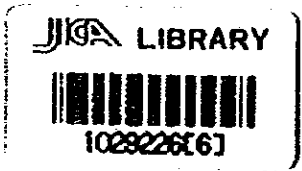


THE
JOURNAL
OF THE
ROYAL ANTHROPOLOGICAL INSTITUTE
PART I
1904

PUBLISHED BY THE INSTITUTE OF CHINESE STUDIES, UNIVERSITY OF TORONTO

JICA
304
685
MPI
LIBRARY



STUDY
ON
IRAN-JAPAN EXPORT REFINERY
BOOK III: SUPPLEMENT

March, 1979

JAPAN INTERNATIONAL COOPERATION AGENCY

国際協力事業団	
受入 月日 84. 9. 28	304
登録No 0003	68.5
09368	MPI

VOLUME I
SITE SURVEY REPORT

VOLUME 1

SITE SURVEY REPORT

C O N T E N T S

	Page
1. INTRODUCTION	1
2. SURVEY TEAM	2
3. SURVEY SYNOPSIS	3
3.1 Reconnaissance in Bushehr	3
3.2 Boring Work	10
4. DATA LIST	10
4.1 Data Given by NIOC	10
4.2 Data Collected by Survey Team	10

ATTACHMENT

- Attachment 1 Site Reconnaissance Route
- Attachment 2 Hearing Record through Site Reconnaissance
- Attachment 3 Report on Geotechnical Site Reconnaissance

1. INTRODUCTION

The site survey was undertaken by the team of JICA to collect necessary data and information for the Feasibility Study during June 1978.

Main activities done during site survey are as follows:

- Interviews and discussions with government officials and NIOC representative in Bushehr.
- Aerial reconnaissance of the sites and pipeline route.
- Ground survey of the candidate sites.
- Soil investigation by borings.

Comfortable accommodation, catering and helicopter/car had been arranged by NIOC, especially by Mr. Abtin who attended during survey at Bushehr.

This report includes the following:

- Survey team member list
- Survey synopsis
- Report on geotechnical site reconnaissance

2. SURVEY TEAM

1) JICA Survey Team Member

Shoei Komatsu	Team Leader	Process Engineer
Nobuyuki Hashimoto	Construction Planning	Process Engineer
Shigeyasu Mori	Off-site Infrastructure	Mechanical Engineer
Ichisei Tomiyama	Port & Civil Works	Civil Engineer
Sunao Yanagawa	Soil Investigation	Civil Engineer
Haruo Hamanaka	Cost Estimation	Civil Engineer

2) NIOC attendant to Bushehr

Mr. A. Abtin	Project Engineer, Overseas Project Affairs
--------------	--

3) Dares and Moore: Soil surveyor (boring test)

Mr. M. Blackwell

Dr. V. Baroyant

3. SURVEY SYNOPSIS

3.1 Reconnaissance in Bushehr

- June 16th Flight to Bushehr
Short meeting with Mr. Abtin on the schedule.
- June 17th
- 09:00-11:00 With Mr. Akghar (NIOC Representative at Bushehr)
at NIOC Bushehr office
- Explanation of site survey purpose and items.
 - Confirmation of Appointments to Government officials.
- 11:00-13:00 Government General Office
- Introduction of personnel related to site survey.
 - Interview with Mr. Behnamfar of Deputy Governor General of Bushehr.

Following are the introduced personnel:

Mr. Behnamfar	Deputy Governor General
Colonel Etehadieh	Ground Force
Captain Arjomandzadeh	Navy
Captain Haghnia	Police
Captain Shamshegi	Air Force
Dr. Fanaii	Head of Port Administration
Mr. Navaii	Head of Ministry of Road Bushehr
Mr. Hormozi	Atomic Power Organization
Mr. Bahraini	Governor of Suburbs of Bushehr
Mr. Afandi	Environmental Department

June 18th Interview with authorities (refer to Attachment 2)

08:30-10:30 Interview with Mr. Iraj-Hormazi and Mr. K. Thieme of Atomic Power Organization.

11:00-12:30 Interview with Mr. Navali of Ministry of Road Bushehr

12:30-13:00 Visit meteorological station at Bushehr airport.

18:30-19:30 Interview with Dr. Fanail of Port Authority.

June 19th Aerial Survey by helicop or (refer to Attachment 1)

08:15 Take off Bushehr airport

- extensive sand and mud exist at the neck of Bushehr peninsula.
- relatively greenish (dates) around/nearby Bushehr peninsula.
- mountain side eroded and steep.

