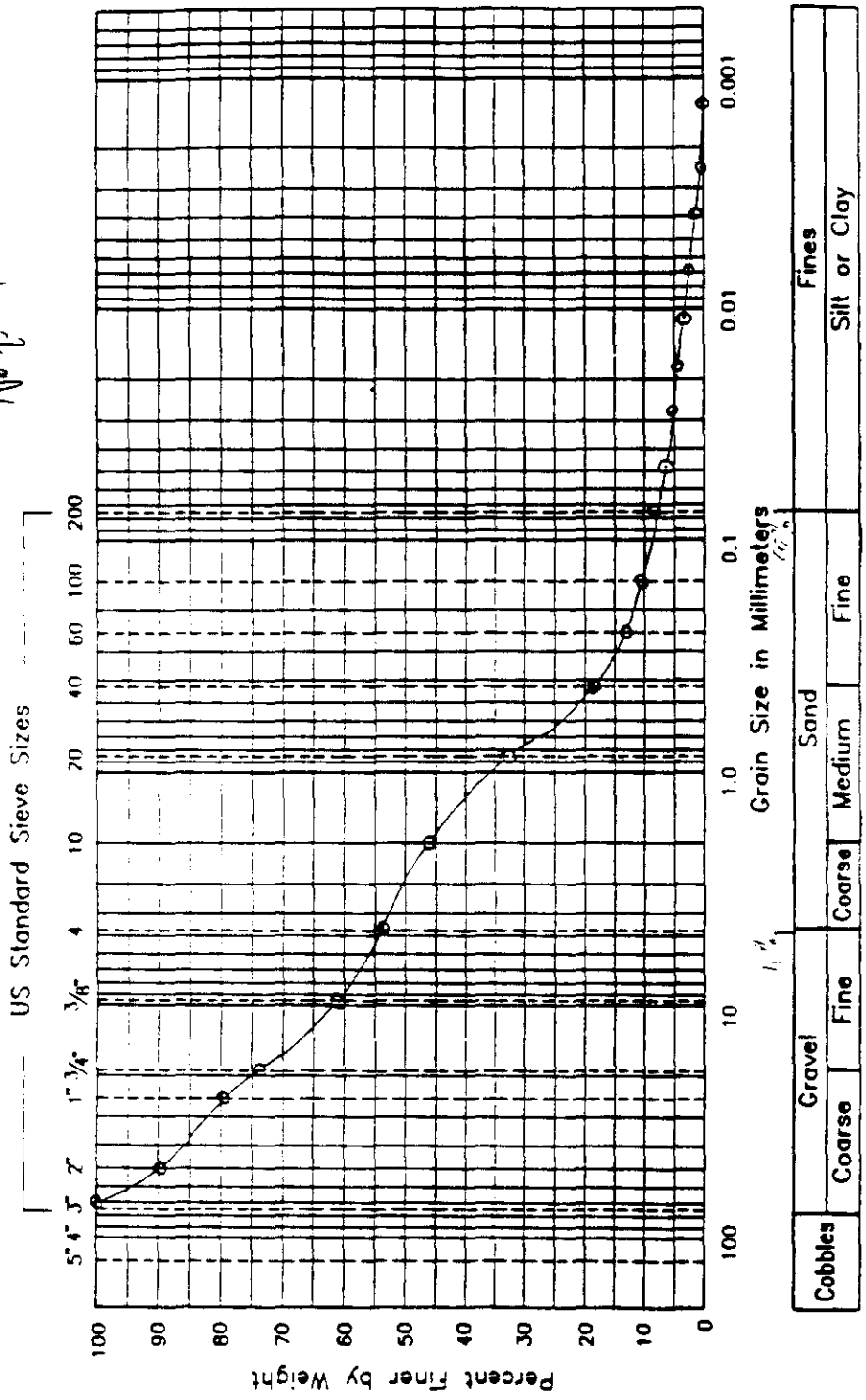
Project: WPS 1105 ERT / INK
Project No. 893-12-4-1010 Date 10/23/89 Tested By: BEN Reviewed By: [illegible]

Golder Associat



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

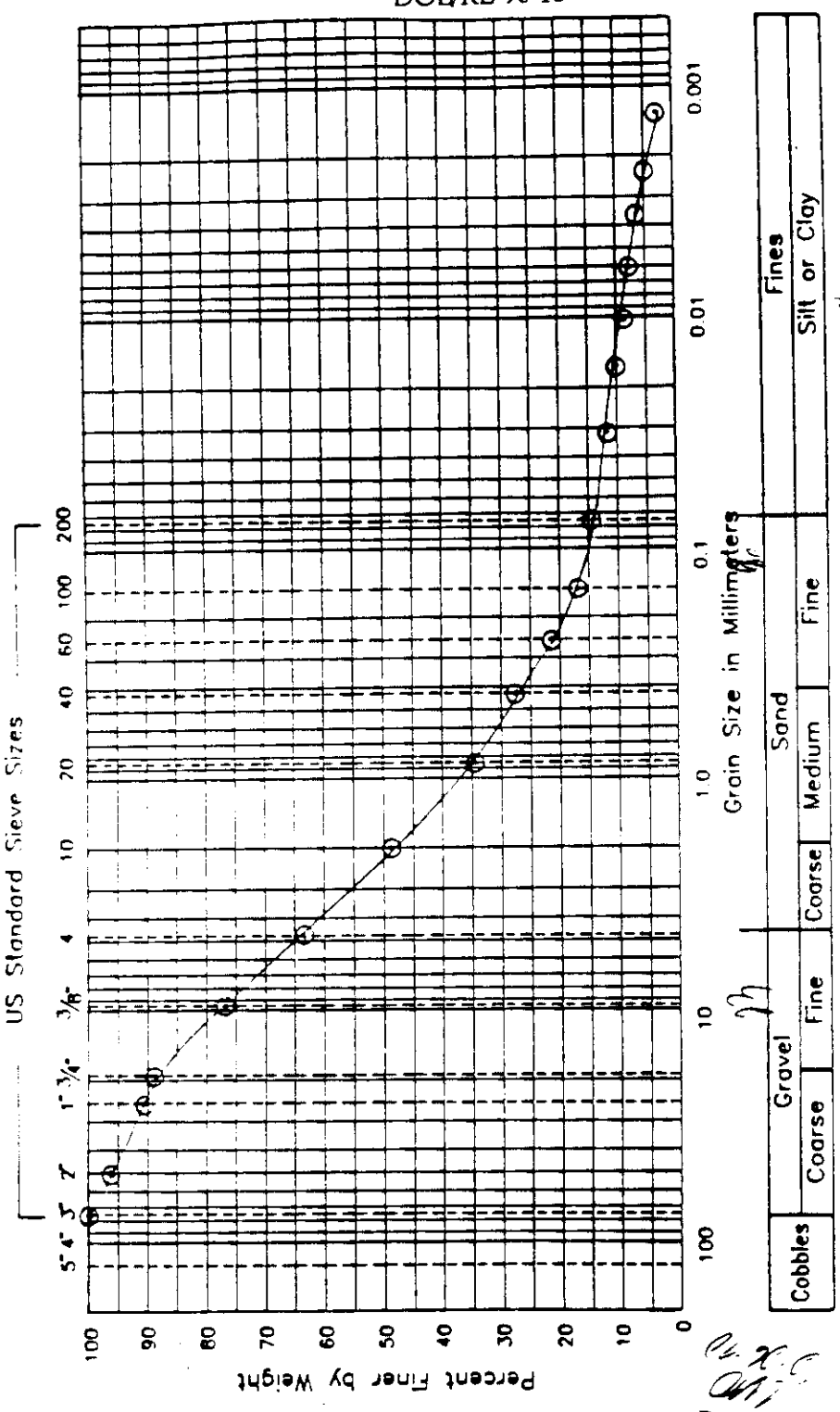
Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1218		2.0				Med. lt. grey, c-f SAND, and c-f GRAVEL, some silt (SW-SM)



Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1220		2.3				Olive grey, coarse sand and c-f GRAVEL, little silt (SP-SM) $C_u = \frac{9}{.18} = 50$ $C_c = \frac{.25^2}{.9(.18)} = .4$

GRAIN SIZE DISTRIBUTION

Project: [illegible]
Project No. [illegible] Date 10/23/[illegible] Tested By BFW Approved By [illegible]
Golder Associates



Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1603		[illegible]				Light olive gray (5Y 5/2), coarse to fine SAND and coarse to fine GRAVEL, some Silt ~~[illegible]~~ (SM)

GRAIN SIZE DISTRIBUTION

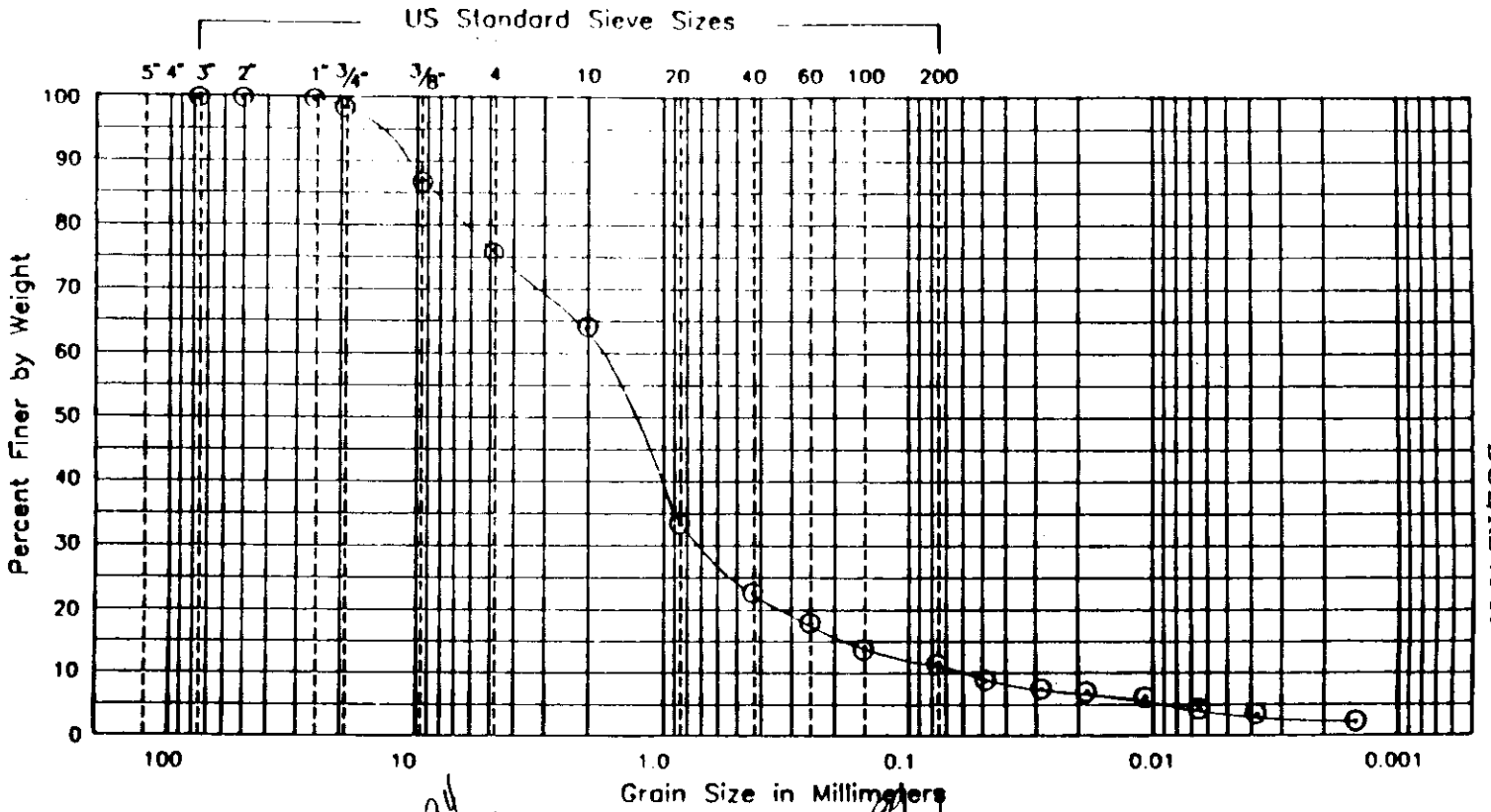
Project [illegible] Project No. [illegible] Date [illegible] Tested By [illegible] Approved By [illegible]

Golder Associates

GRAIN SIZE DISTRIBUTION

Project: [illegible]
Project No. [illegible]
Date 2-1-92 Tested By DRC/[illegible] Reviewed By [illegible]

Golder Associates

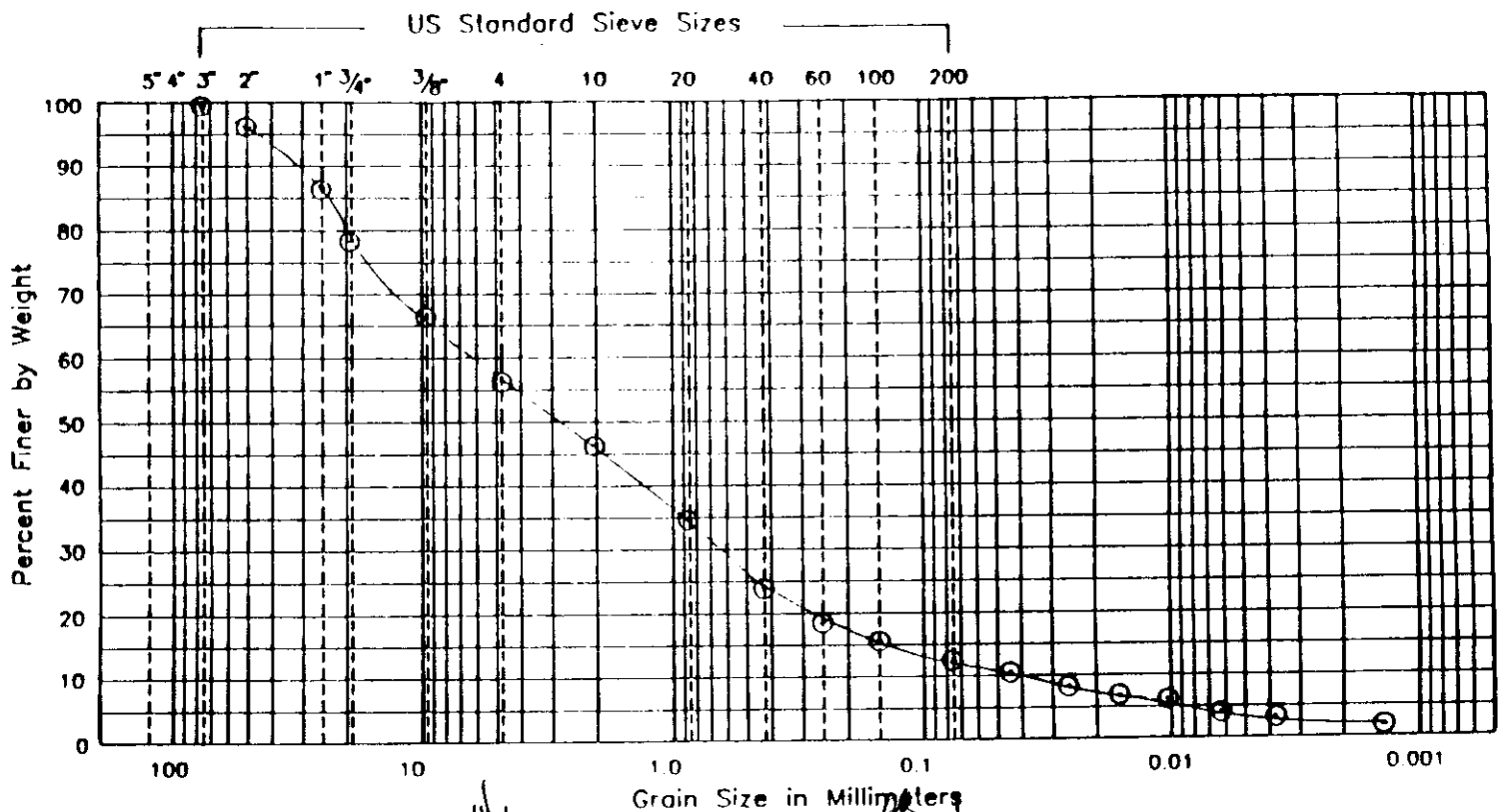


Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	24				65	11

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1E06		1.81				Medium olive gray (5Y 4/1), coarse to fine SAND, some Gravel, little Silt ~~(SP)~~ (SP-SM)

GRAIN SIZE DISTRIBUTION

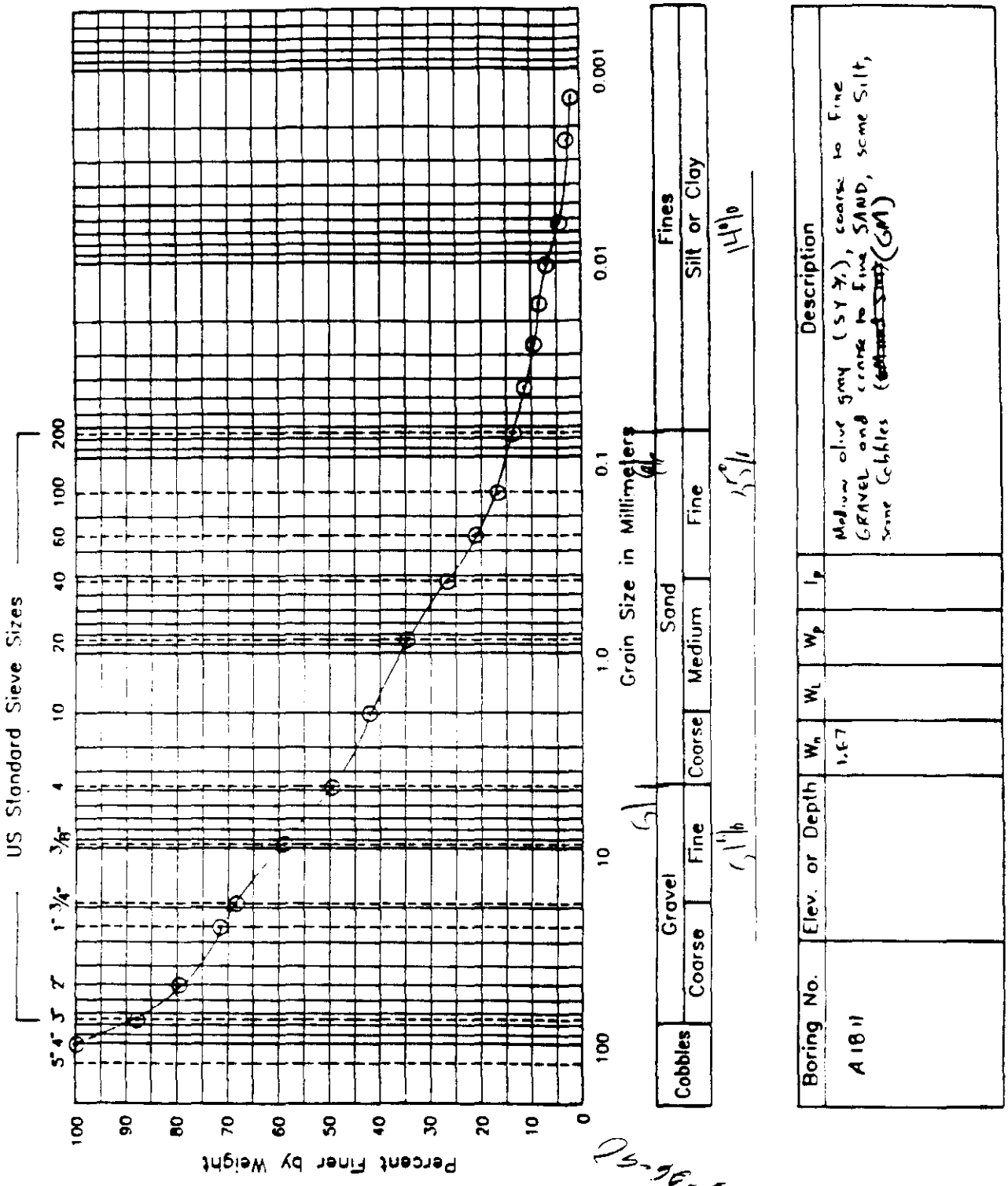
Project: [illegible]
Project No. [illegible] Date [illegible] Tested By DK/EAH Approved By [illegible]



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	[illegible]				[illegible]	12%

Boring No.	Elev. or Depth	W_n	W_L	W_p	I_p	Description
A 1809		1.69				Medium olive grey (5Y 4/1), coarse to fine SAND and coarse to fine GRAVEL; ~~little to~~ some Silt ~~fine sand fine~~ (SM)

Golder Associates

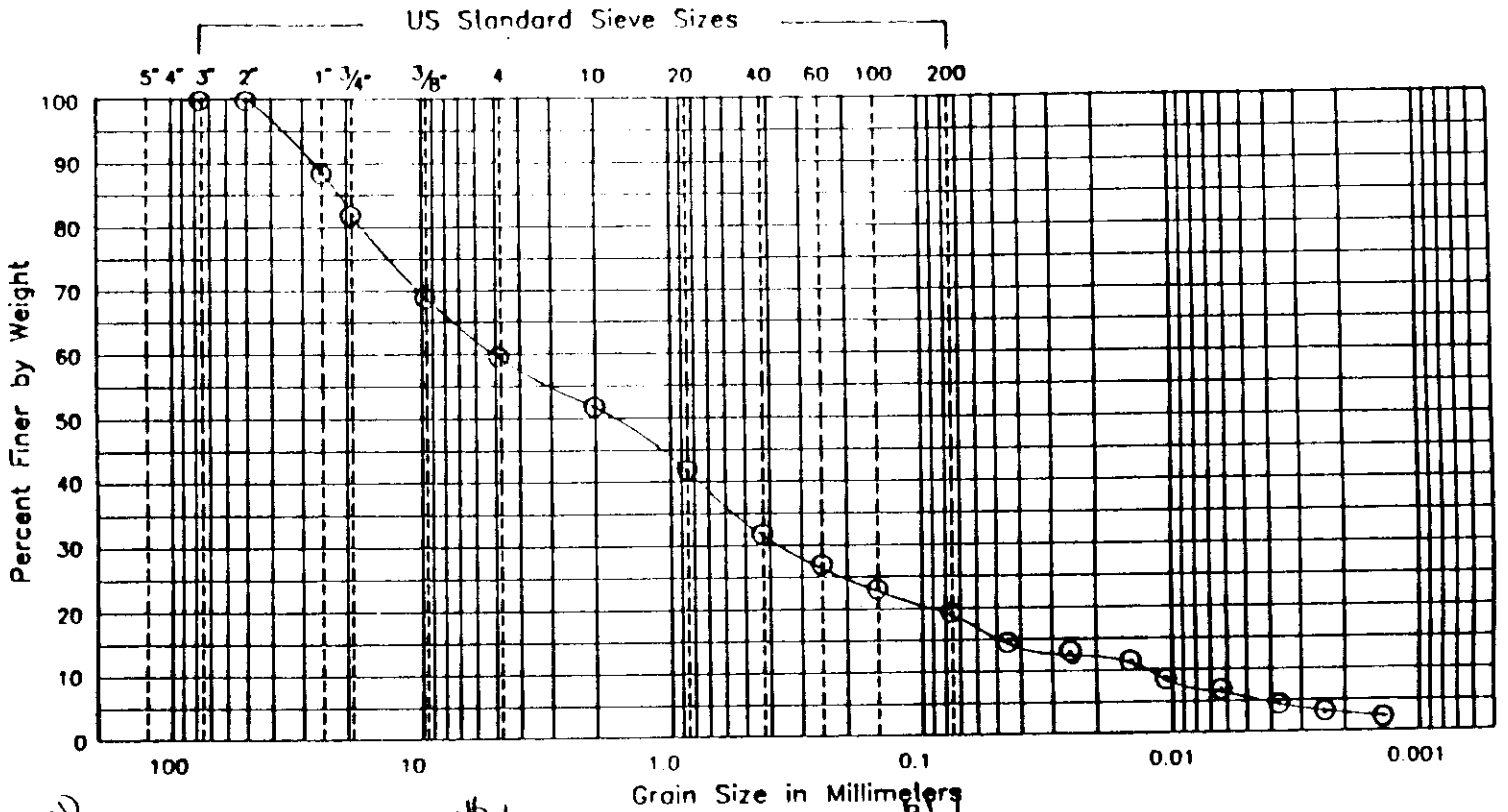


GRAIN SIZE DISTRIBUTION

Project: [illegible] Project No: 883-1754 Date: 7-1-96 Tested By: [illegible] Approved By: [illegible] Golder Associates

GRAIN SIZE DISTRIBUTION

Project [illegible]
Project No. [illegible] Date 2-1-90 Tested By DPS/JB Approved By [illegible]