08:45 Landing at Ameri

09:15 Landing near site B

- Flat and wide area
- Muddy and wet in appearance

09:30 Refuelling at Bushehr airport

10:00 Landing at the mouth of Helleh river.

10:40 Circling over Gurreh pump station

- Approx. half of pipeline route is flat area, the other half is hilly and mountainous area.
- Existing pipelines to Kharg Is. are buried.
- At wadi crossing and mountain side, the pipelines are laid above ground.

11:05 Refuelling at Kharg Is.

11:30 Return to Bushehr (Cumulative distance: approx. 360 Km).

June 20th Ground survey of southern site

	<u>Distance from Bushehr (KM)</u>	
07:15	0	Start at Buser. - Paved road to Borojan/Shiraz.
07:42	22	Junction of Shiraz road and Ameri road. - Gravel road - Date palms planted
08:08	40	Chah Talk-e-Pain - Drive Track, unpaved - Date palms around village
09:20	55	Muhasad Azeri
09:40	65	Bashi - Rocky area hard to drive - Deep wadis

	<u>Distance from Bushehr (KM)</u>	
10:25	80	Rustani
10:43	87	Ameri site <ul style="list-style-type: none"> - Distance to the next village is approx. 2 Km. - Flat area from shore to foot of mountain seems to be approx. 1 Km. - Shoreline is sand beach. - It seems little difference between North area and South area of Ameri. - Granular surface, presumably good soil condition.
(12:00 - 12:45)		Lunch at Rustani
12:45	80	Rustani
13:33	60	Bashi
13:40	57	South of Muhammad Ameri <ul style="list-style-type: none"> - Stop near boring location No.1 and No.2. - Sand dune near shore and road.
14:15	55	Muhammad Ameri <ul style="list-style-type: none"> - Gendarm station

	<u>Distance from Bushehr (KM)</u>	
14:35	53	North of Muhammad Ameri site - Stop near boring location No.3/4 - Wider area than Southside of Muhammad Ameri. - Wadis of 1 - 1.5m depth exist some intervals. - Palm dates planted.
16:00	40	Chah Talkh - e - Pain site - Stop near boring location No.5 - Village close to road (east side) - Neither plantation nor facilities in west side of road (sea side). - Blackish soil
16:30	22	Chughadak site (North side of paved road) - Stop near boring No.7 - No plantation - Wavehouse and small shops along road.
18:00	-	Bushehr.

June 21th

Ground survey of northern site

	<u>Distance from Bushehr (KM)</u>	
07:15	0	Start from Bushehr - Paved road
08:20	42	At junction of Hossinaki and Bushehr Borazjan - Drive track on a plane through villages: Kargazi, Zendan, Heydari, Haft Jush, Ziarat, Kolol - Most places are desert, some places near villages are cultivated.
09:25	70	Reached to Helleh river (near Halt Jush) - River water seems to be used as domestic water.
10:05	85	On asphalt paved road of Borazjan- ganaveh Bridge on Helleh river (near Ab Pakhsh)
10:10	90	On gravel road (25 Km long) - Canal along road - Palm dates plantation continuing. 17 Km.
10:40	115	Took motor track - Pass through villages: Korreh- Band, Ghaleh-Sukhteh, Asgavi, Moerezi, Rustami, Parageh

	<u>Distance from Bushehr (KM)</u>	
11:30	136	Farageh site - Genderm station - No cultivation - Flat and very wide - Ketty near shore line
(12:50 - 13:50)		Lunch
15:00	85	On the asphalt paved road
16:10	22	South side of Chugadak - Stop near boring No.6
17:30	0	Bushehr
18:30-19:30		Team meeting - Decided boring point
June 22nd		Back to Teheran
June 23rd		Team meeting regarding site selection
June 24th		Meeting with NIOC
June 25th		
10:00-12:00		Visited Daves and Moore Office - Confirm Actual Boring Schedule Flight to Tokyo

3.2 Boring Work

(Refer to Attachment 3 "Geotechnical Site Reconnaissance")

June 22 - 28	Mobilization
June 29 - July 7	Boring
July 10 - Aug. 1	Laboratory test
July 7 - Aug. 12	Report preparation
Aug. 28	Report delivery