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	16%		11%			19%

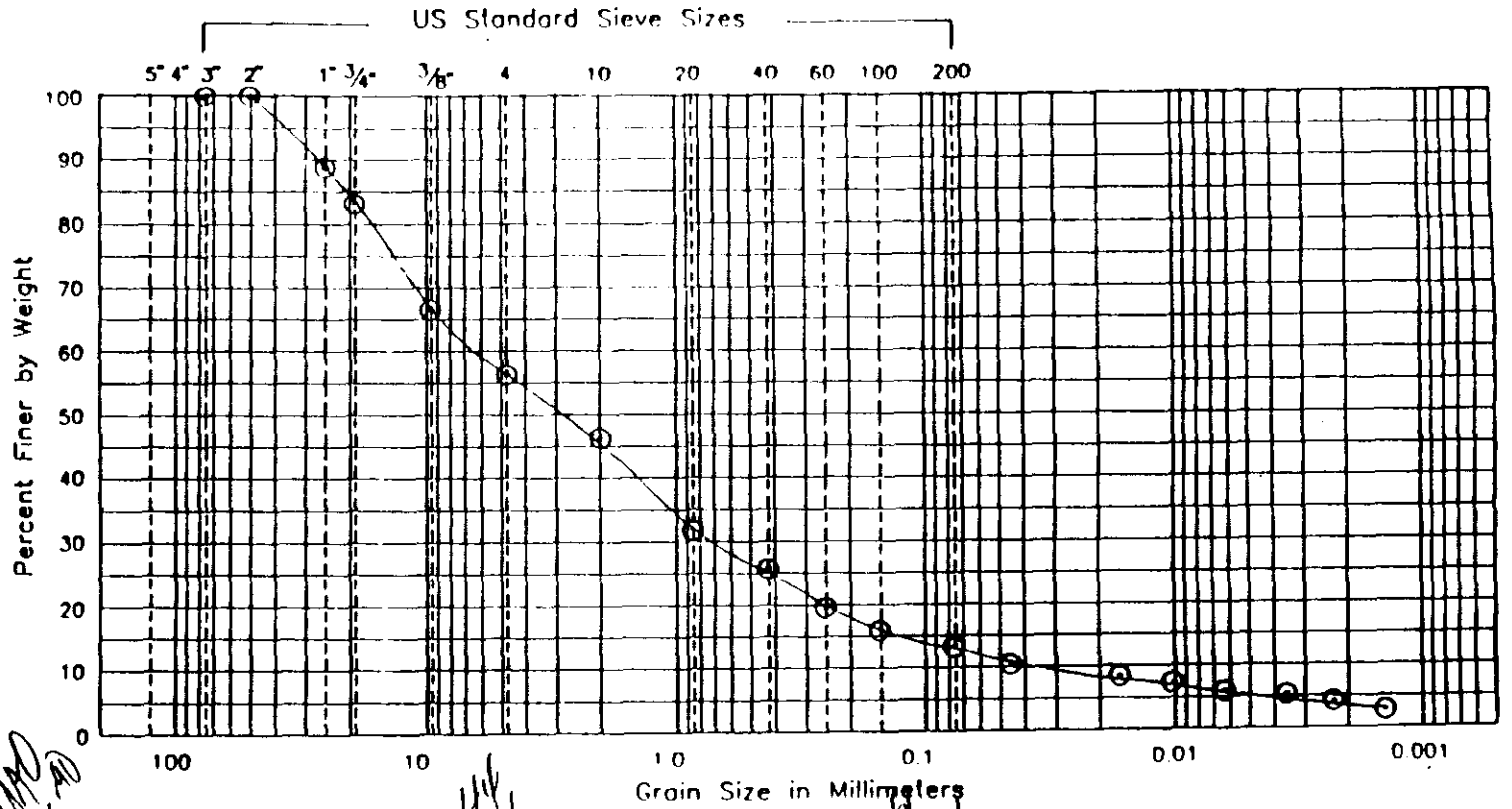
Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1B13		2.2%				Medium olive gray (5Y 5/1), coarse to fine SAND and coarse to fine GRAVEL, some Silt ~~(Silt and Gravel)~~ (SM)

Golder Associates

GRAIN SIZE DISTRIBUTION

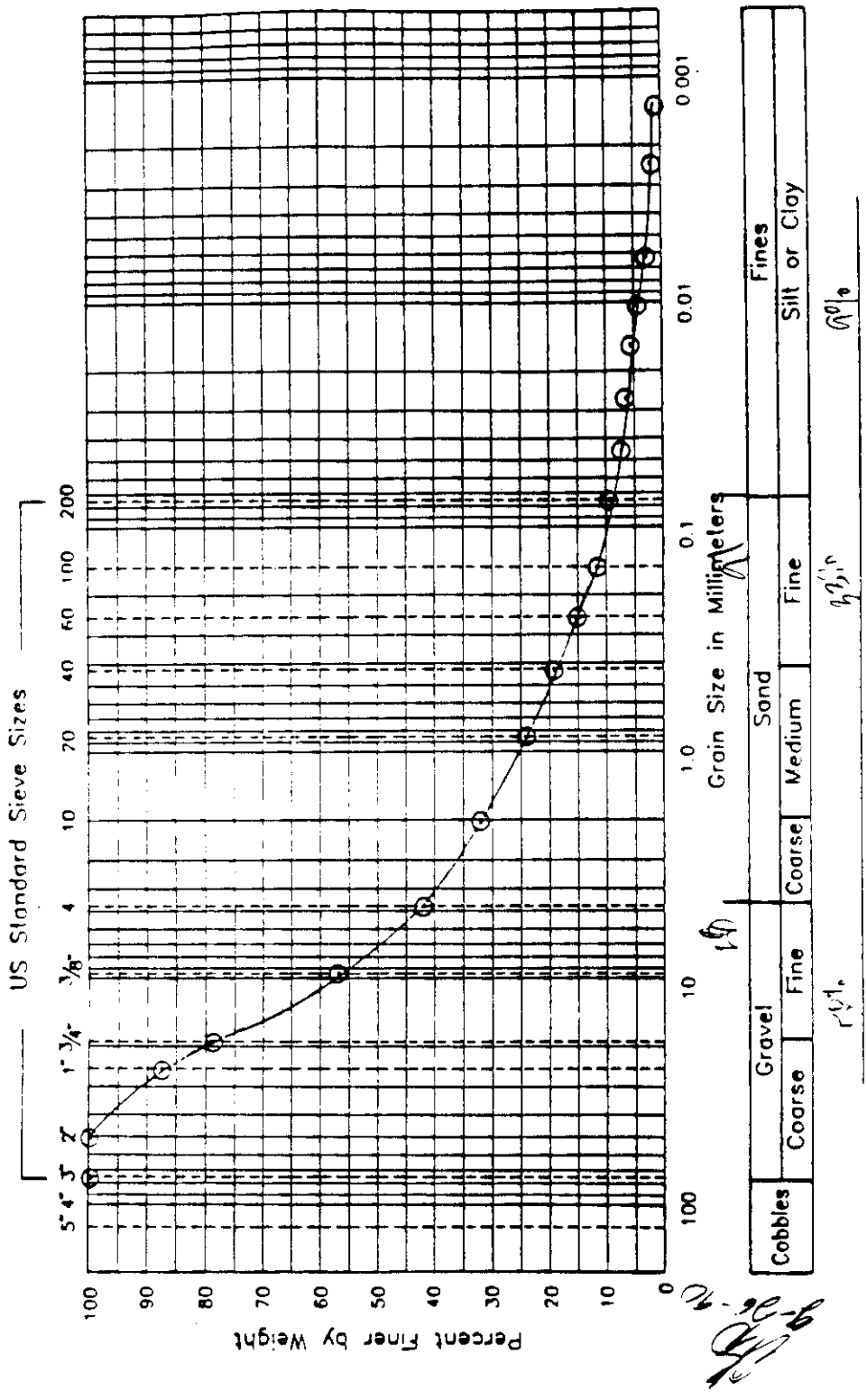
Project: W[illegible] EM-1/WA
Project No. [illegible] Date: 2-9-96 Tested By: DPE/[illegible] Approved By: [illegible]

Golder Associates



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	11%		12%			1%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A2003		3.51				YELLOWISH GREY (5Y 7/2), c-f GRAVEL and c-f SAND, some silt. (GP)



Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A2006		2.18				Medium light gray (GW) coarse to fine GRAVEL and coarse to fine SAND, little Silt ~~(GW-GM)~~ (GW-GM)

GRAIN SIZE DISTRIBUTION

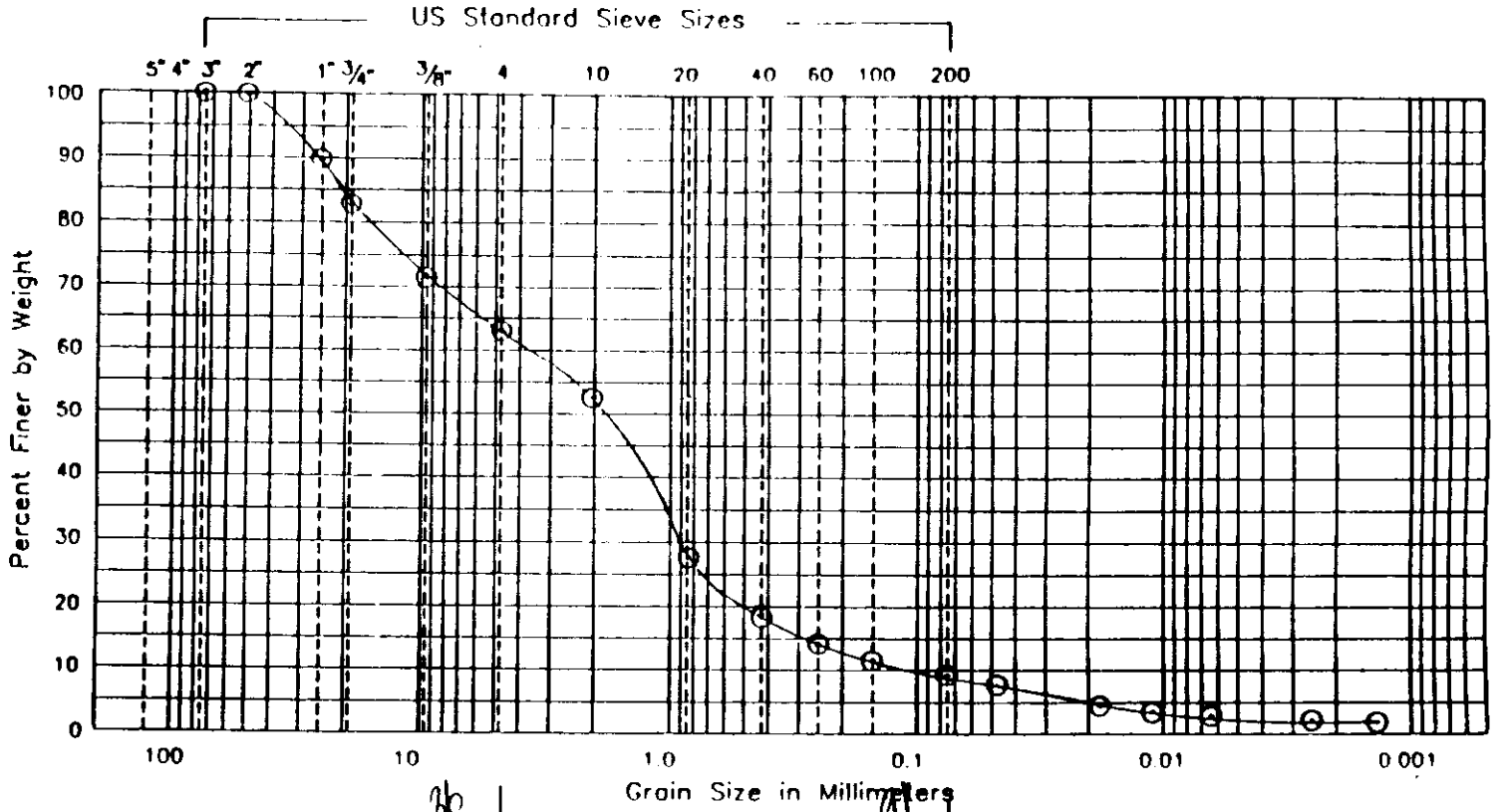
Project WHC / HWL - EPI-1 / WA
Project No. 893-1754.06 Date 7-9-90 Tested By DPC / RJM Approved By KLD

Golder Associates

GRAIN SIZE DISTRIBUTION

Project: [illegible]
Project No. [illegible]
Date: [illegible]
Tested By: [illegible]
Reviewed By: [illegible]

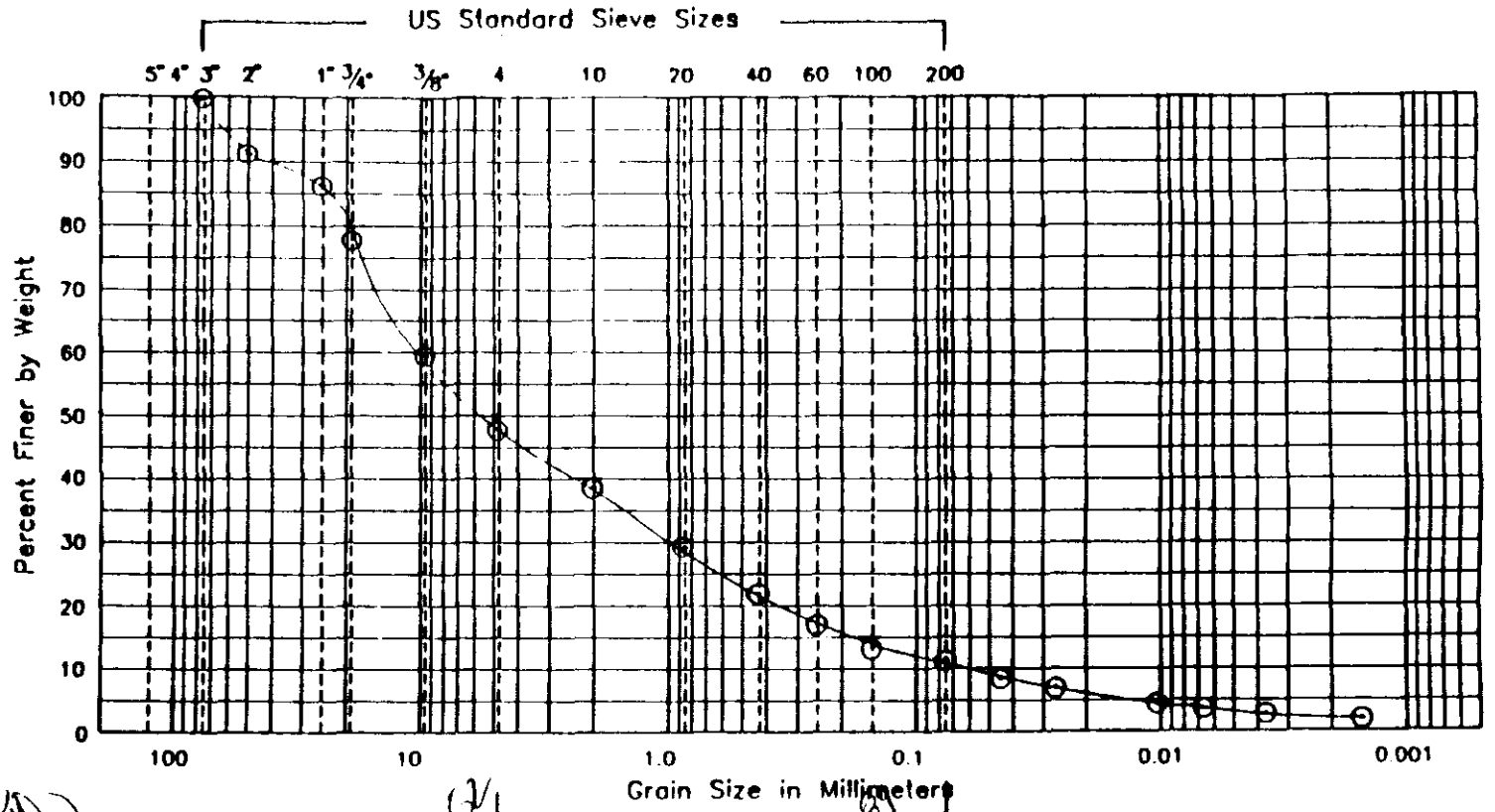
Golder Associates



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	[illegible]				[illegible]	[illegible]

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A2008		2.64				Medium gray (SNS) ~~coarse to medium~~ ~~medium to fine~~ SAND and ~~fine to coarse~~ GRAVEL, little Silt ~~trace fines~~ coarse to fine (SW-SM)

2-26-90



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	62%			37%		1%

Boring No.	Elev. or Depth	W_n	W_L	W_p	I_p	Description
A2011		2.4				Med. lt grey, (GNG) c-f GRAVEL and c-f SAND, little silt. (GP-GM)

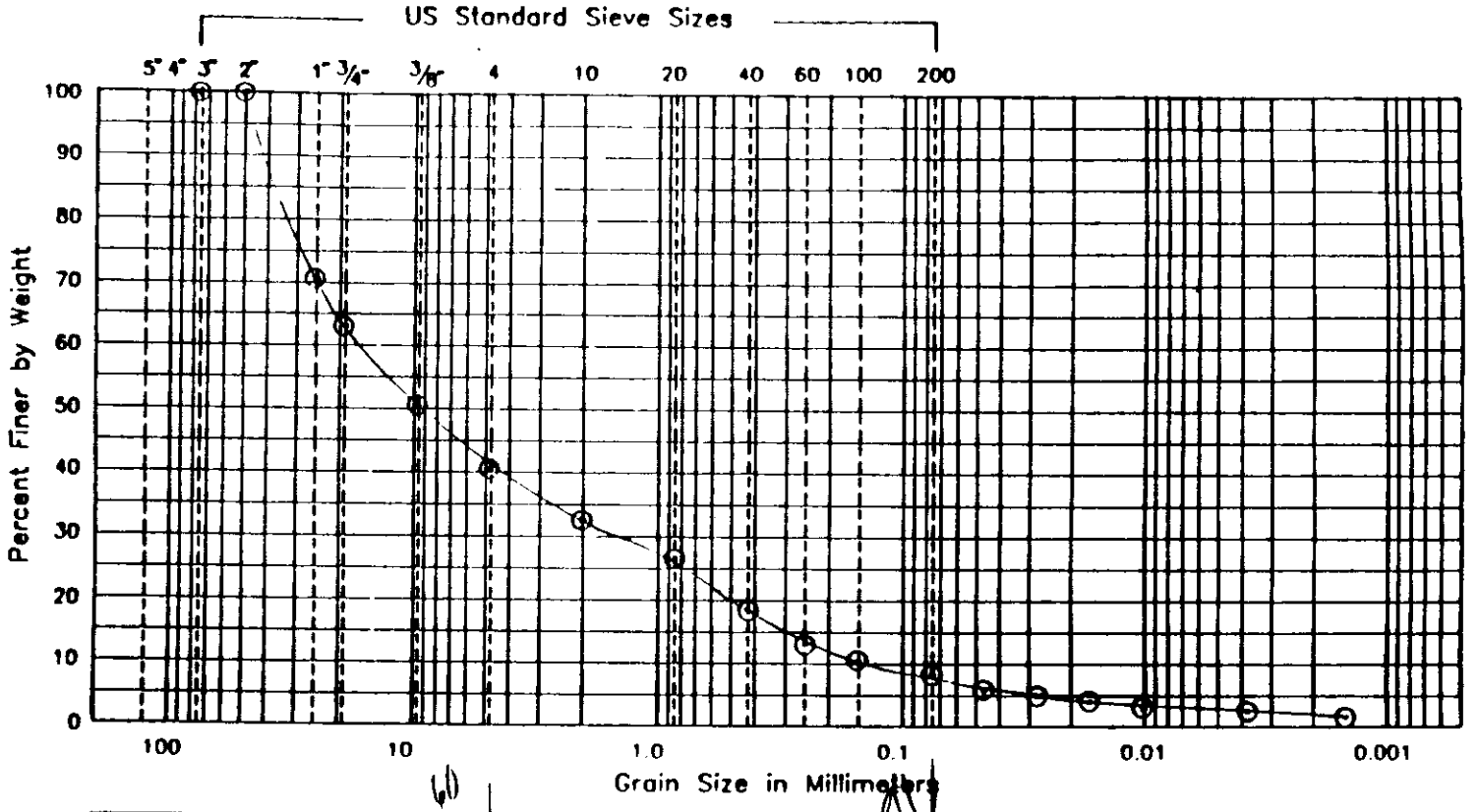
GRAIN SIZE DISTRIBUTION

Project WNC/1100-EM-1/WA
Project No. 893-1254.000 Date 1-91 Tested By DPL/TSR Reviewed By KLS

Golder Associates

GRAIN SIZE DISTRIBUTION

Project: WRC/1100-EM-1/WA
Project No. 893-1354.000 Date: [illegible] Tested By: DRJ/GJD Approved By: [illegible]
2-1-90



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	61%				31%	6%

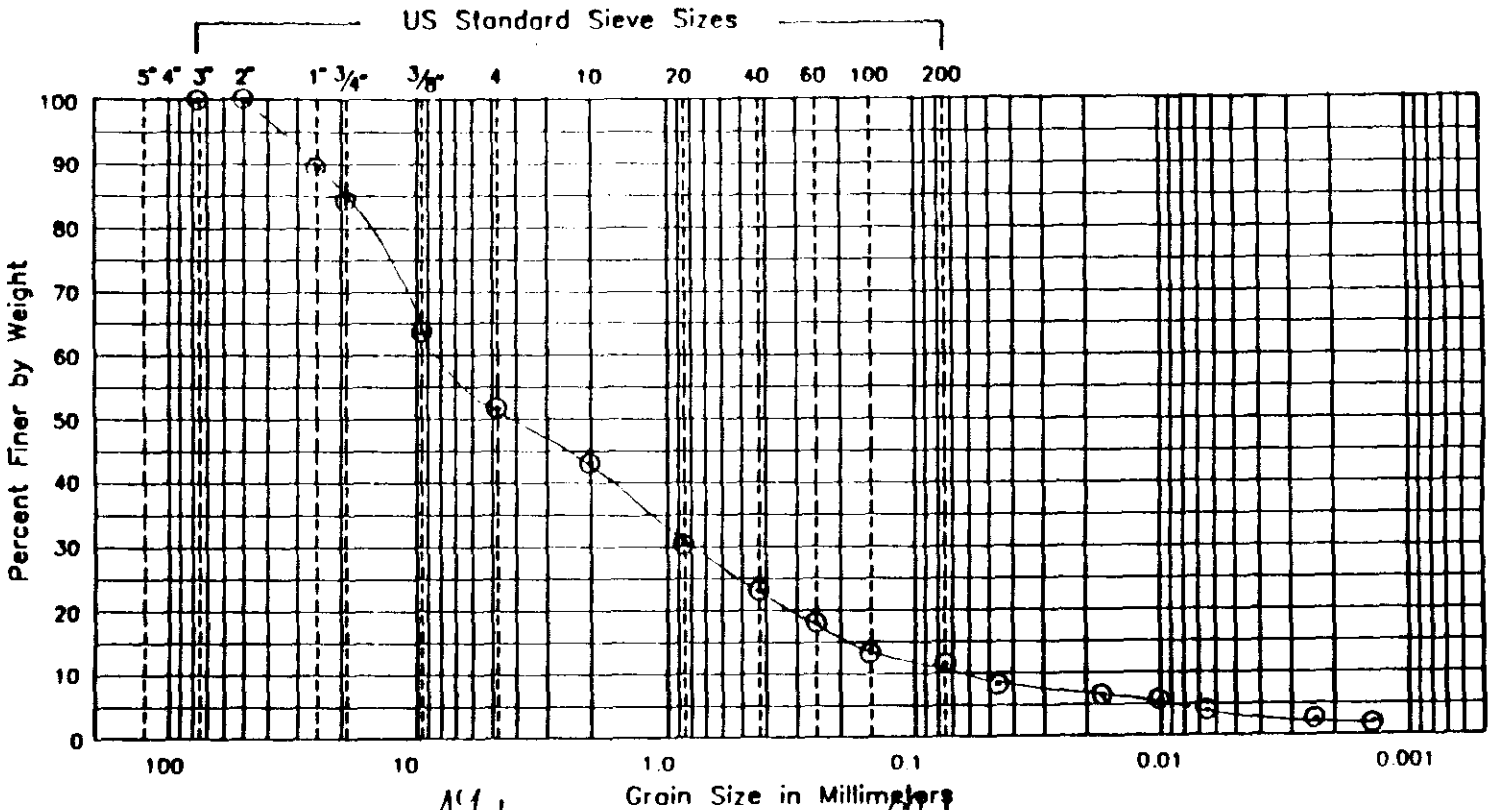
2-26-90

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A 2013		2.71				Medium gray (5N5), coarse to fine GRAVEL and coarse to fine SAND, ~~(GP and SP)~~ (GP-GM) little silt

Golder Associates

GRAIN SIZE DISTRIBUTION

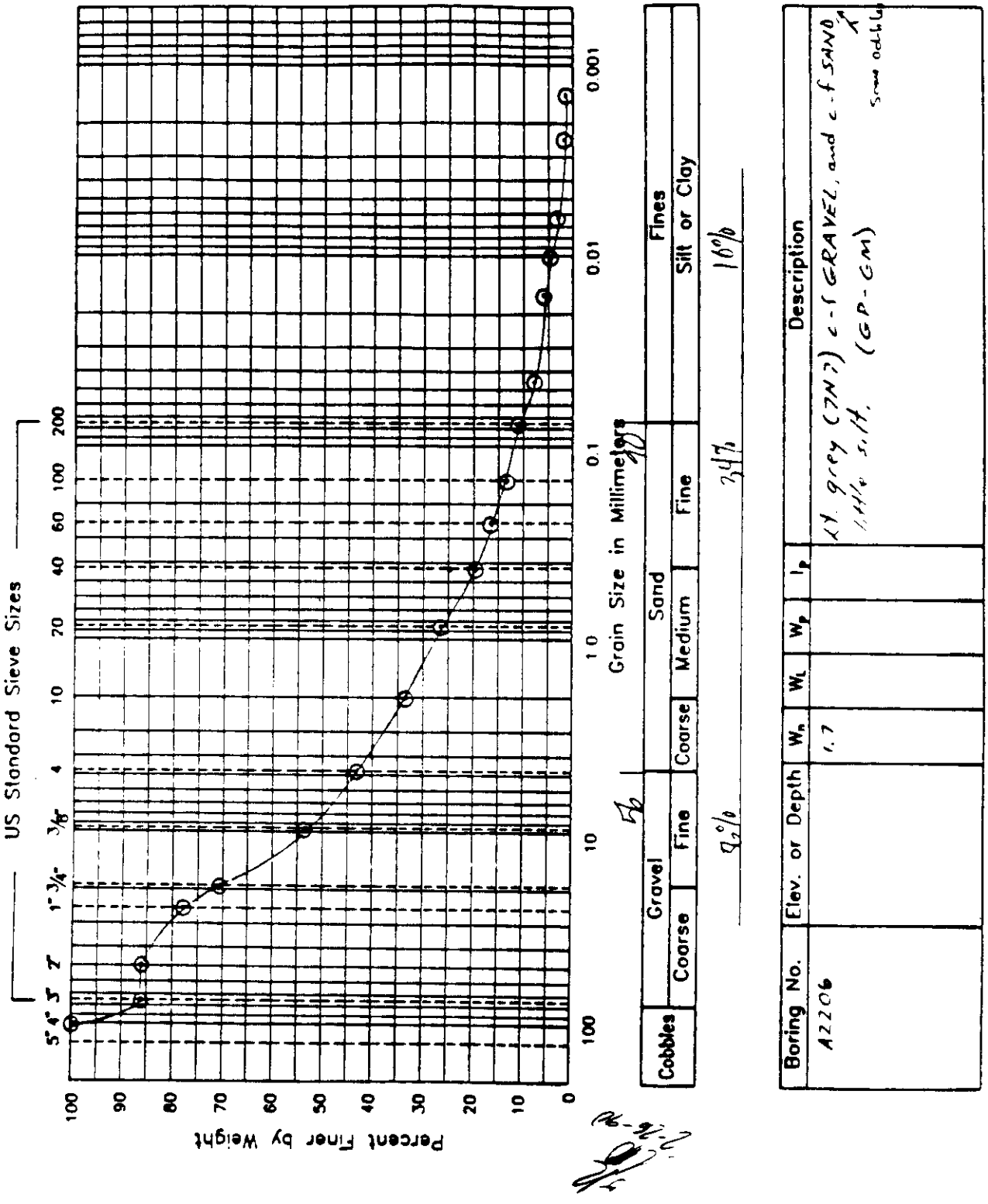
Project WNC/1100-EM-1/WA
Project No. 893-1354.000 Date 7-7-90 Tested By DPO/TK Reviewed By [illegible]



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	19%			70%		11%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A22 03		102				Light olive gray (5Y 5/2), coarse to fine GRAVEL and coarse to fine SAND, little Silt ~~(unclass SW)~~ (GW-GM)

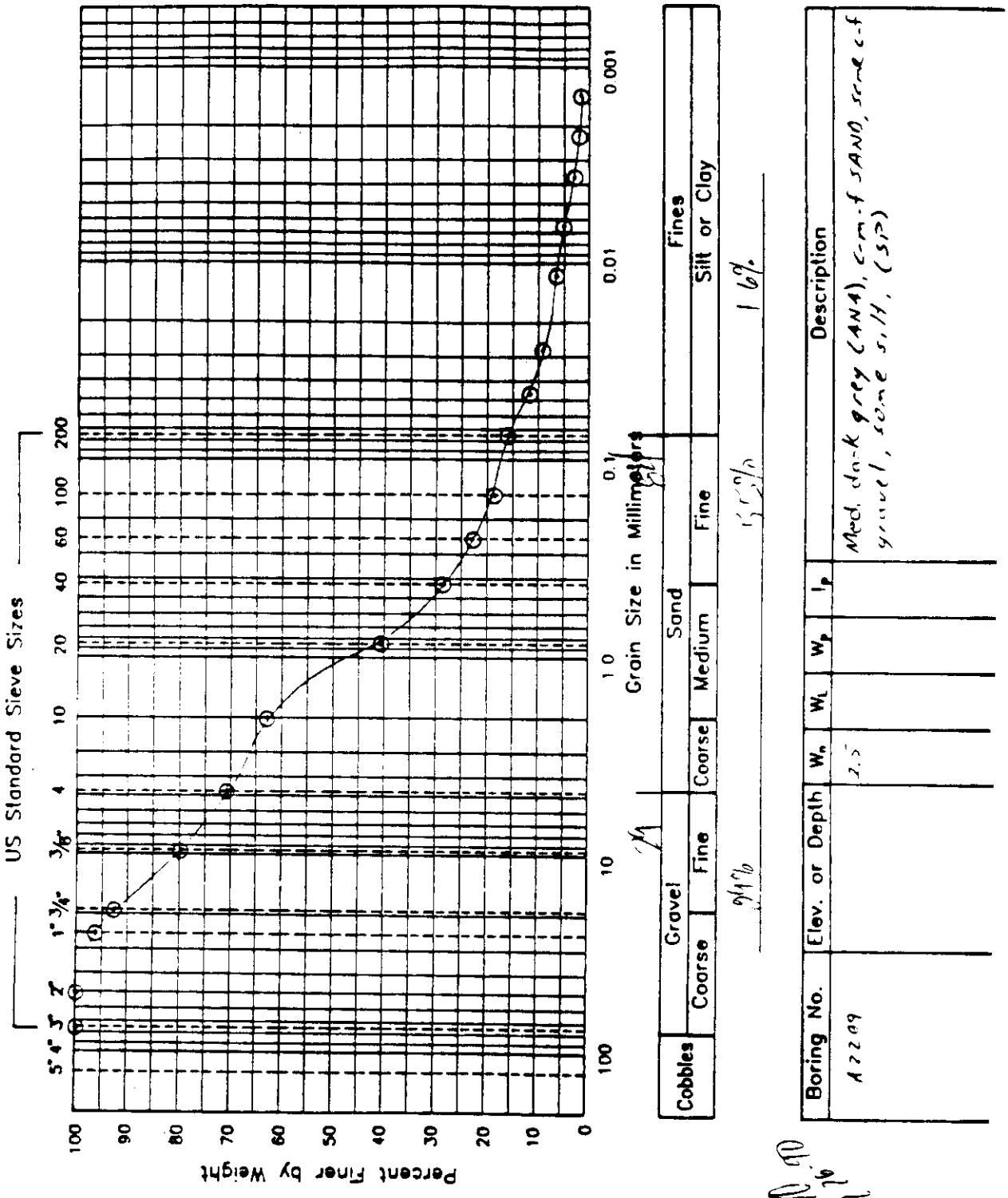
Golder Associates



GRAIN SIZE DISTRIBUTION

Project WAC/1100-EM-1/WA
Project No. 893-1754.000 Date 7-19-96 Tested By DPW/TR Approved By KHB

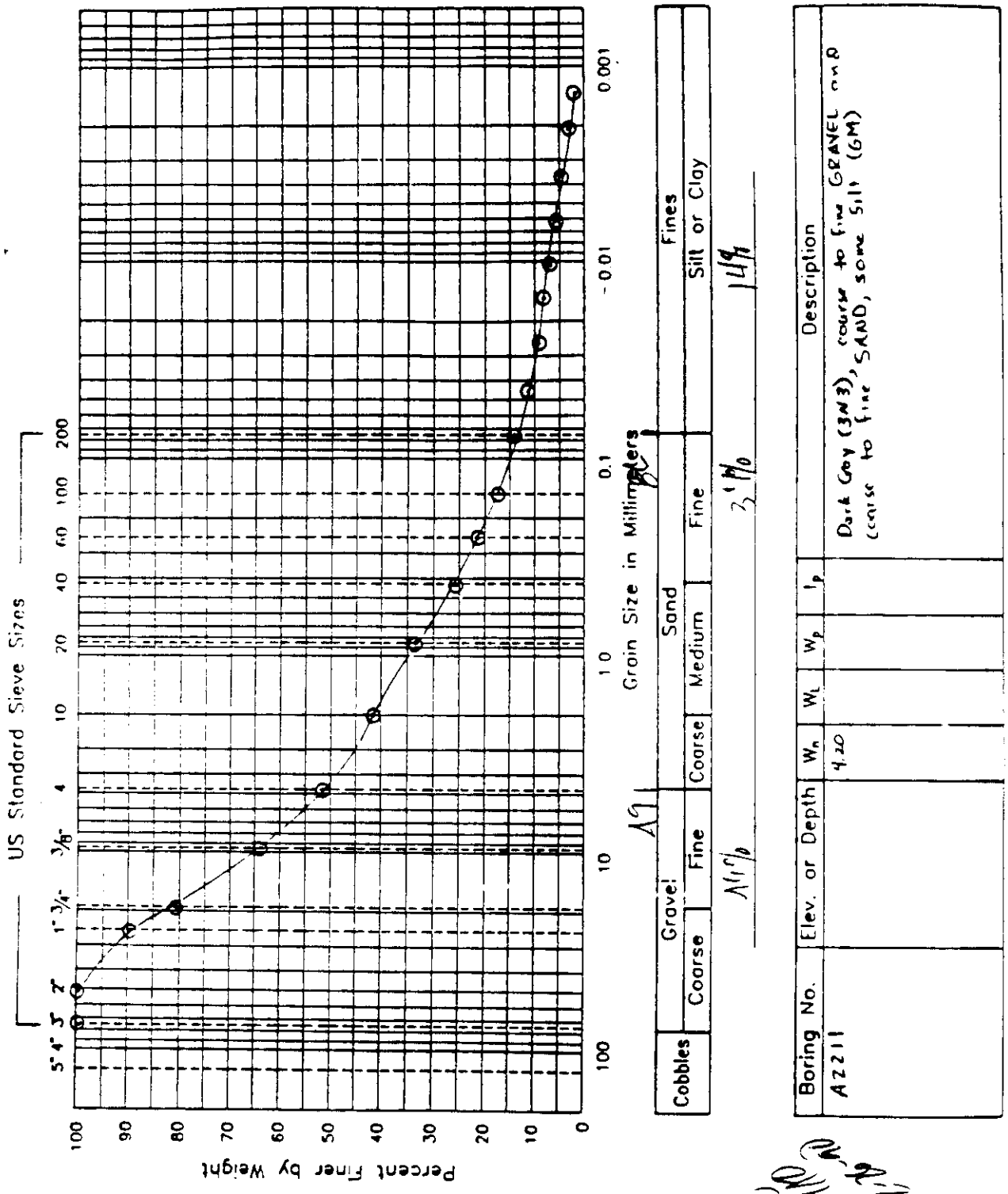
Golder Associates



GRAIN SIZE DISTRIBUTION

Project WMC / 1100-EM-1 / WA
Project No. 893-1754.000 Date: 2-9-91 Tested By DPU/TWR Approved By KLH

Golder Associates



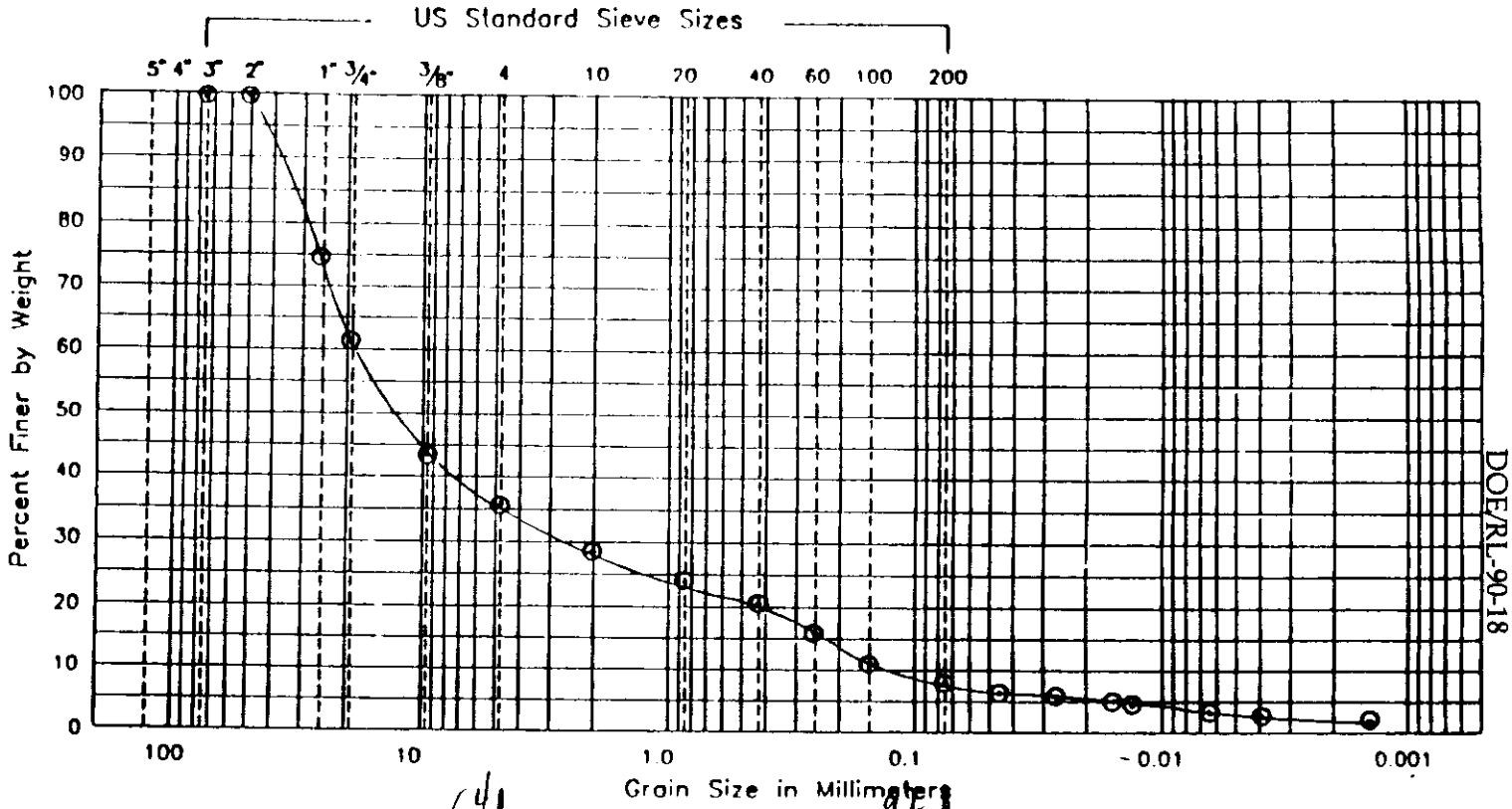
GRAIN SIZE DISTRIBUTION

Project WNL/UCC FM-1/WA
Project No. 903-1754.000 Date 3-9-90 Tested By D.P.U./RJB Approved By KHB

Golder Associates

GRAIN SIZE DISTRIBUTION

Project: [illegible]
Project No. [illegible]
Date: [illegible] Tested By: DTD/[illegible] Approved By: [illegible]



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	61%				28%	8%

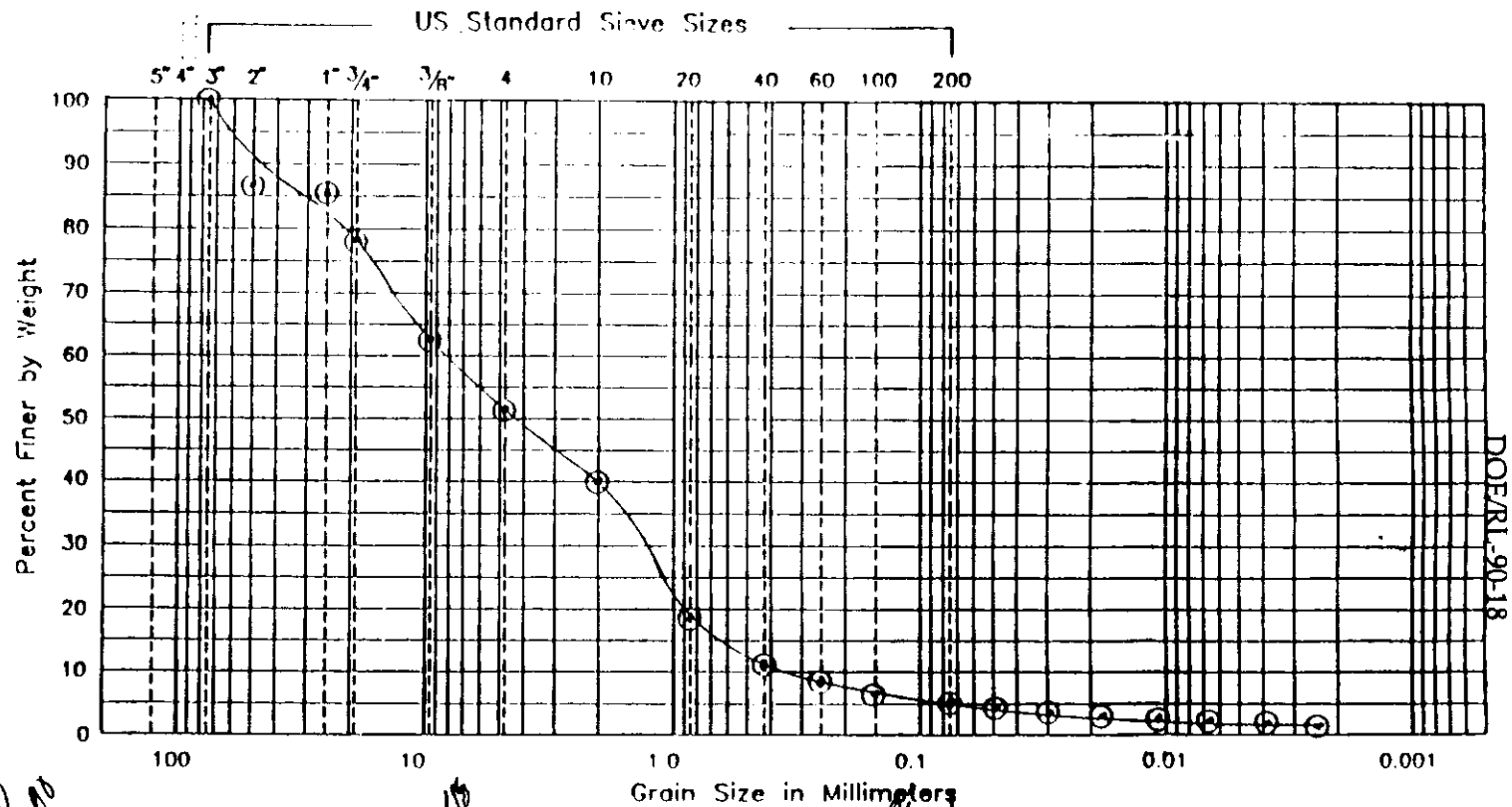
Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A2Z13		6.47				Olive gray (5Y 3/2), coarse to fine GRAVEL, some coarse to fine Sand, little Silt (GP-GM)

Golder Associates

GRAIN SIZE DISTRIBUTION

Project: [illegible]
Project No: [illegible] Date: [illegible] Tested By: DPC Approved By: [illegible]

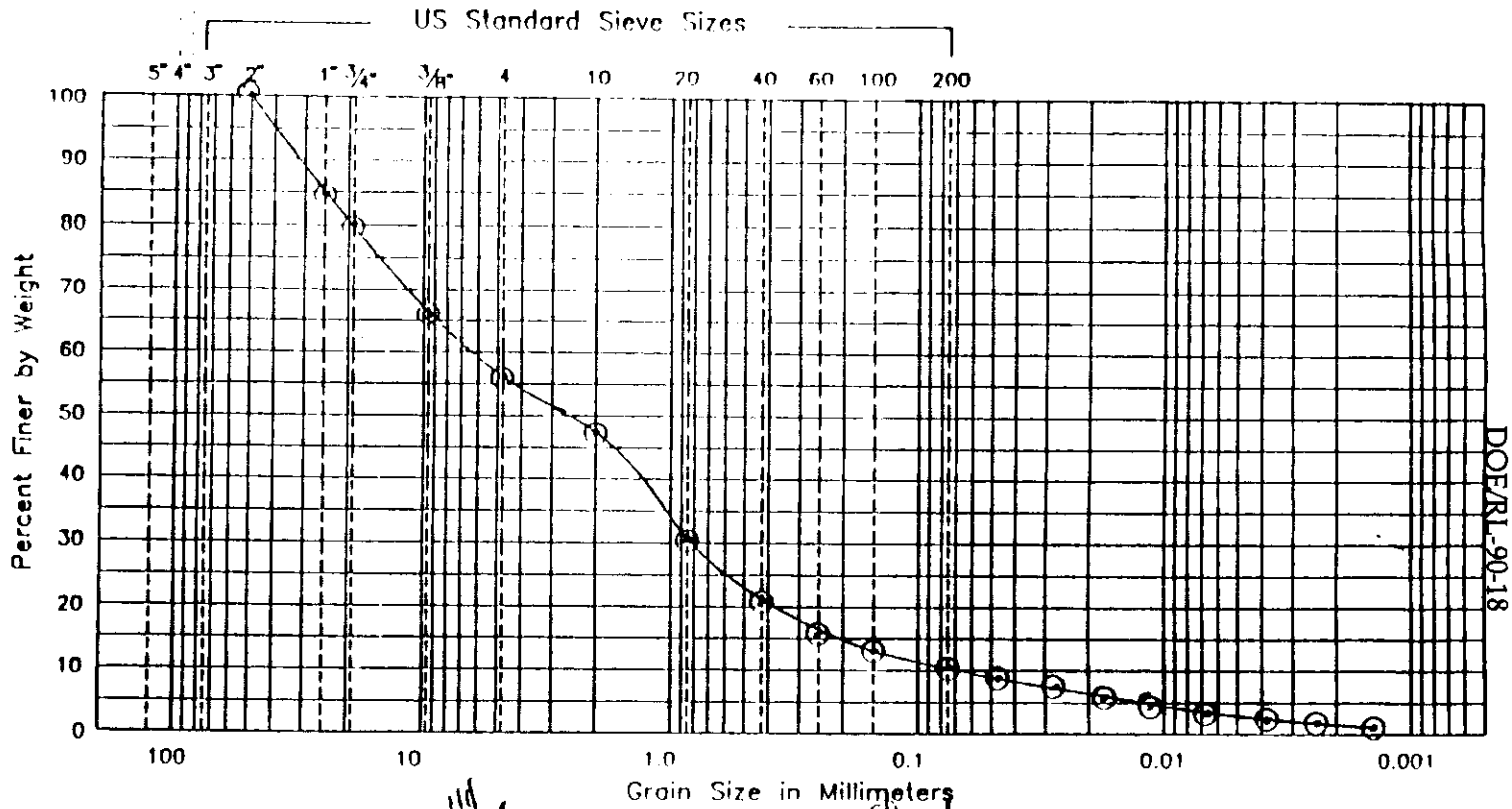
Golder Associates



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	11%				47%	5%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A 1503		2.7				Olive black, c-f GRAVEL and SAND, little silt, (GM-GP).

GRAIN SIZE DISTRIBUTION



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	11%			46%		10%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1505		2.9				Olive grey, c-F SAND and GRAVEL, little silt, (SM-SW).

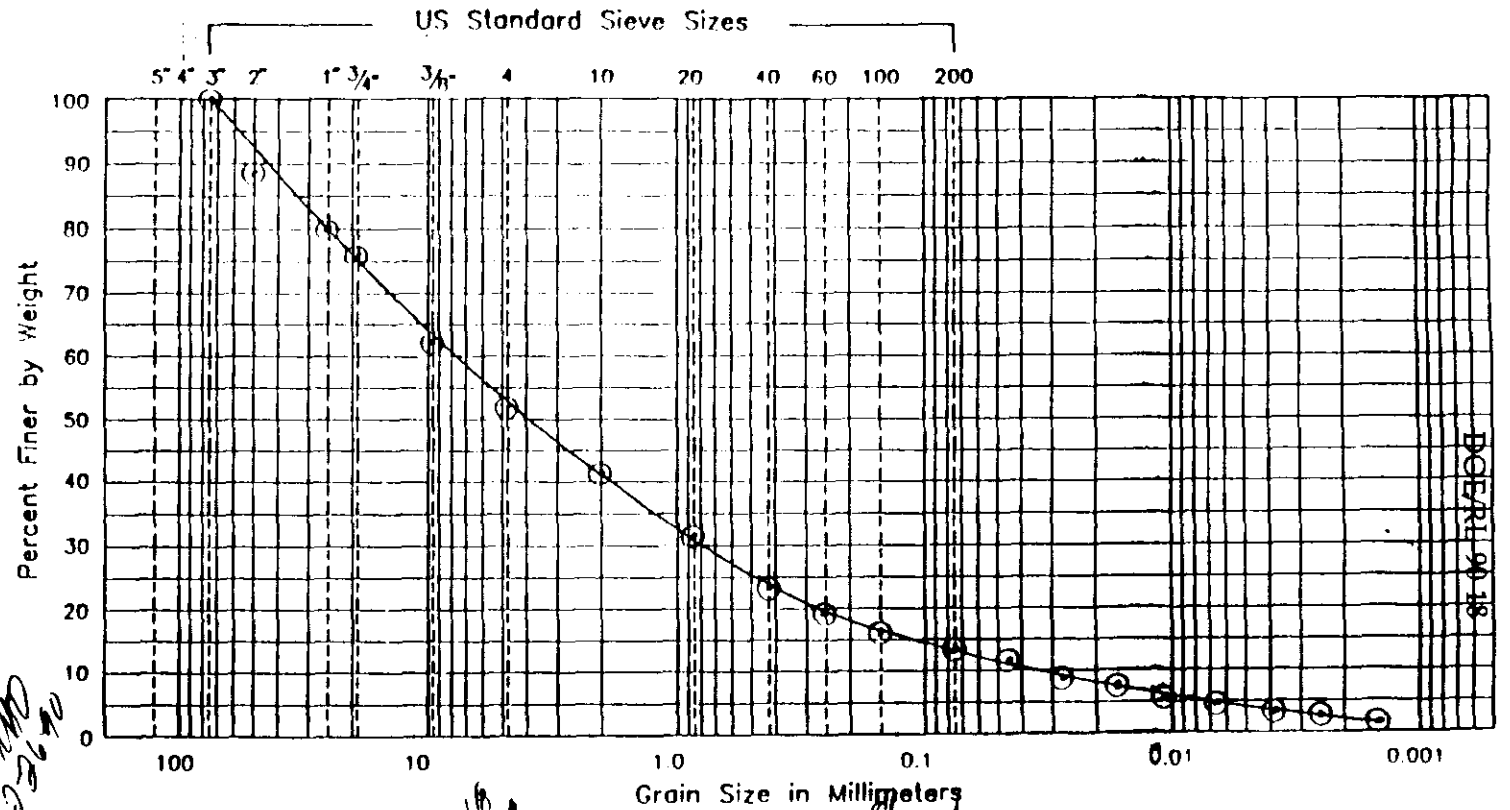
Project: [illegible] Date: [illegible] Tested By: [illegible] Approved By: [illegible]

Golder Associates

GRAIN SIZE DISTRIBUTION

Project: [illegible] Project No. [illegible] Date 1-17-96 Tested By DRC Approved By [illegible]

Golder Associates



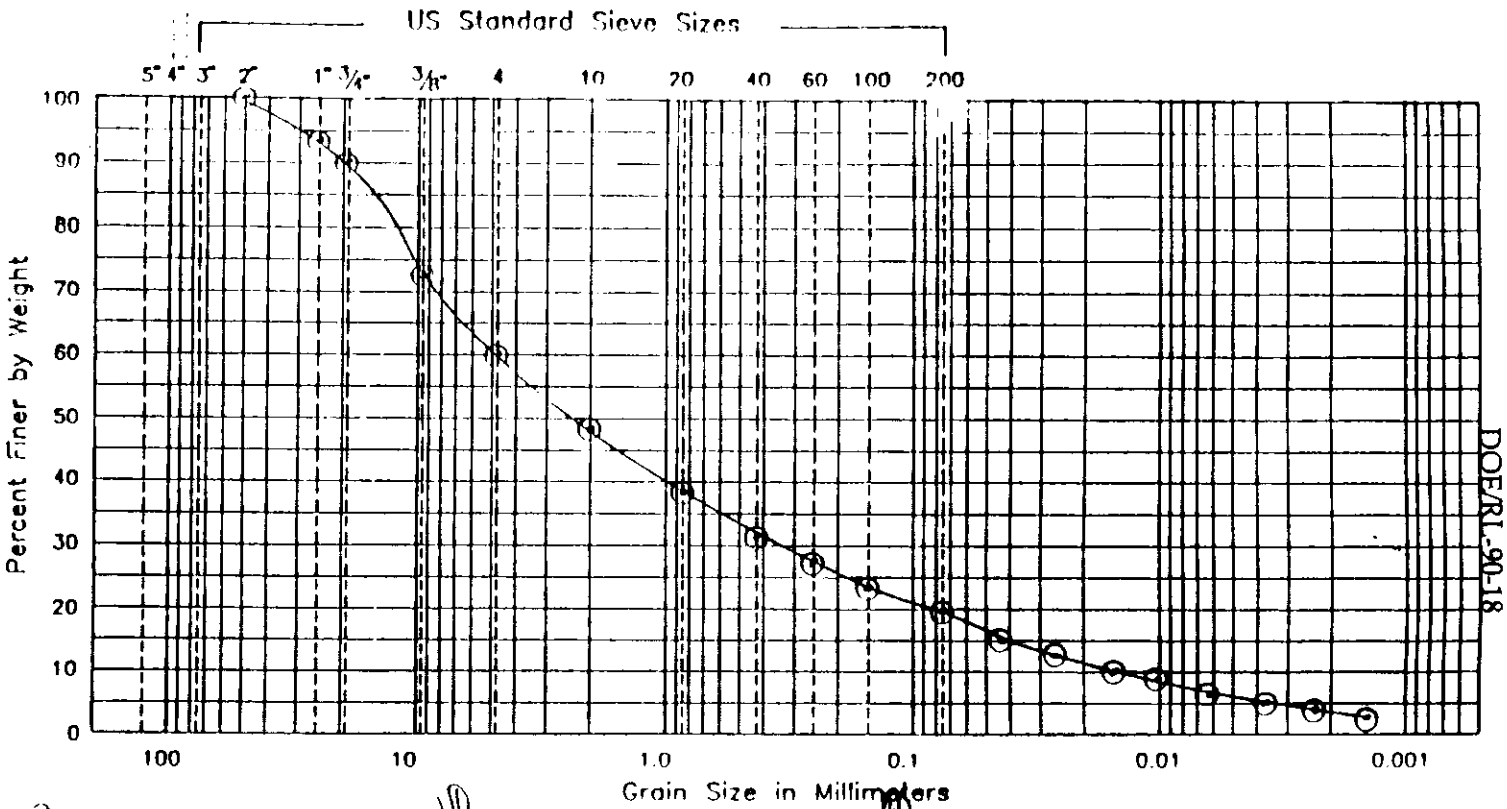
Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	11%				38%	51%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1508		3.1				Olive grey, c-f GRAVEL and Sand, some silt, (am).

DOE/RL-90-18

GRAIN SIZE DISTRIBUTION

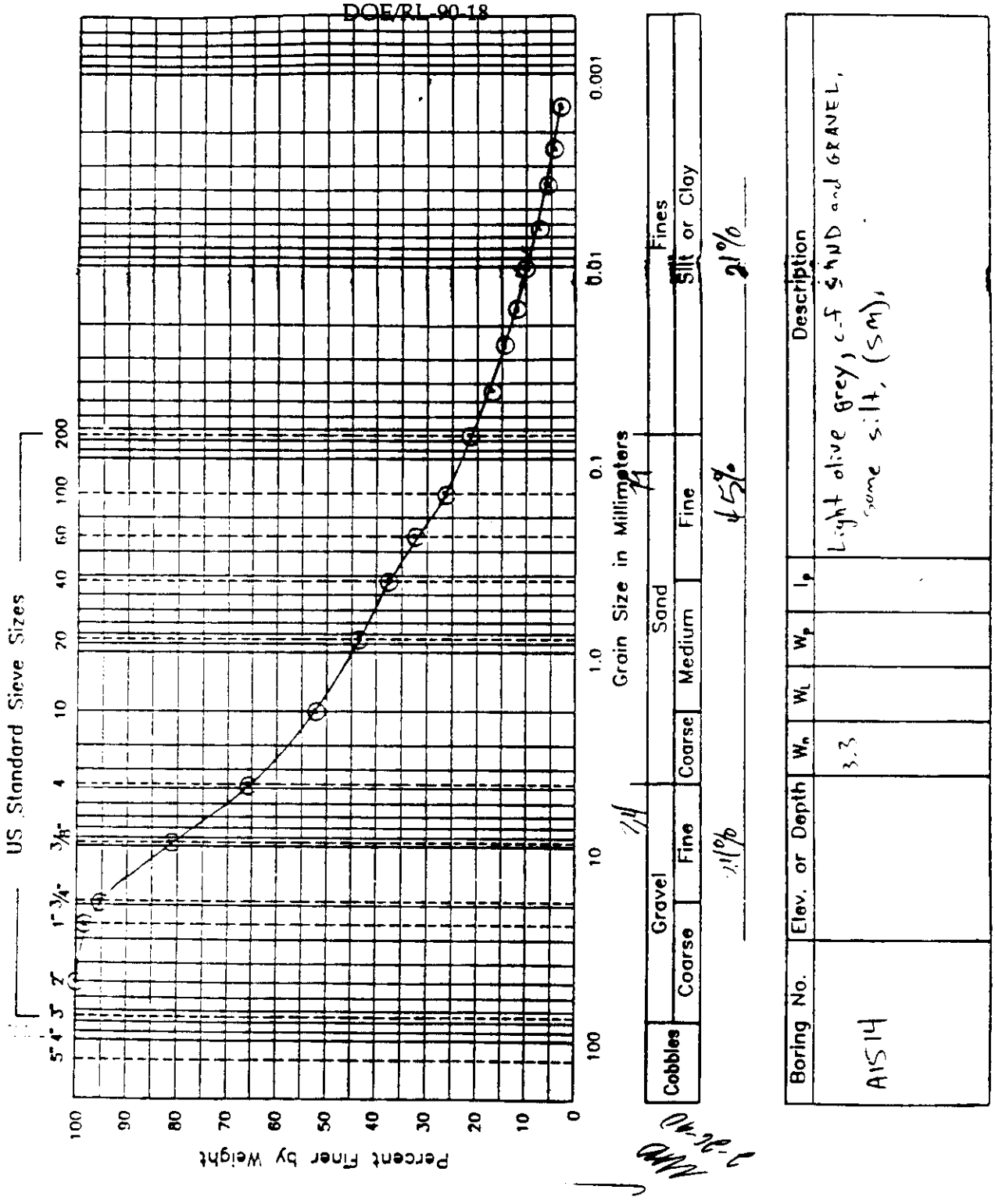
Project: [illegible]
Project No.: [illegible]
Date: [illegible] Tested By: DPC Approved By: [illegible]



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	41%				1/10%	2%

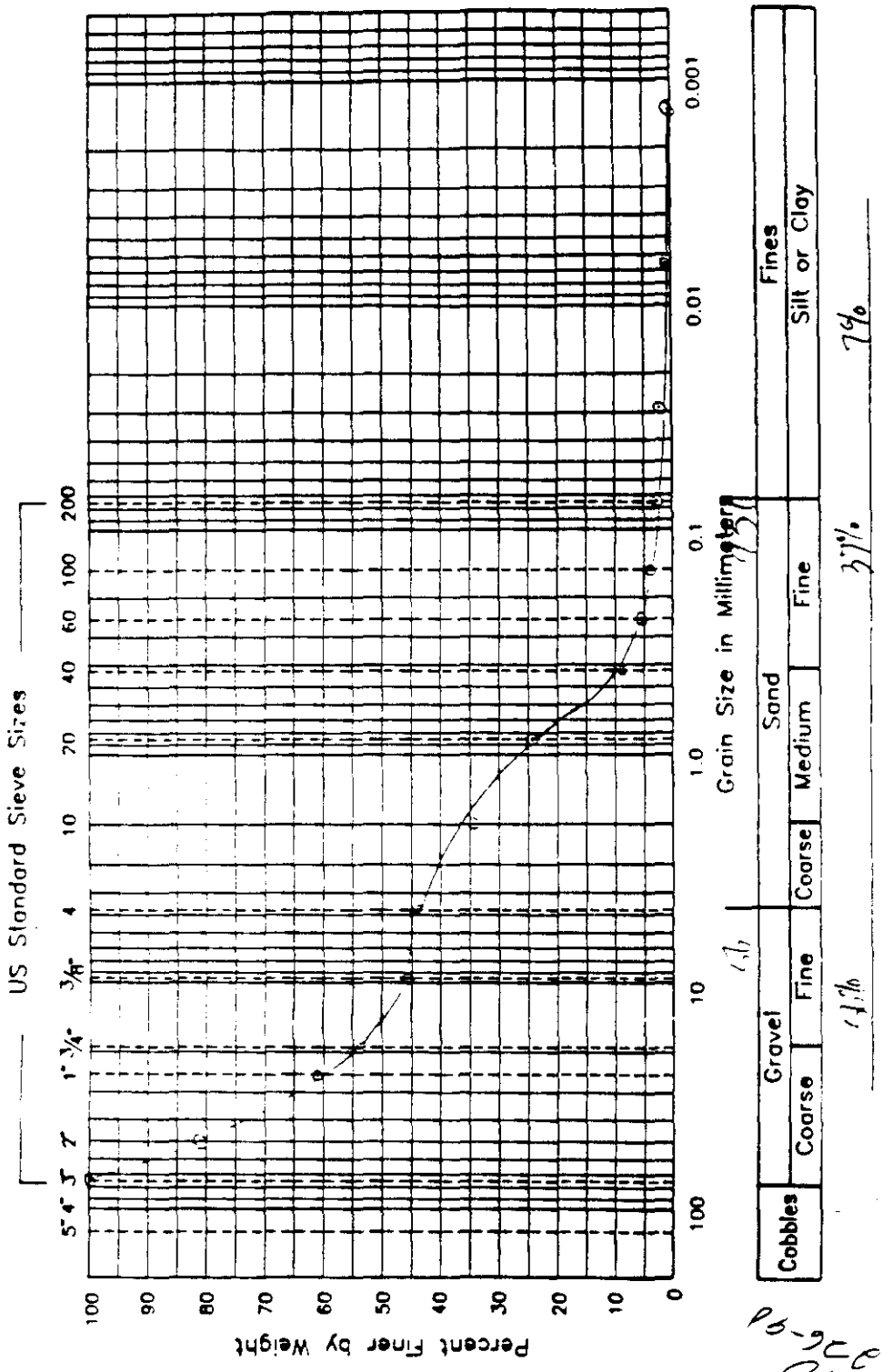
Boring No.	Elev. or Depth	W_n	W_L	W_p	I_p	Description
A1511		3.2				Moderate olive grey, c-f SAND and GRAVEL, some silt, (SM).

Golder Associates



GRAIN SIZE DISTRIBUTION

Project: [illegible] Date: 1-17-92 Tested By: DPO Approved By: [illegible] Golder Associates



GRAIN SIZE DISTRIBUTION

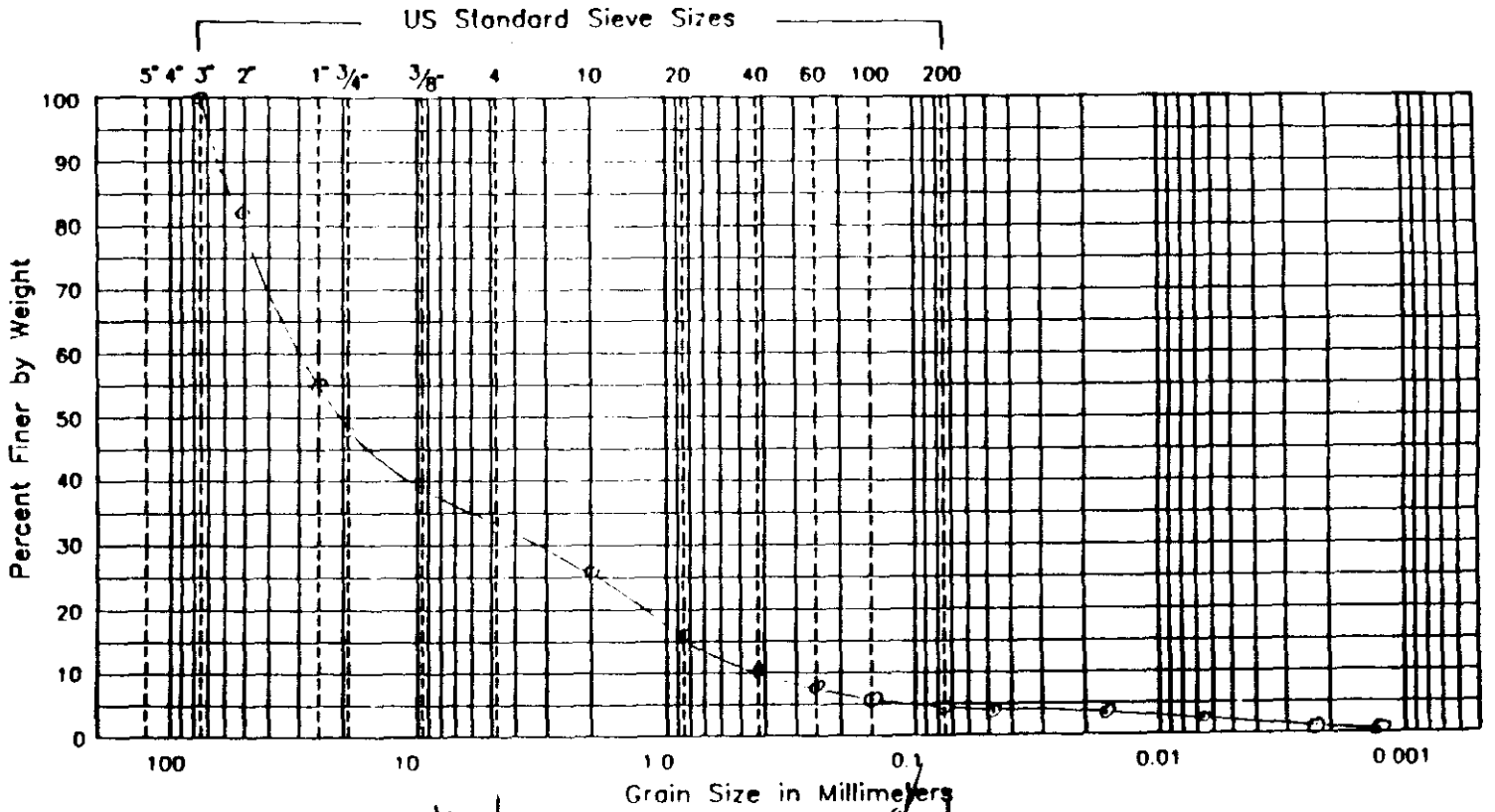
Project
Project No. Date Tested By Approved By

Golder Associates

GRAIN SIZE DISTRIBUTION

Project: [illegible]
Project No. [illegible]
Date: [illegible] Reviewed By: [illegible] Approved By: [illegible]

Golder Associates



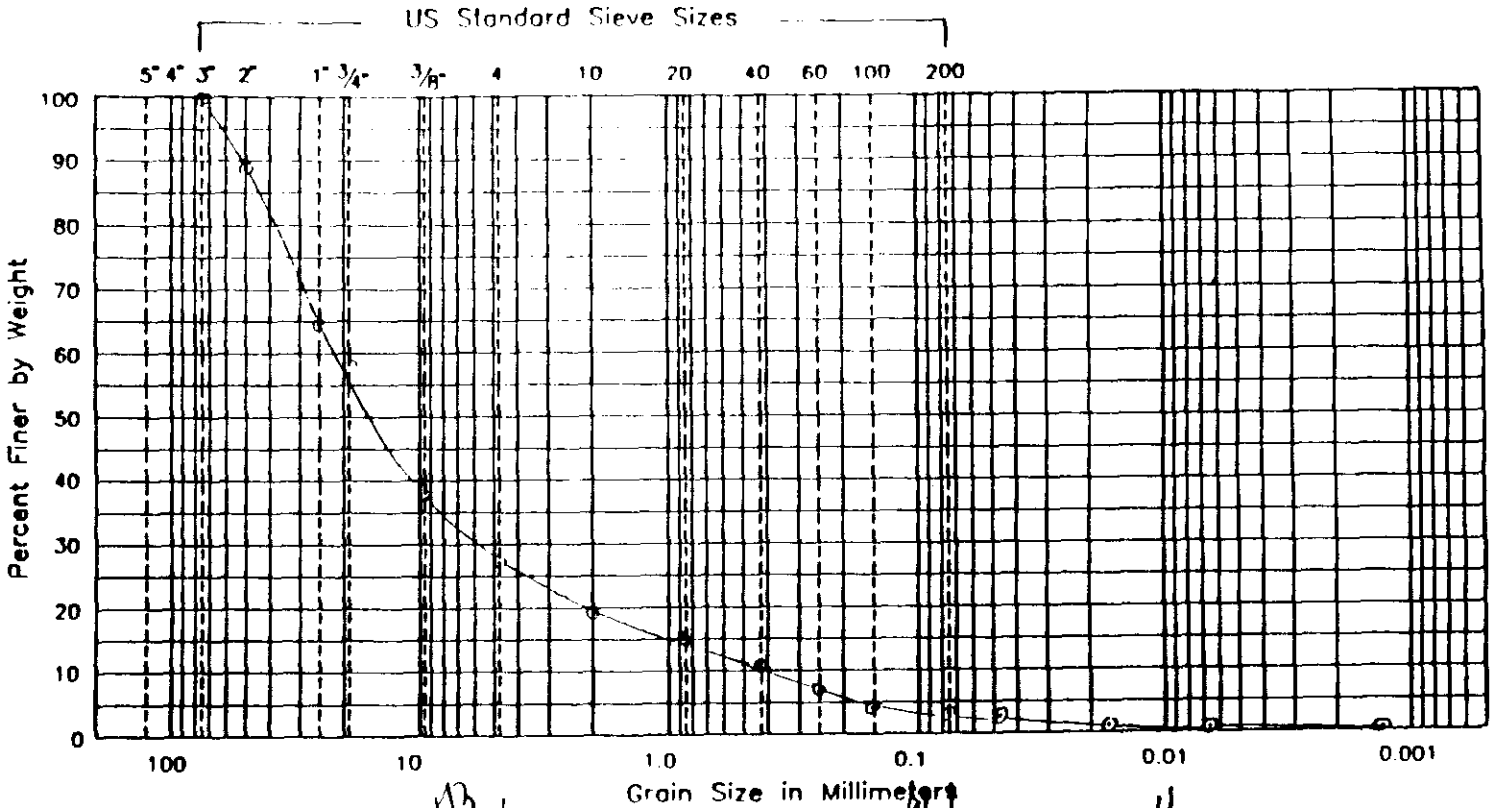
Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	16%				27%	57%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A 1606		2.1				Olive grey, c-m-f sandy, c-f GRAVEL, tr. silt. (GW)

GRAIN SIZE DISTRIBUTION

Project: [illegible]
Project No. [illegible] Date [illegible] Tested By [illegible] Approved By [illegible]

Golder Associates



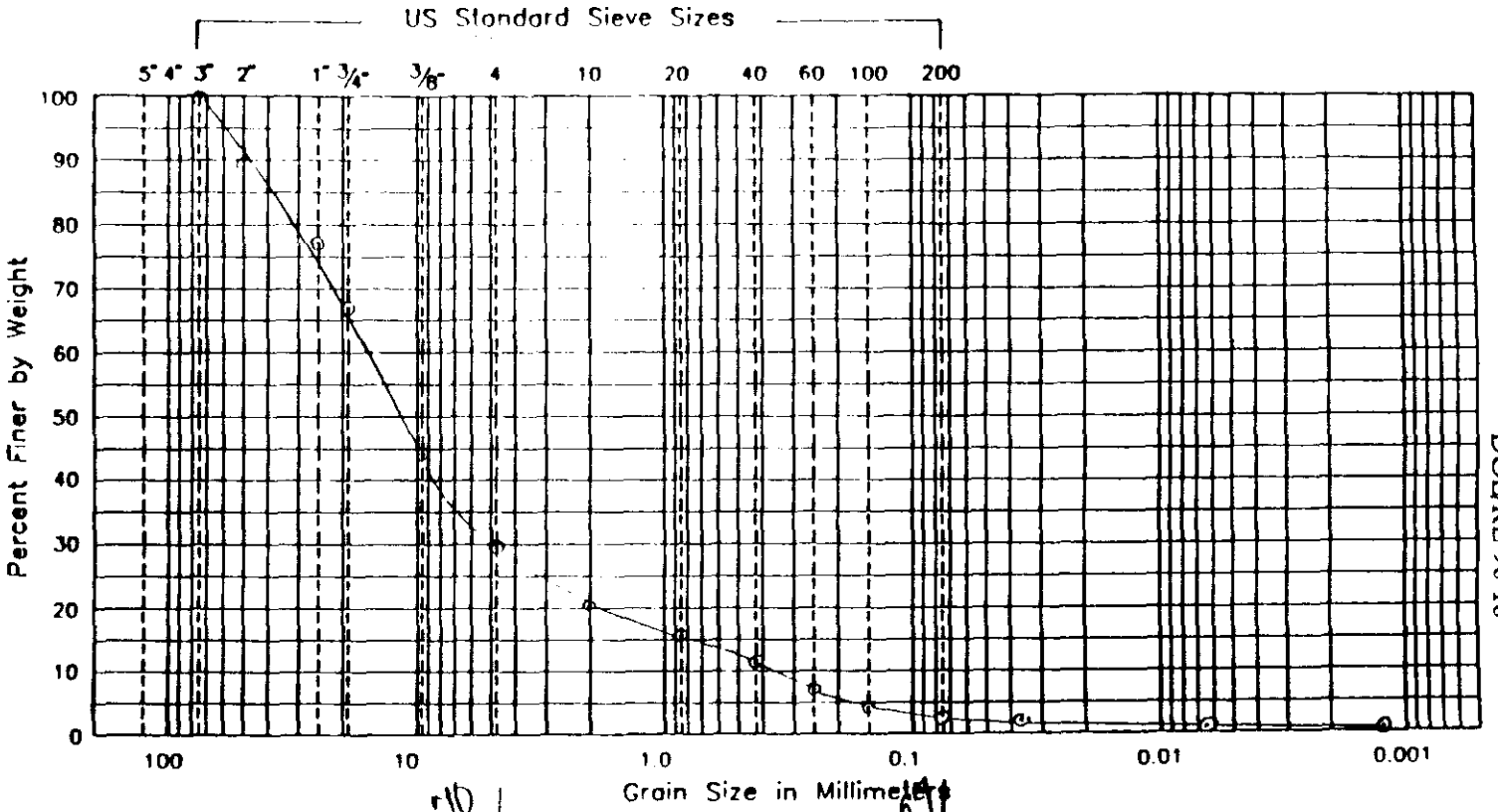
Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	17%				83%	1%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1609		30				Dark olive grey, c.f sandy, c.f GRAVEL, tr. silt (GP)

GRAIN SIZE DISTRIBUTION

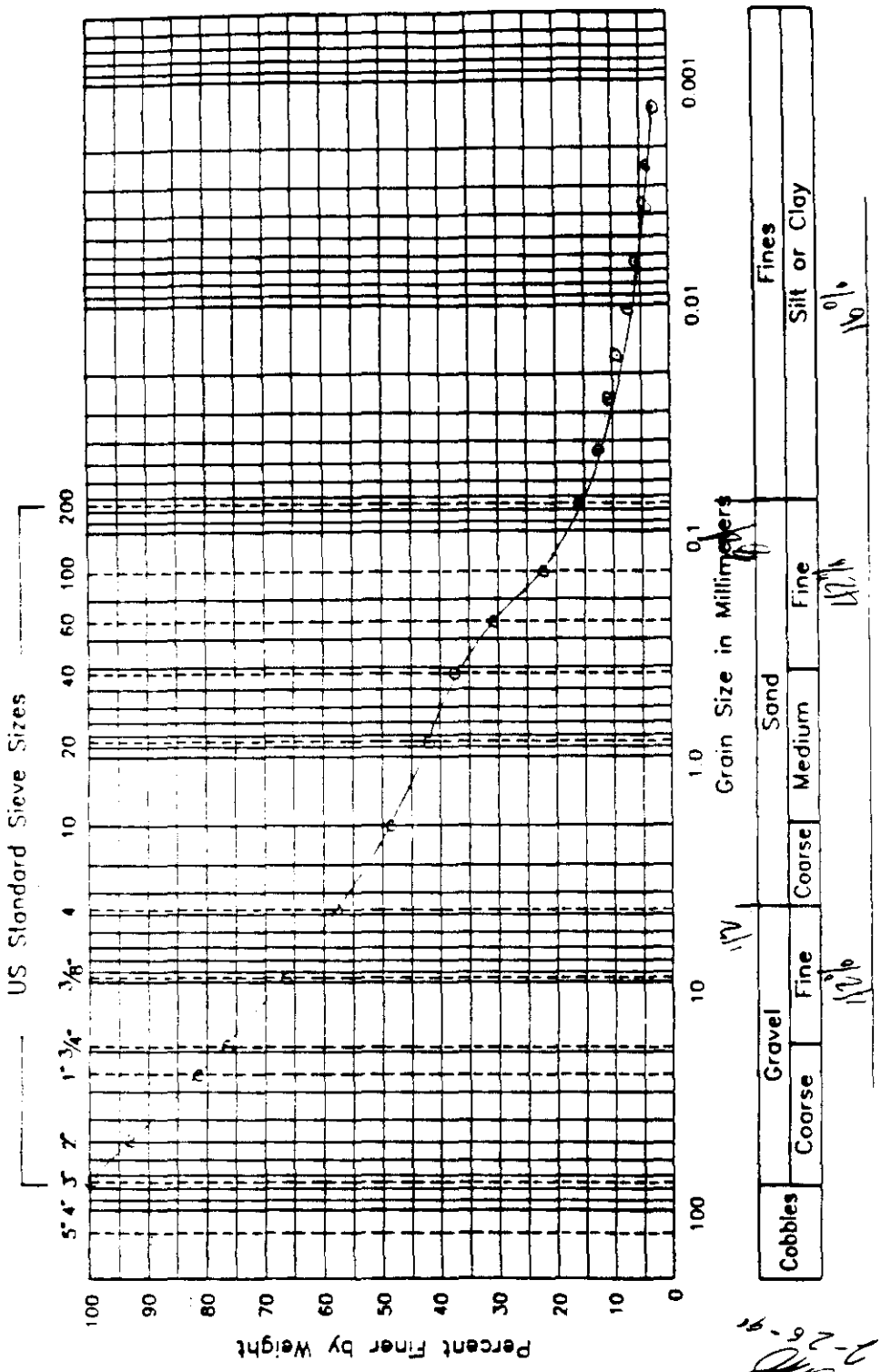
Project: [illegible]
Project No. [illegible]
Date [illegible] Tested By DPC Approved By [illegible]

Golder Associates



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	11%			27%		3%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A 1610		7.1				olive grey, c-m-f sandy, c-f GRAVEL, tr silt. (GP)



GRAIN SIZE DISTRIBUTION

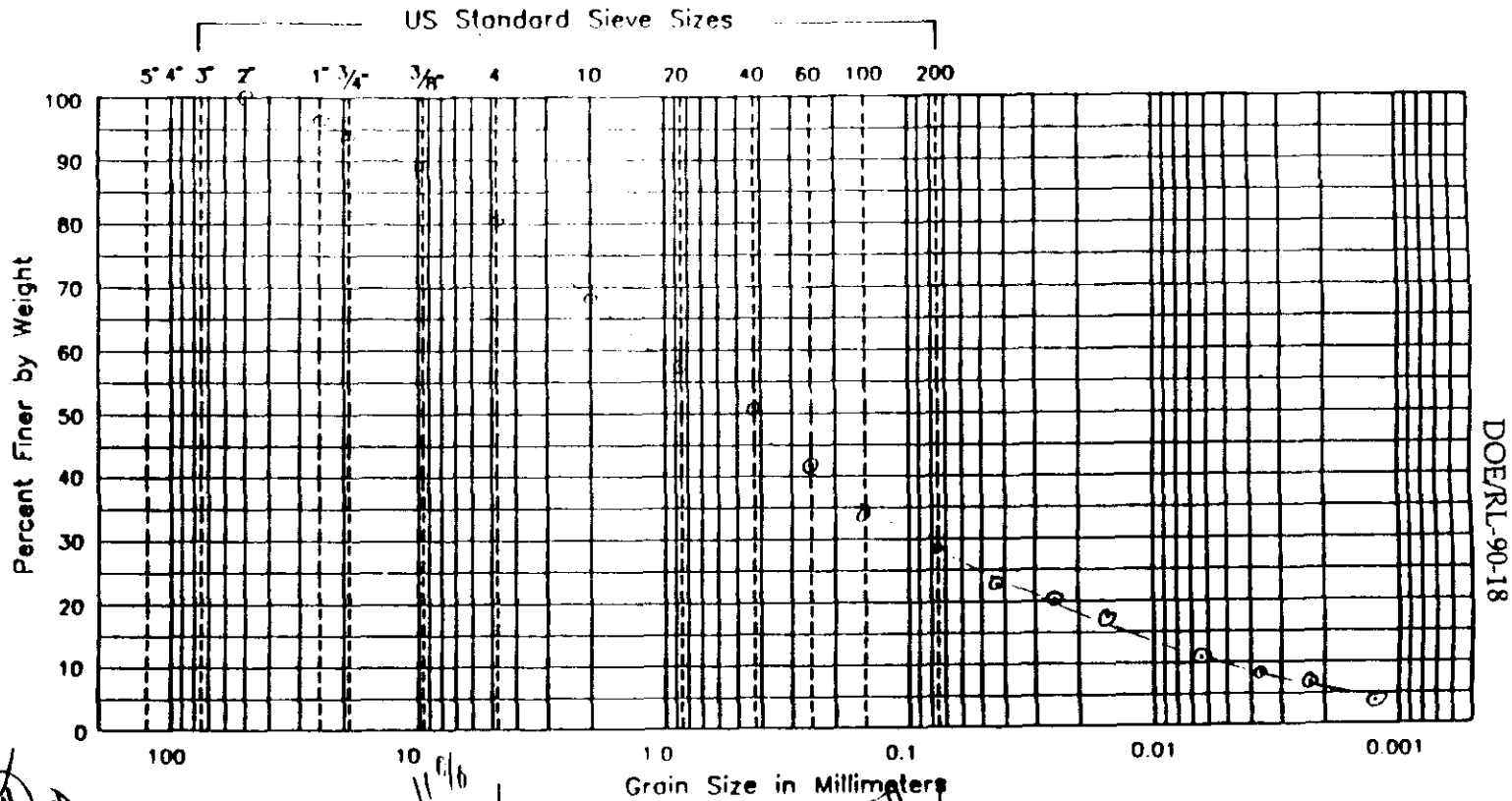
Project: [illegible]
Project No: [illegible] Date: [illegible] Tested By: [illegible] Approved By: [illegible]

Golder Associates

GRAIN SIZE DISTRIBUTION

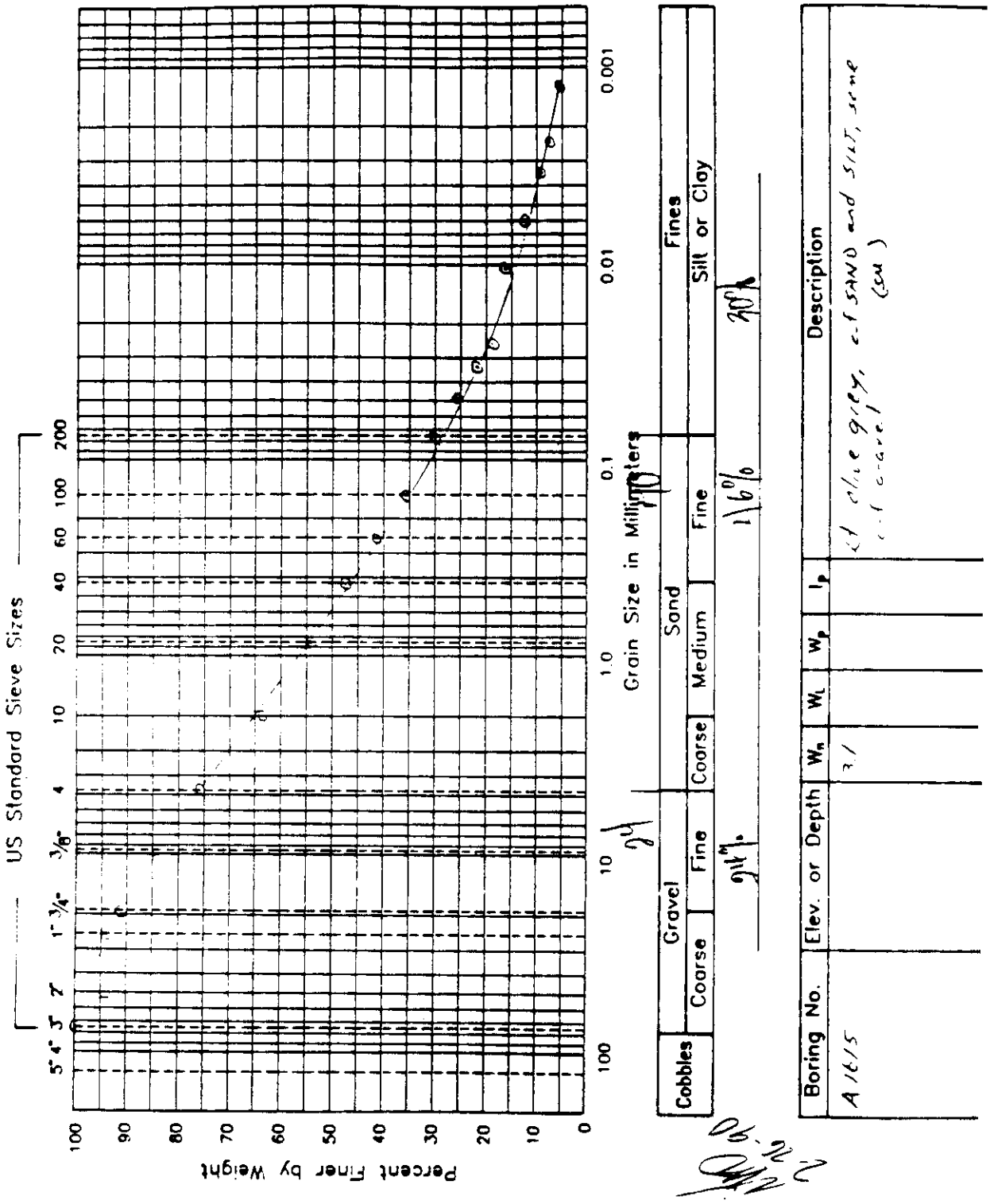
Project: [illegible]
Project No. [illegible] Date [illegible] Logged By [illegible] Approved By [illegible]

Golder Associates



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	11 %				10 %	29 %

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1614		1.9				Yellowish grey, silty, c-f SAND some c-f gravel (SM)



GRAIN SIZE DISTRIBUTION

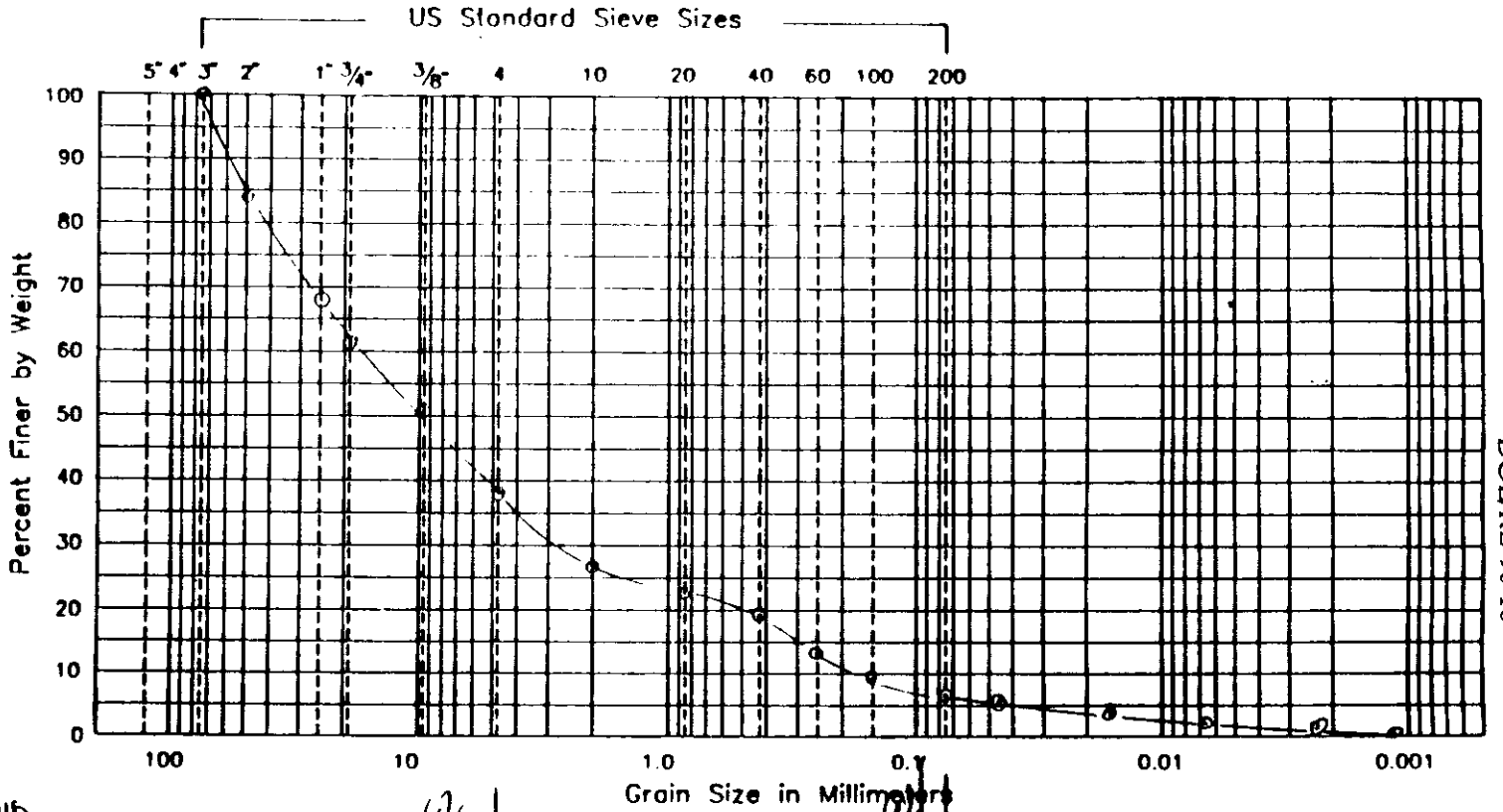
Project: [illegible]
Project No. [illegible] Date 1-23-89 Reviewed By DPC Approved By KKB

Golder Associates

GRAIN SIZE DISTRIBUTION

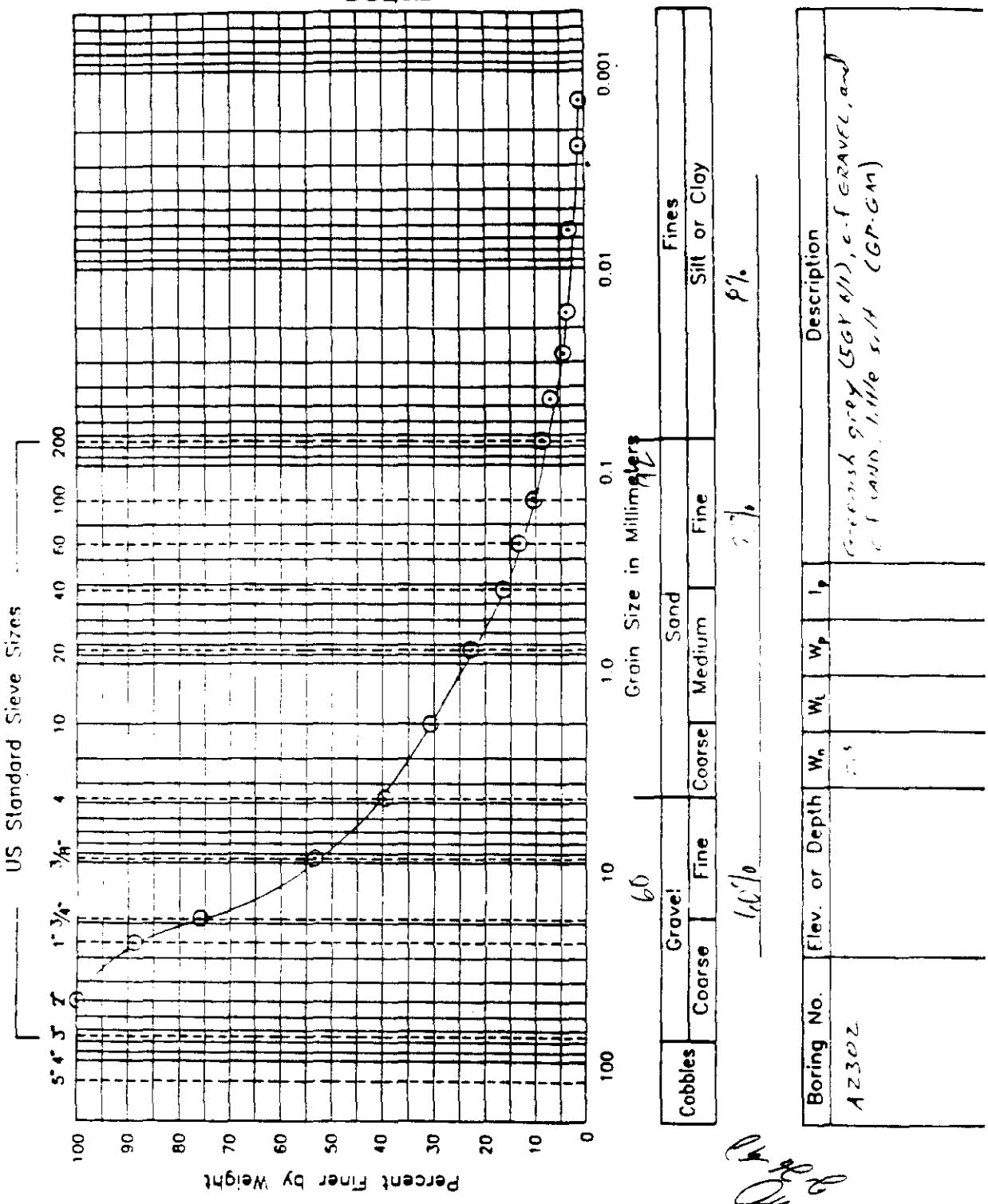
Project: [illegible] EM-1/W4
Project No. [illegible] Date 1-23-[illegible] Prepared By DPC Approved By KKB

Golder Associates



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	67%				32%	6%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1616		4.4				Olive grey, c-f GRAVEL, and c-f SAND, little silt. (GP-GM)



GRAIN SIZE DISTRIBUTION

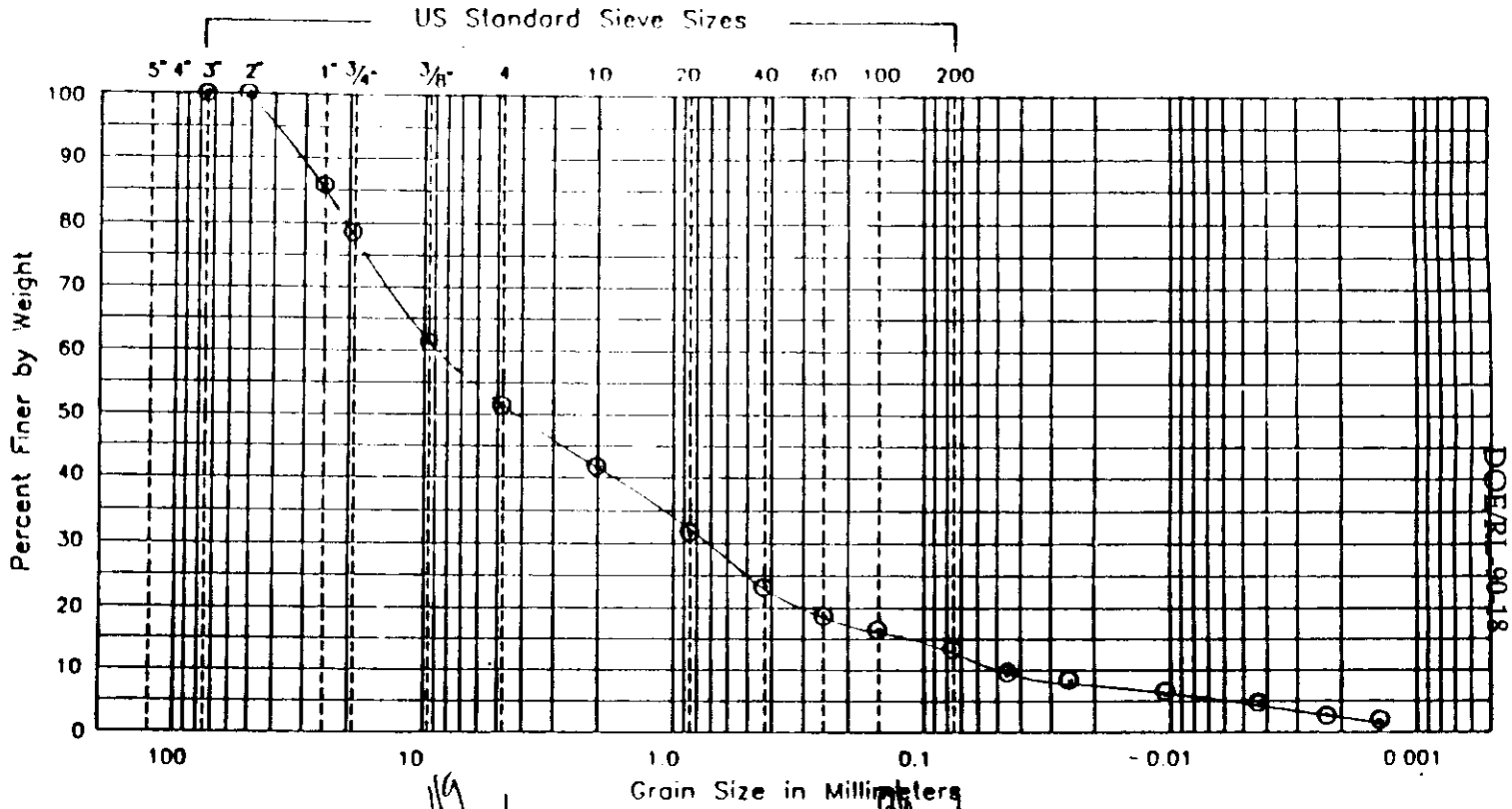
Project
Project No. Date Tested By Approved By

Golder Associates

GRAIN SIZE DISTRIBUTION

Project [illegible]
Project no. [illegible] Date 2-7-90 Tested By [illegible] Reviewed By [illegible]

Golder Associates



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
		1/9			1/9	
		1/9			2/9	1/9

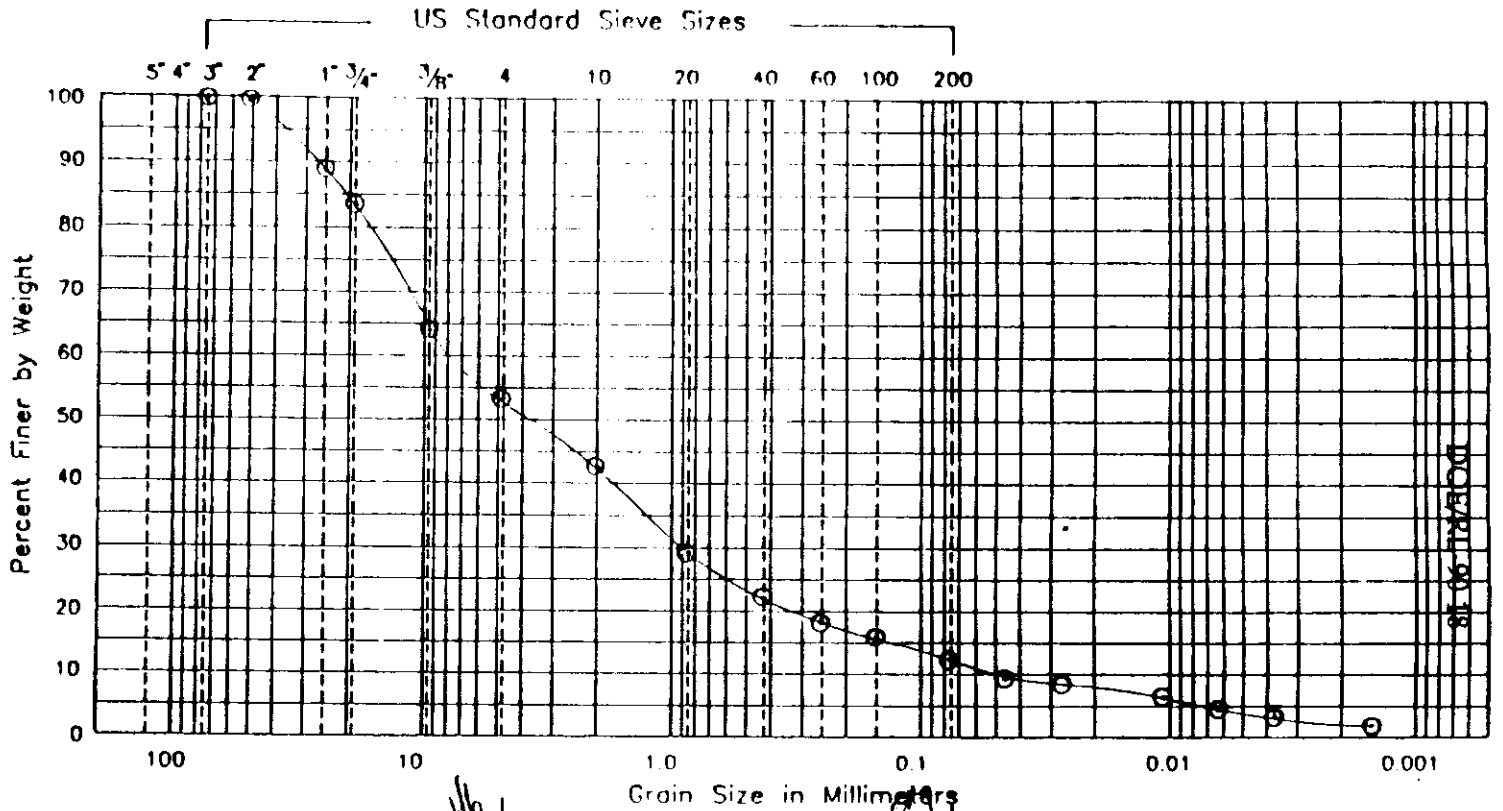
2-26-90

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A2305		2.23				Light grey (7N 7), coarse to fine GRAVEL and coarse to fine SAND, some Silt (GM)

GRAIN SIZE DISTRIBUTION

Project: [illegible]
Project No. [illegible] Date: 2-4-91 Tested By: DRD/[illegible] Approved By: KB

Golder Associates



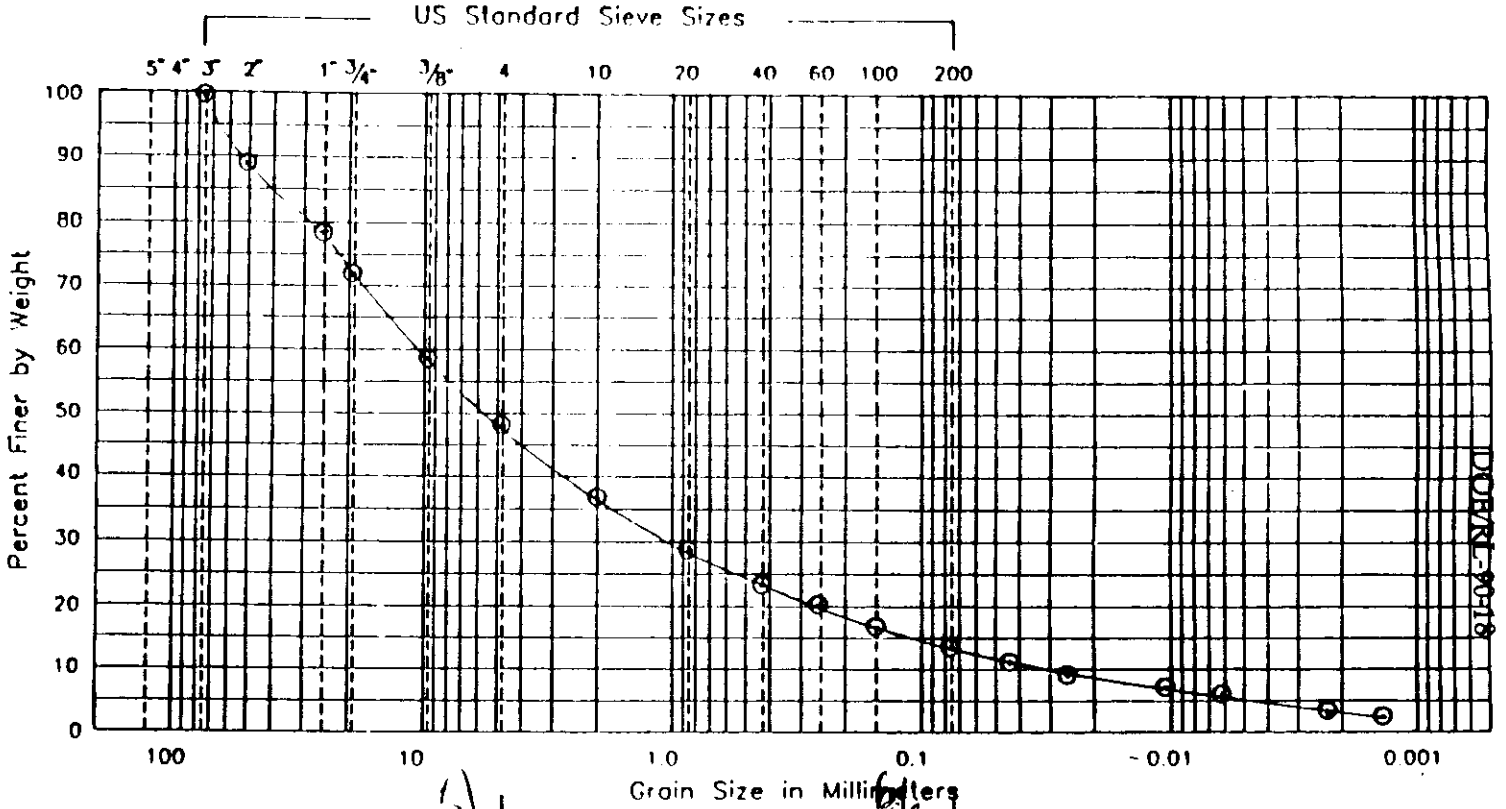
Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	1%				11%	13%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A2309		2.34				Medium light gray (GN6), coarse to fine GRAVEL and coarse to fine SAND, some Silt (GM)

GRAIN SIZE DISTRIBUTION

Project [illegible]
Project No. [illegible] Date [illegible] Tested By [illegible] Approved By [illegible]

Golder Associates



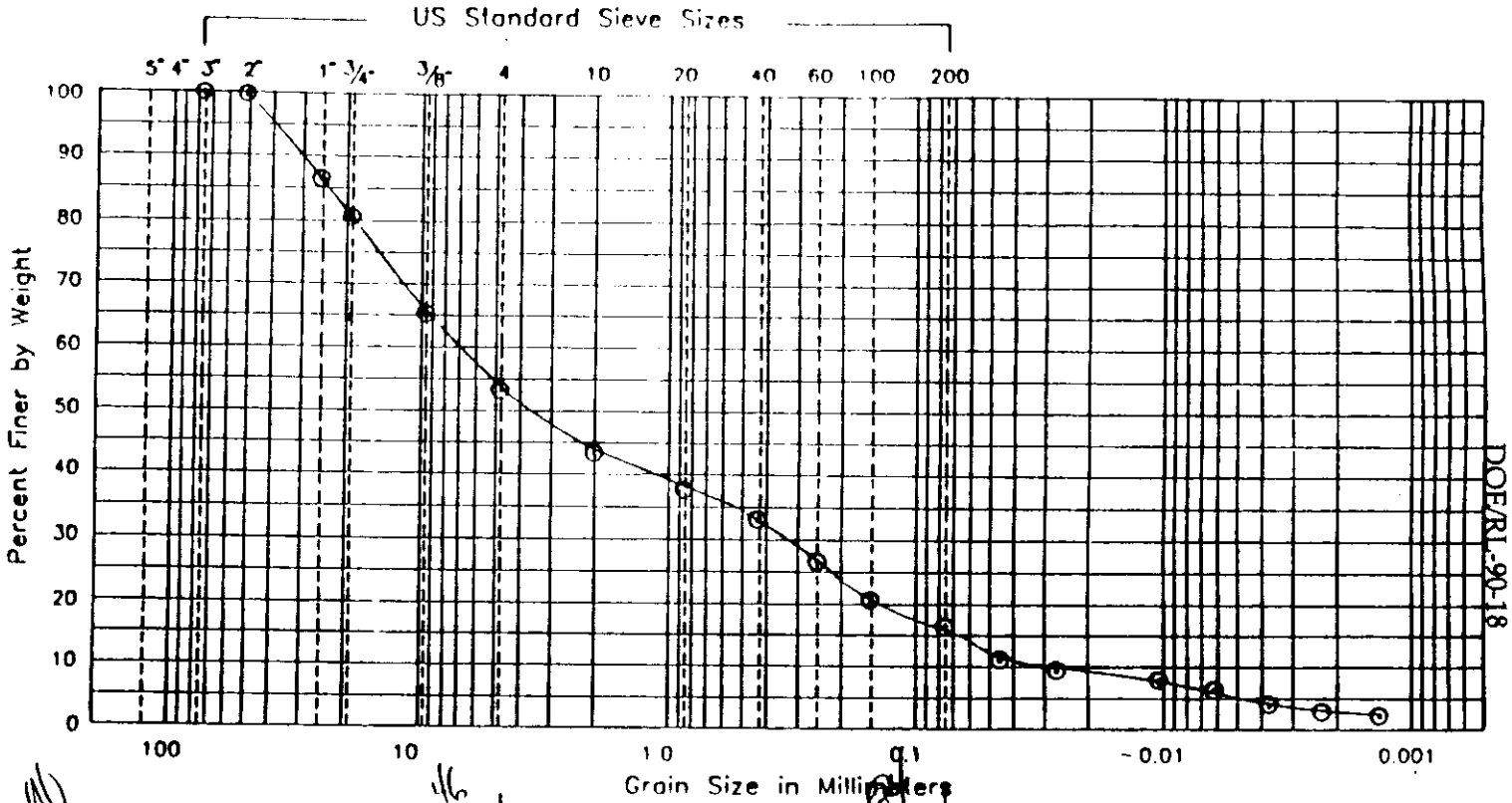
Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	61%				25%	14%

Boring No.	Elev. or Depth	W_n	W_L	W_p	I_p	Description
A 2311		[illegible]				Grayish yellow green (5GY 7/2), coarse to fine GRAVEL and coarse to fine SAND, some silt (GM)

DOE/RL-90-18

GRAIN SIZE DISTRIBUTION

Project: WRP/IRM EM-1/WA
Project No. 0-[illegible]
Date: 7-9-92 Tested By: [illegible] Reviewed By: [illegible]
PE/ATR



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	46%			37%		16%

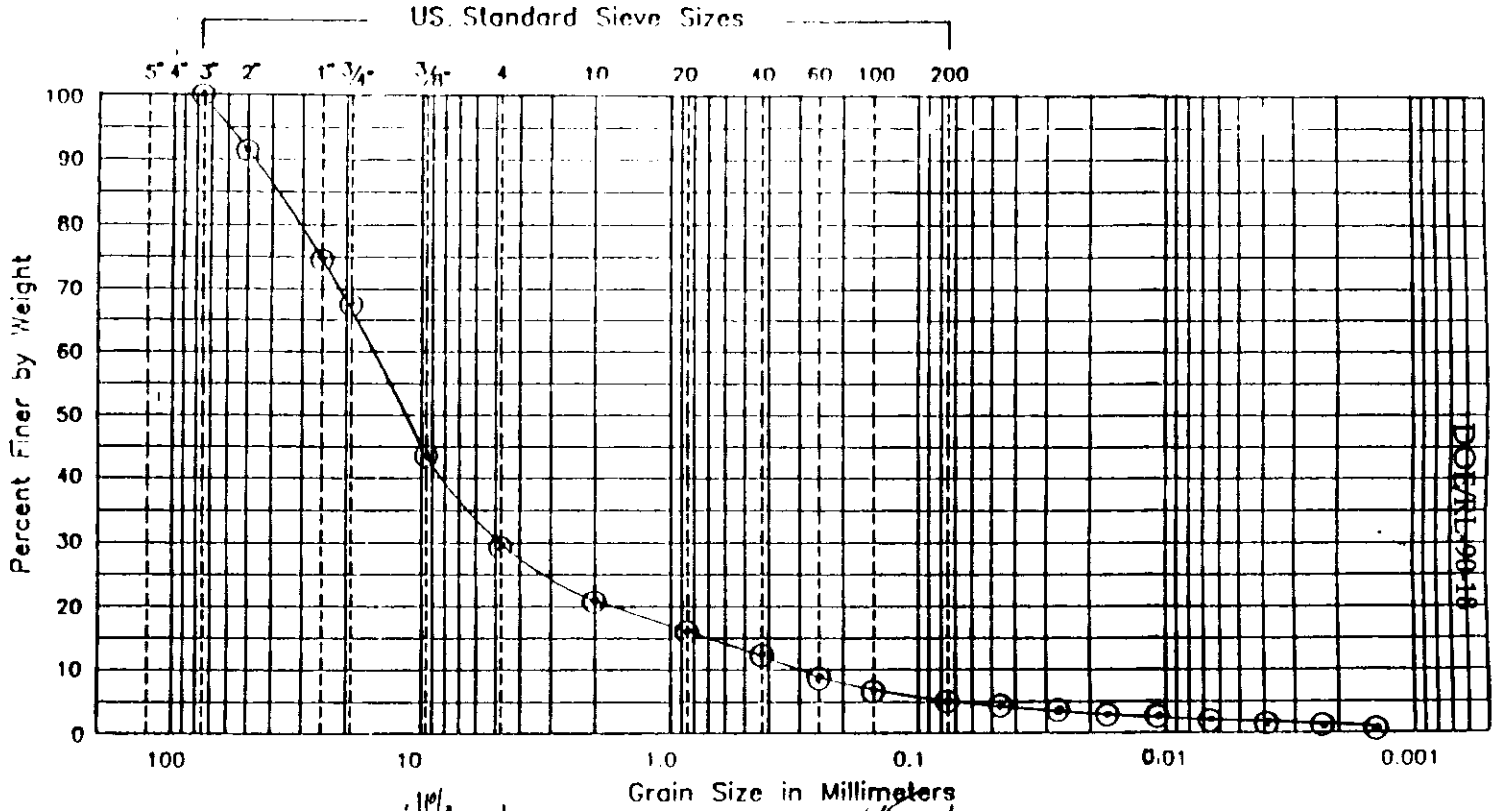
Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A2313		1.52				Very Pale Orange (10YR 8/2) coarse to fine GRAVEL and coarse to fine SAND, some Silt (GM)

Golder Associates

GRAIN SIZE DISTRIBUTION

Project: [illegible]
Project No. 893-135-01 Date 10-13-93 Tested By DPC Approved By [illegible]

Golder Associates

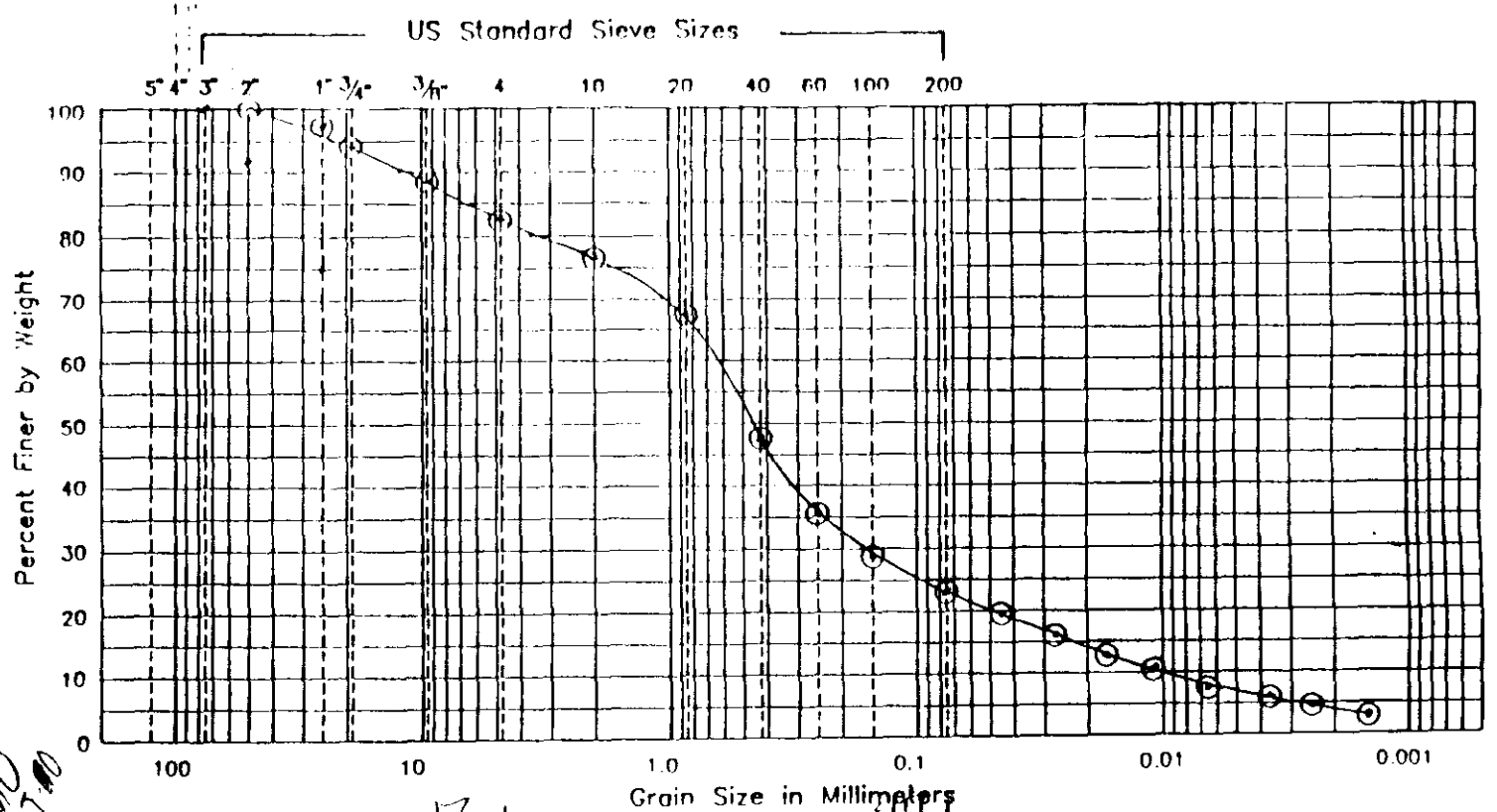


Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	1%			15		5%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1403		3.1				Olive black, sandy c-f GRAVEL, little silt, (GM-GP).

DOE/RL-90-18

GRAIN SIZE DISTRIBUTION



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	17%			60%		23%

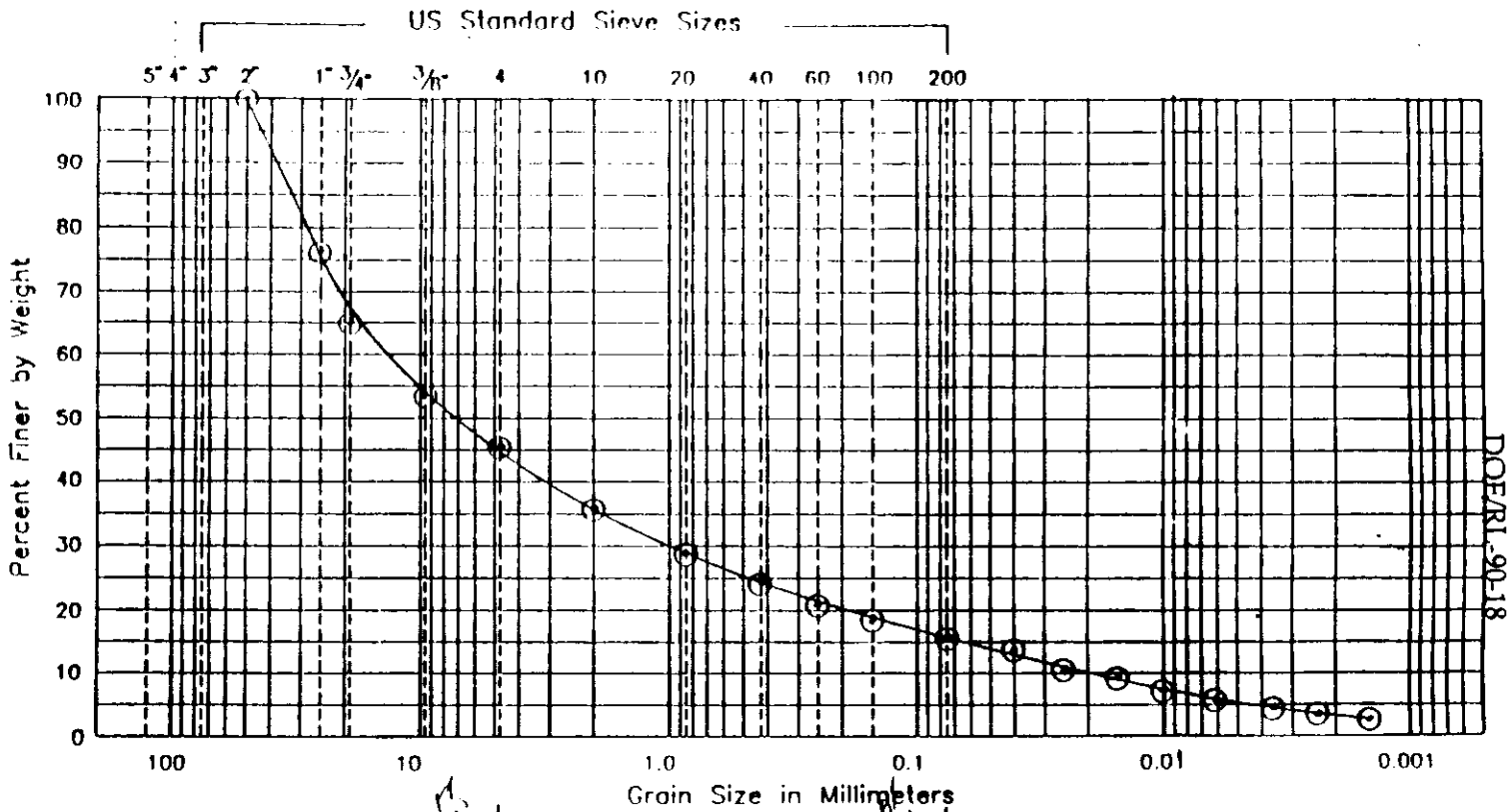
Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1405		3.8				Light olive grey, c-f SAND, some silt, some c-f gravel, (SM).

Project: [illegible]
Project No.: [illegible] Date: [illegible] Tested By: DRC Approved By: [illegible]
Golder Associates

GRAIN SIZE DISTRIBUTION

Project: [illegible]
Project No. [illegible]
Date [illegible] Tested By PRO
Approved By [illegible]

Golder Associates



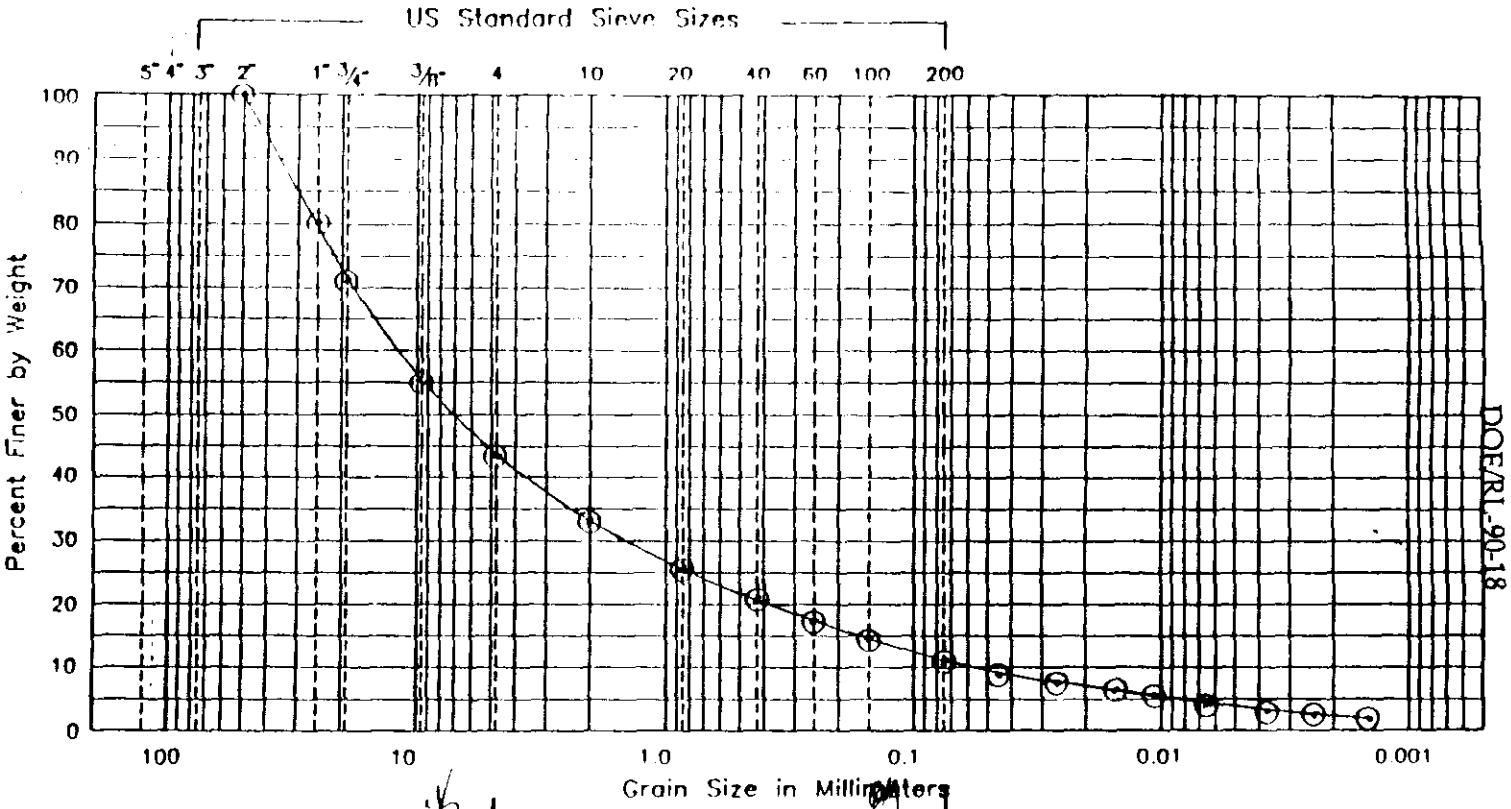
Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	2%		7%			15%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1408		4.1				Moderate olive grey, c-f GRAVEL, some c-f sand, some silt, (GM).

GRAIN SIZE DISTRIBUTION

Project: [illegible]
Project No. [illegible] Date [illegible] Tested By DPC Approved By [illegible]

Golder Associates



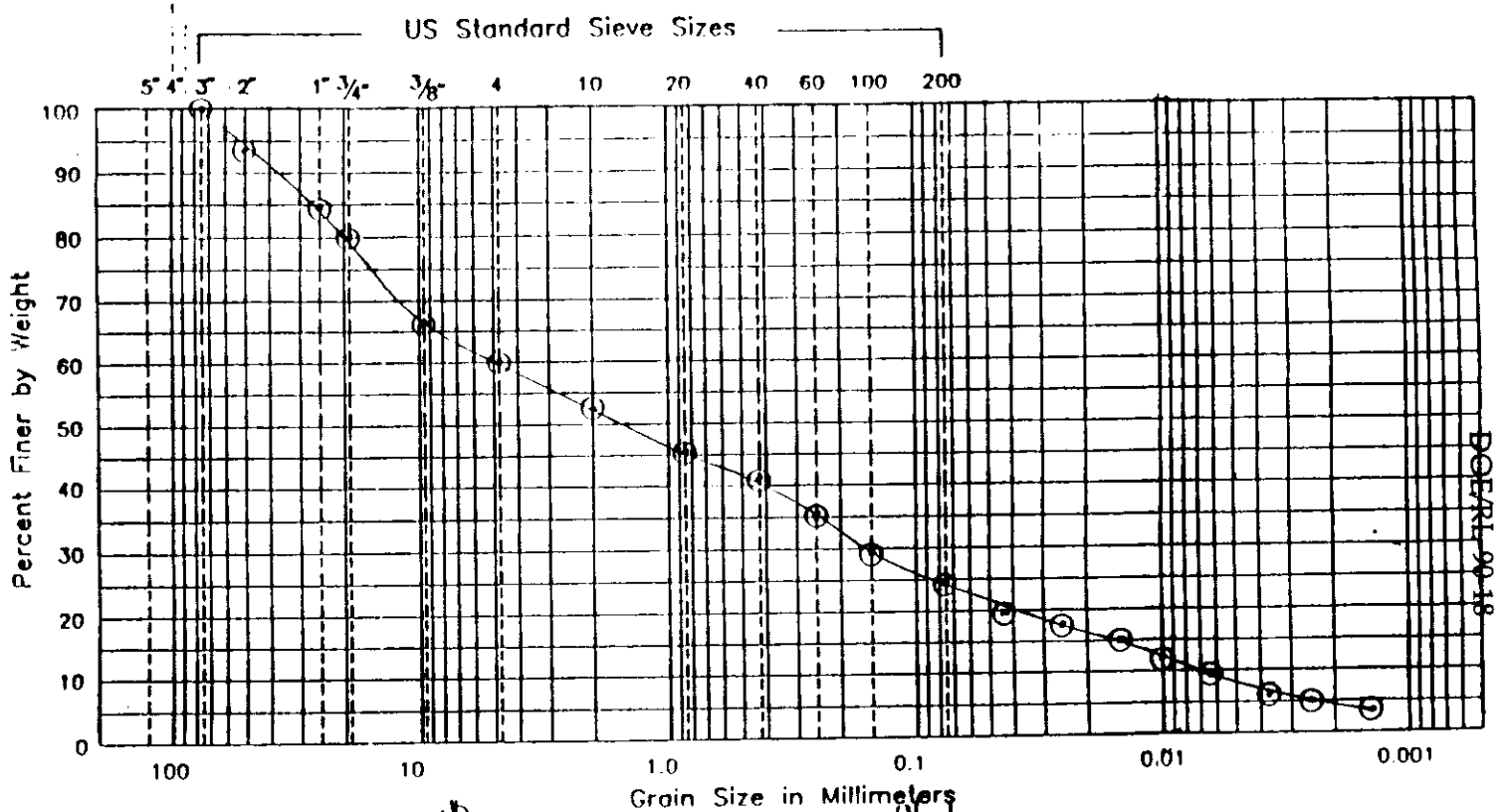
Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	11%		71%			18%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1L110		3.4				Light olive grey, c-f GRAVEL and SAND, little silt, (GM-GP).

GRAIN SIZE DISTRIBUTION

Project: [illegible] Project No. [illegible] Date 1-12-94 Tested By DRO Approved By [illegible]

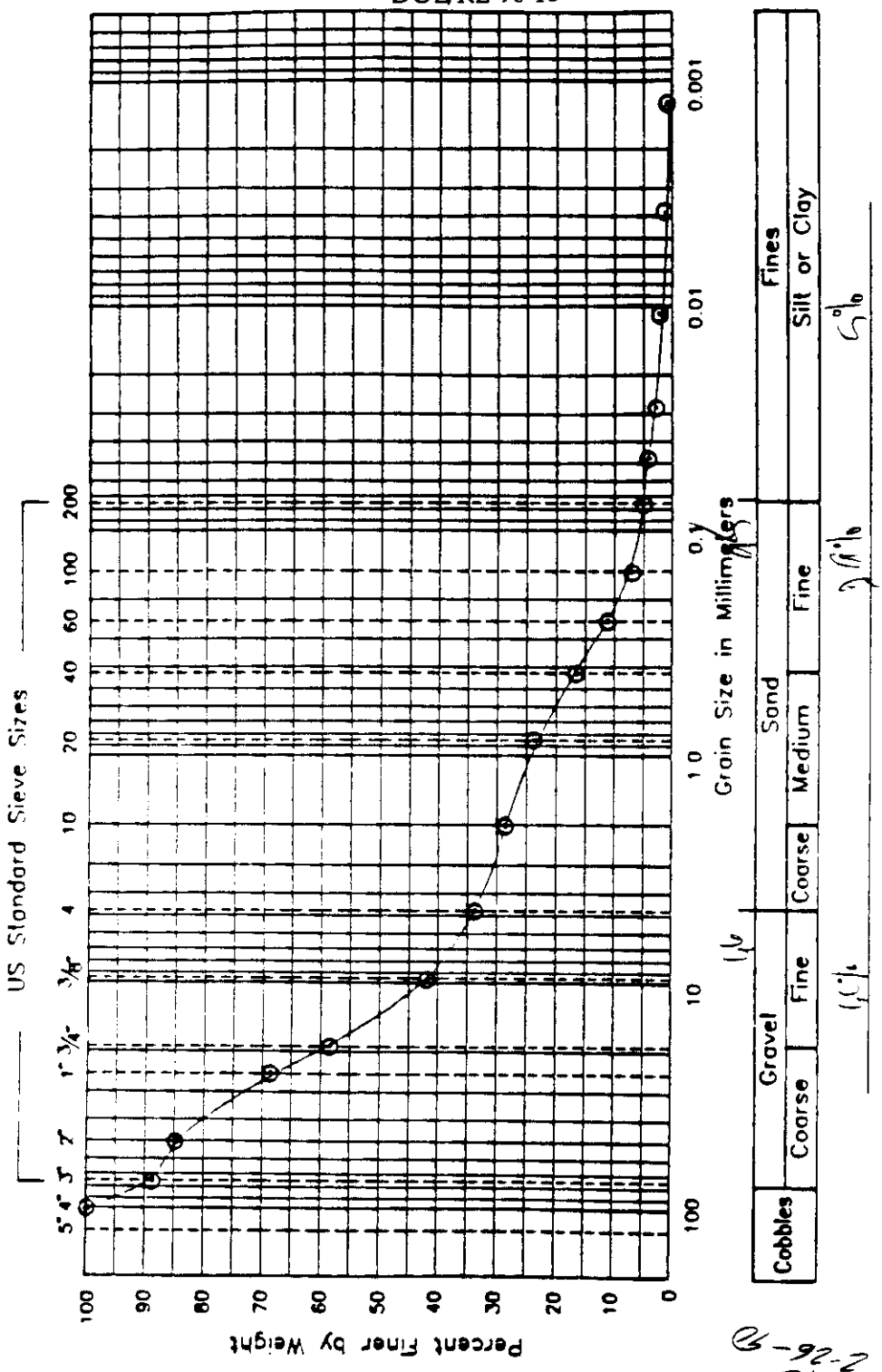
Golder Associates



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	40%				36%	24%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1413		1.8				Yellowish grey, a.f GRAVEL and SAND, some silt, (GM).

DOE/RL-90-18

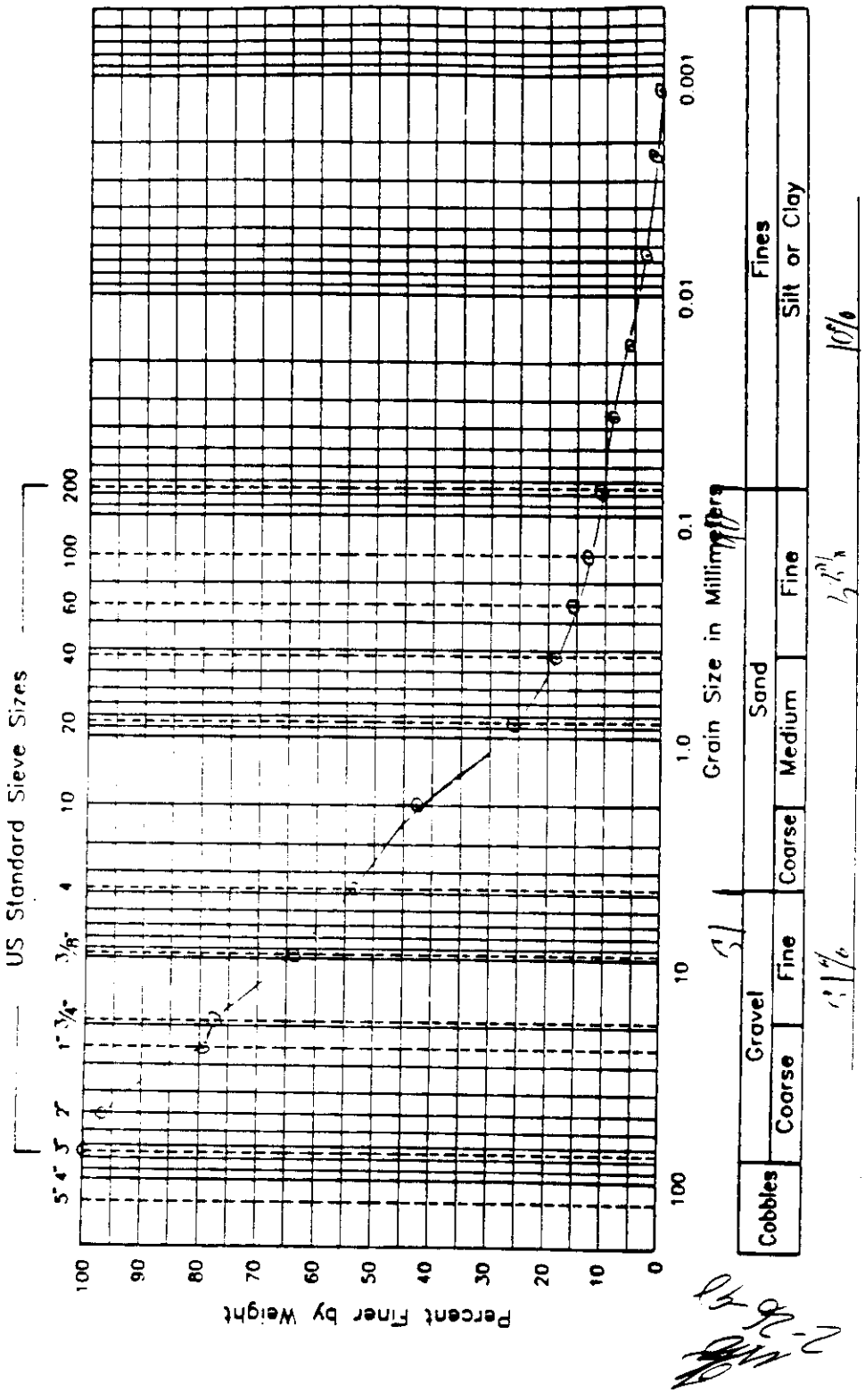


Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1904		1.8				Light olive grey, c-F GRAVEL, some c-F sand, little cobbles, little silt, (GM-GW)

GRAIN SIZE DISTRIBUTION

Project WMC / 1100-EM-1
Project No. BE3-1754.000 Date 7/1/90 Tested By DPO Approved By KKB

Golder Associate



Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1703		2.5				Med. gray to lt. olive gray, c-f GRAVEL and c-f SAND, little silt. (GW-GM)

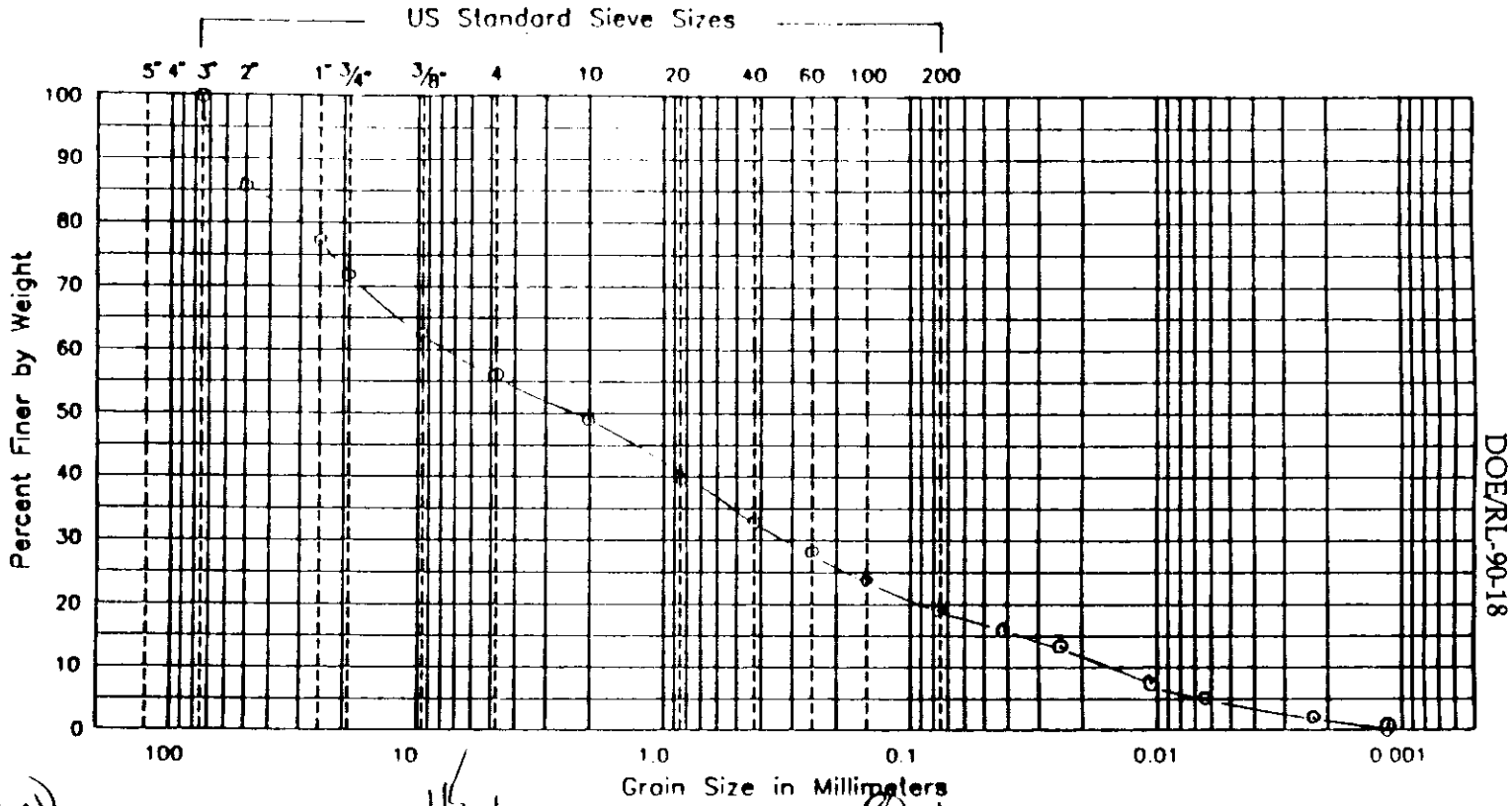
GRAIN SIZE DISTRIBUTION

Project: [illegible] EN-1/WA
Project No. E-F-3 1754 Date 1-23-91 Tested By DPK Approved By [illegible]

Golder Associates

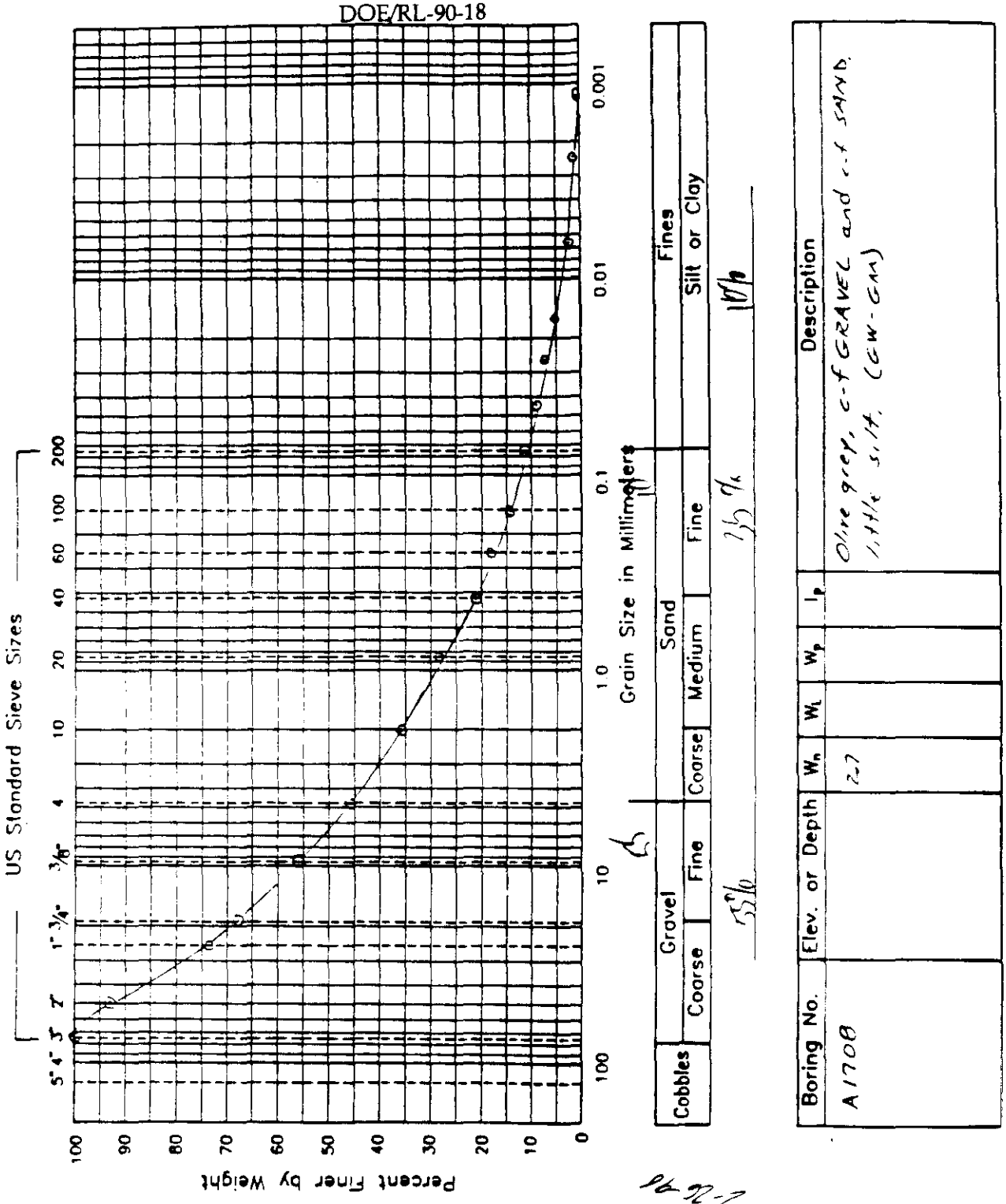
GRAIN SIZE DISTRIBUTION

Project: 4th Ave. Utility - E. Main
Project No. 903-1254 Date 1-23-92 Tested By DZ Approved By KRB



Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1705		1.9				Med gray to lt. olive gray, c. f SAND, and c. f GRAVEL, some silt. ~~(SM)~~ (GM) KRB

Golder Associates



GRAIN SIZE DISTRIBUTION

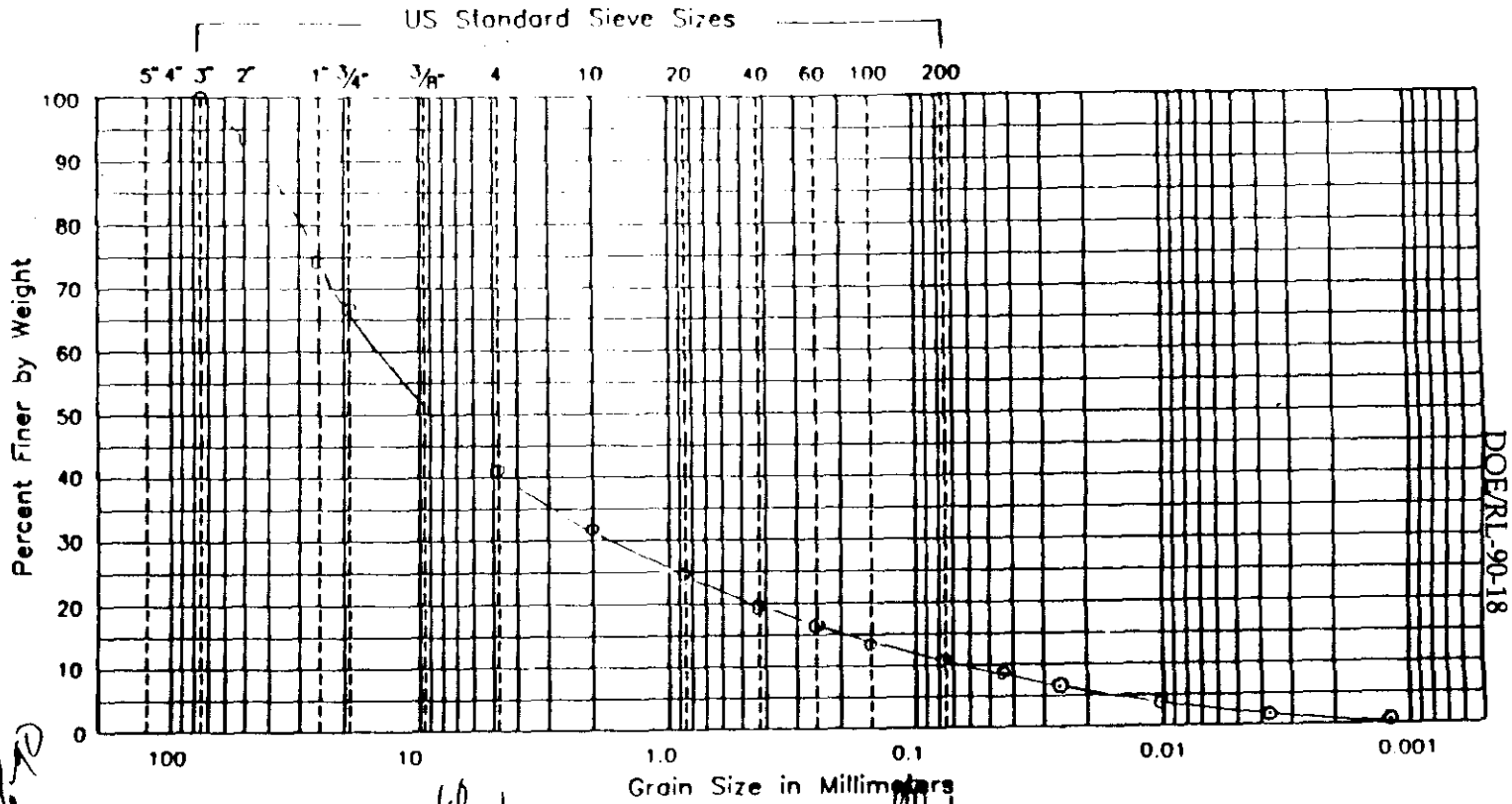
Project: M-Area - EM-11WA
Project No: EF3-1254 Date: 1-23-91 Reviewed By: DPC Approved By: KHD

Golder Associates

GRAIN SIZE DISTRIBUTION

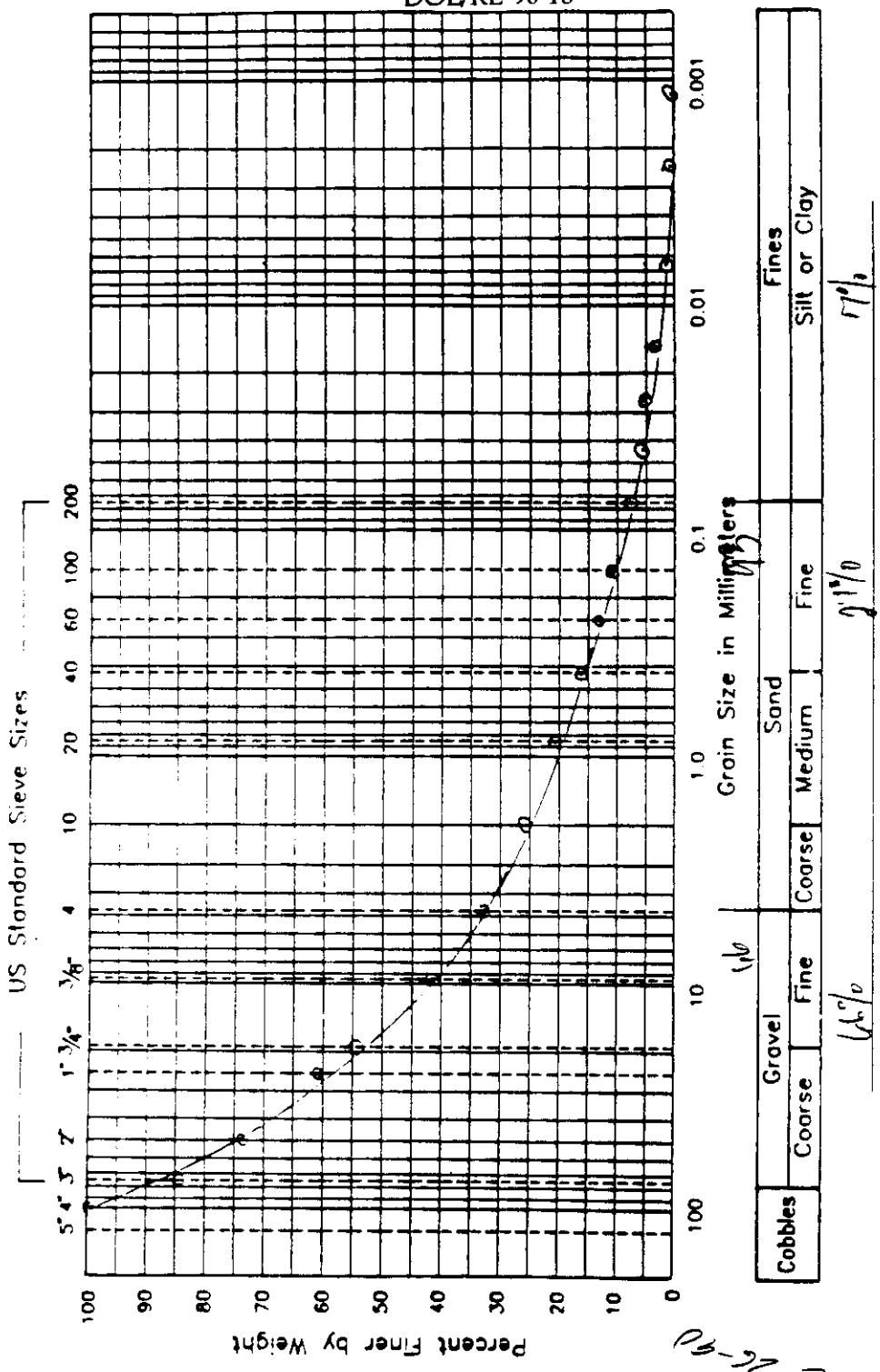
Project [illegible]
Project No. [illegible] Date 2-2-90 Tested By DPO Approved By [illegible]

Golder Associates



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	16%			74%		10%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1711		2.22				LY. olive grey, c-f GRAVEL and c-f SAND, little silt. (GP-GM)



Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1713		2.8				Lt olive grey, c-f sandy, c-f GRAVEL some cobbles, little silt (GW-GM)

GRAIN SIZE DISTRIBUTION

Project: [illegible]-EM-1/WA
Project No: EE3-1754 Date: 1-23-94 Tested By: DPC Approved By: KKS

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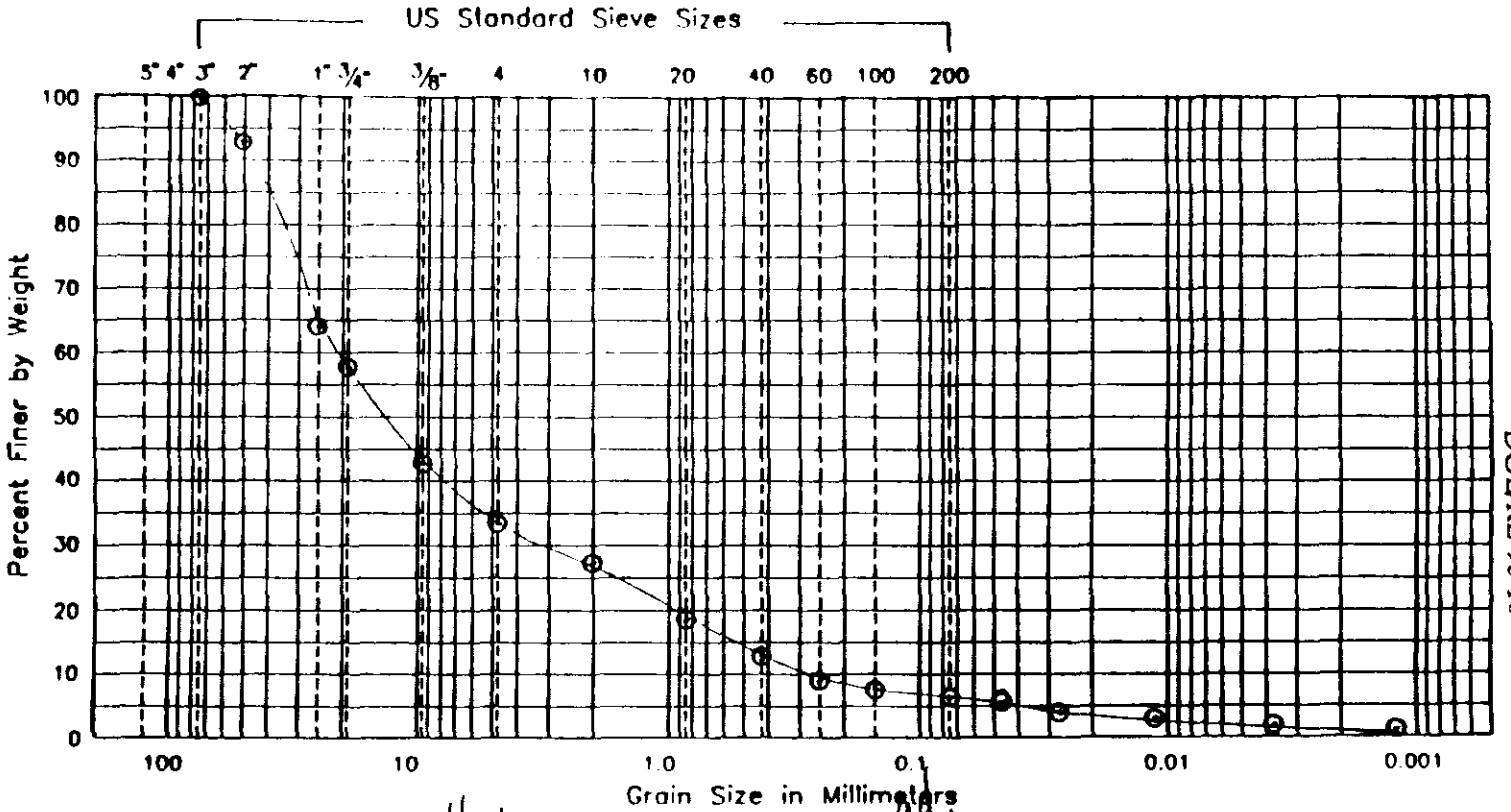
GRAIN SIZE DISTRIBUTION

Project: WRC / 1100-EM-1
Project No: 893-1754.000 Date: 2/11/90 Tested by: D.P.O. Reviewed by: [illegible]



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	16%		28%			6%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A 1907		2.5				Medium olive grey, c-f GRAVEL, some c-f sand, ~~little cobbles~~, little silt, (GM-GW). little cobbles

2-26-90

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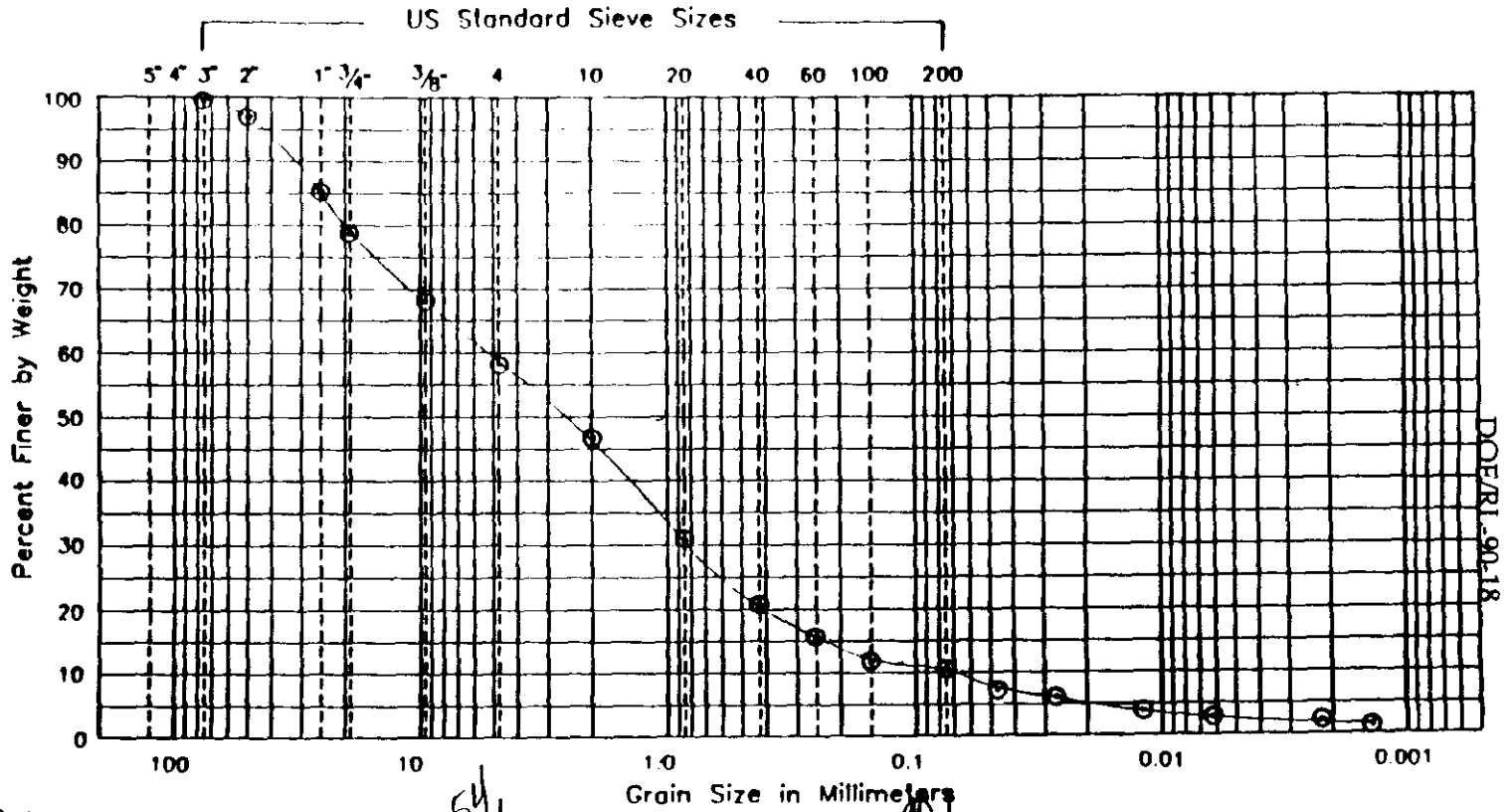
GRAIN SIZE DISTRIBUTION

Project: WRC/1100-EMI-1
Project No. 883-1754.000 Date 3/1/90 Tested By DPO Reviewed By [illegible]



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	51%				36%	10%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1908		2.2				Medium olive grey, c-f SAND and GRAVEL, little silt, ~~trace cobbles~~ no cobbles, (SM-SW).

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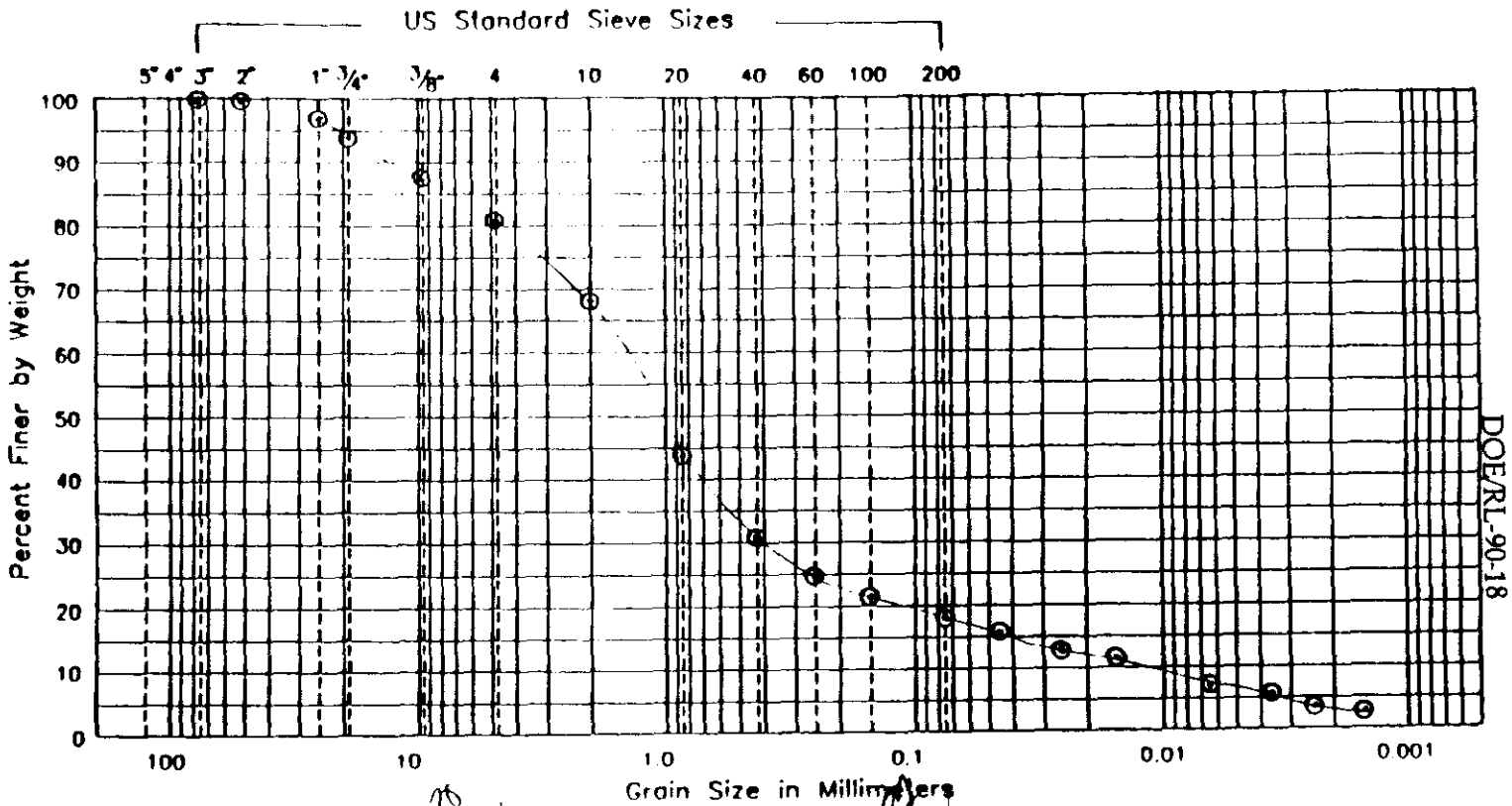

Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	28%		60%			12%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1910		3.7				Olive grey, c-f SAND, some silt, some c-f gravel, (SM).

GRAIN SIZE DISTRIBUTION

Project: WMC/110h-EM-1
Project No. 893-17534.000 Date 2/1/90 Tested By P.P.O. Approved By [illegible]

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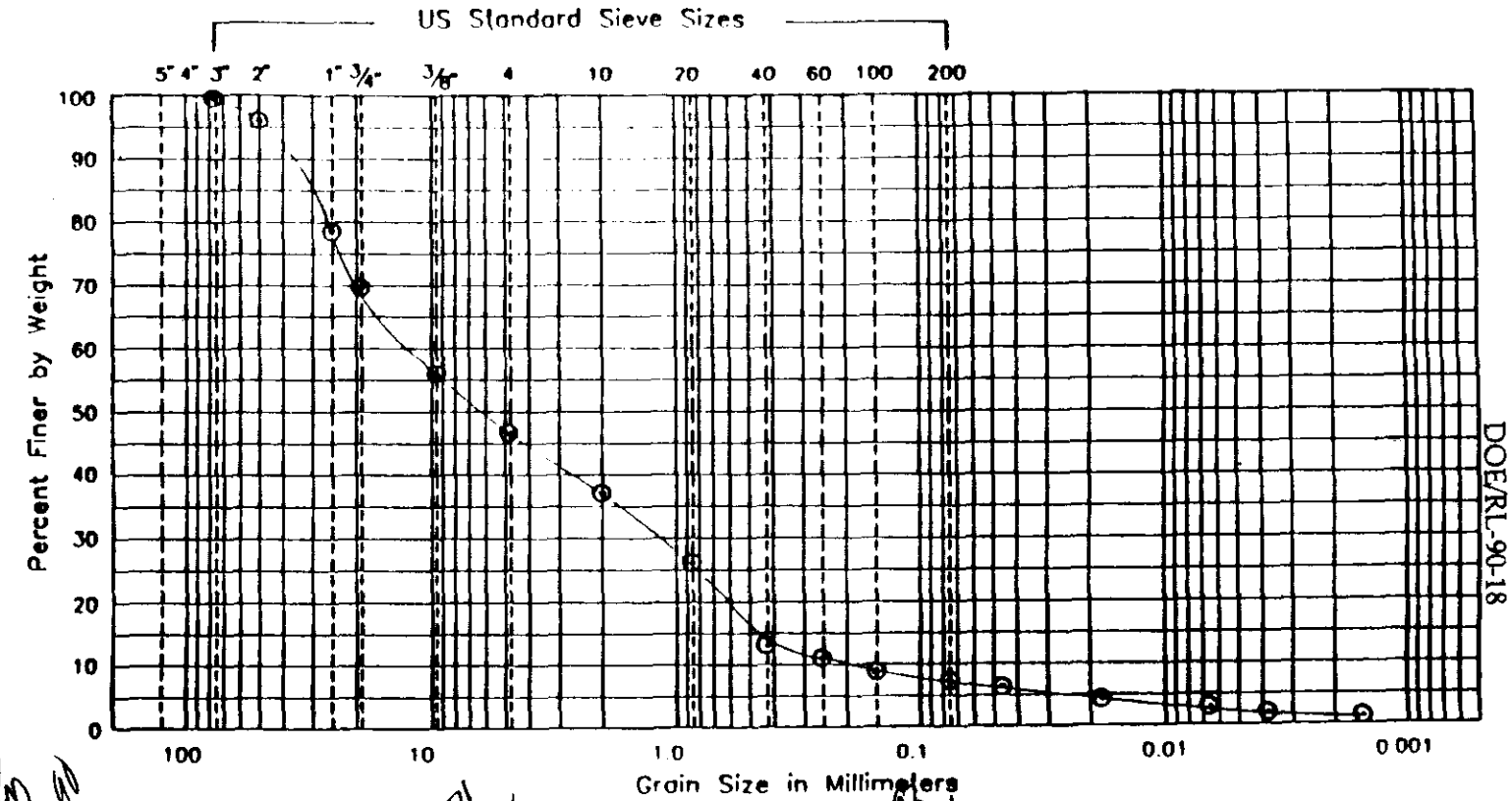
GRAIN SIZE DISTRIBUTION

Project: WMC/1100-EM-1
Project No. 883-1754-000 Date 3/1/90 Tested by DPO Approved by KKD

Golder Associates

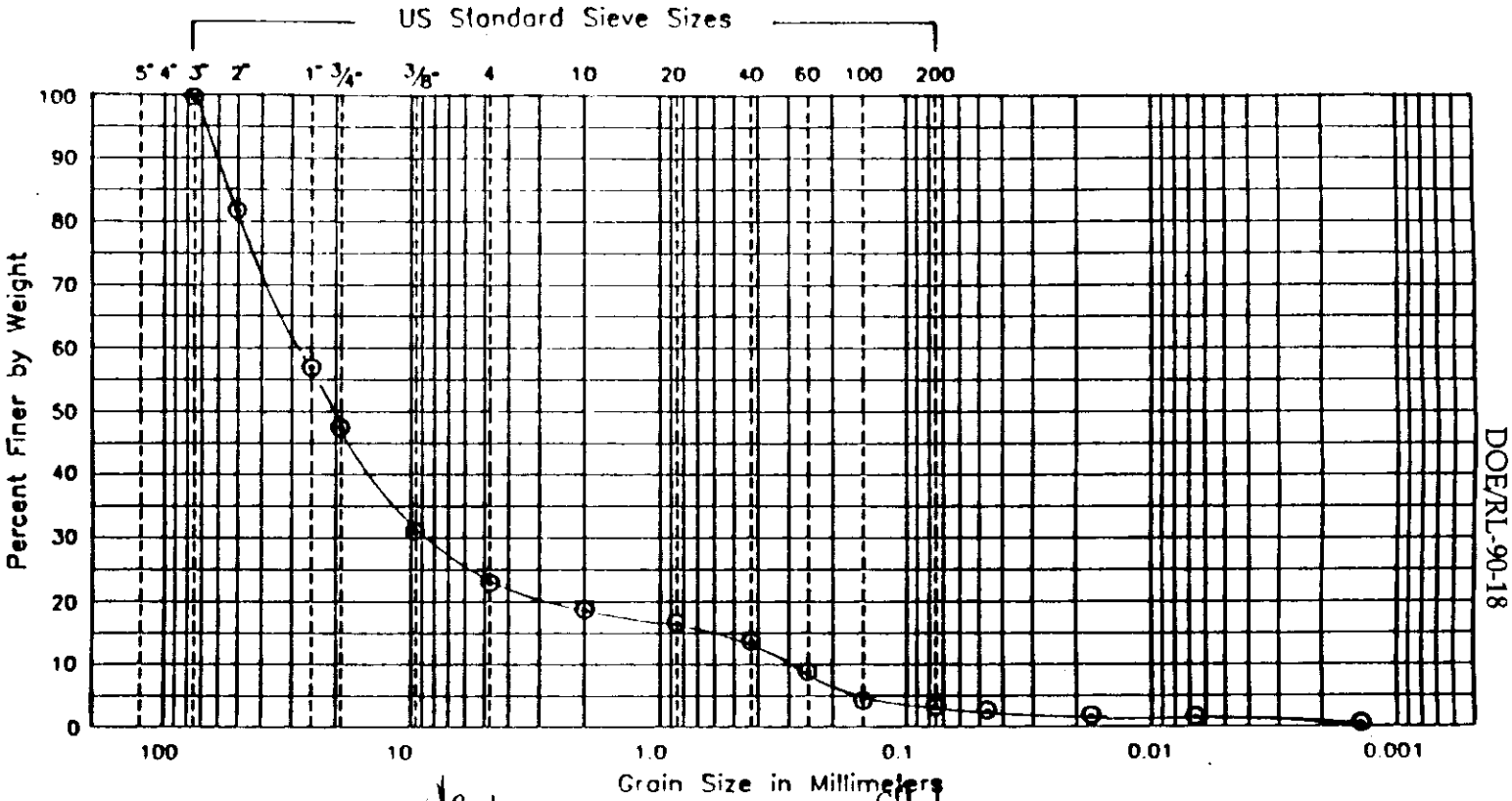


Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	21%		28%			1%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A 1911		30				Dark olive grey, c-f GRAVEL and SAND, little silt, (GM-GP).

GRAIN SIZE DISTRIBUTION

Project WHC/300-EM-1
Project No. 883-7754.000 Date 2/1/90 Tested By DPO Approved By [illegible]



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	16%			21%		3%

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
A1913		3.6				Dark olive grey, c-f GRAVEL, some c-f sand, trace silt, (GP).

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