4. DATA LIST

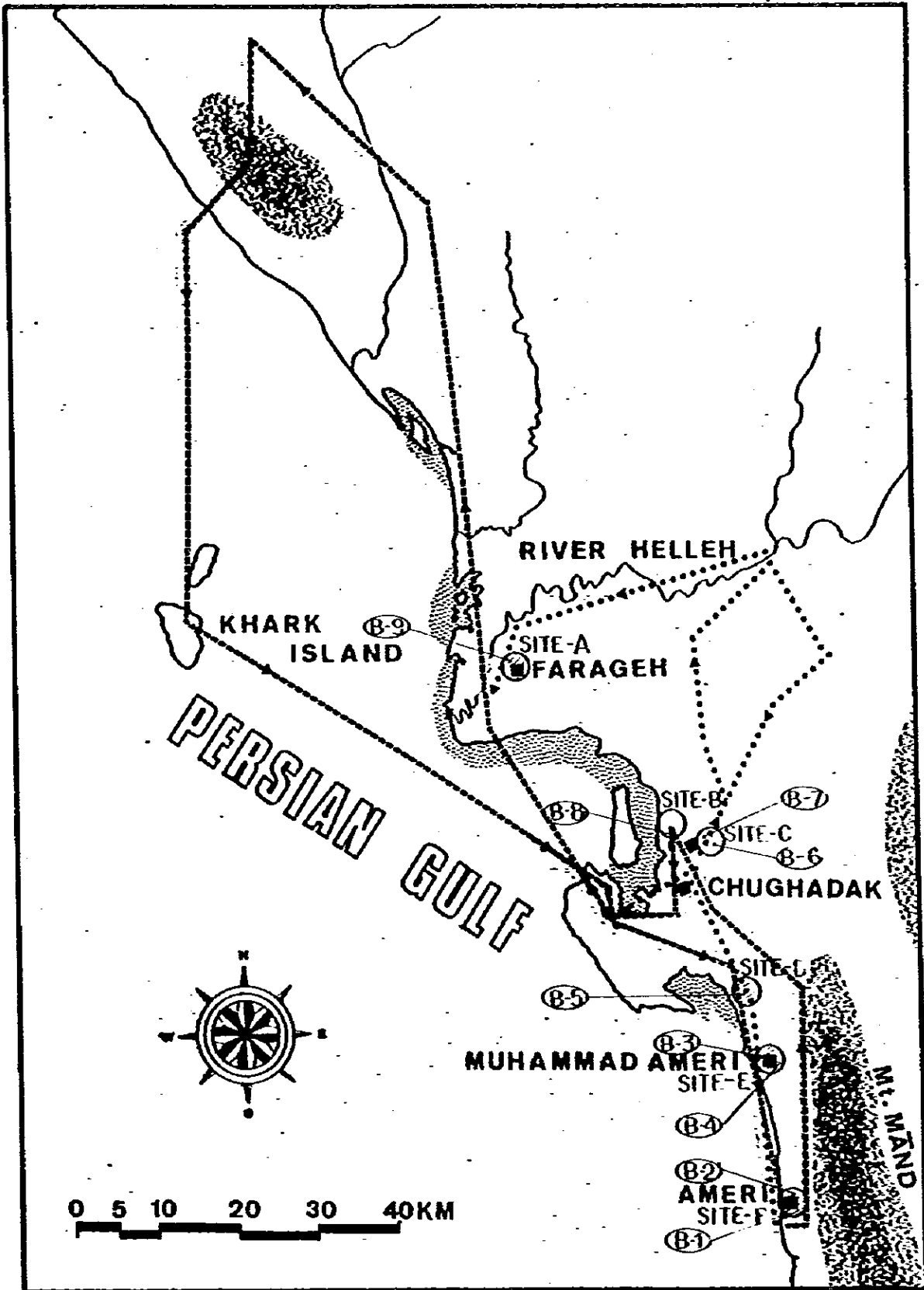
4.1 Data Given by NIOC

- (1) Maps 1/50,000
- (2) Road Map
- (3) Bushehr harbor plan
- (4) Climatic data
- (5) Boring log of NIOC Bushehr oil depot

4.2 Data Collected by Survey Team

- (1) Iran Almanac
- (2) General map of Iran
- (3) General Information around Bushehr (Refer to Attachment 2)
- (4) Report on soil condition (Refer to Attachment 3)

ATTACHMENT 1
SITE RECONNAISSANCE ROUTE



□ LEGEND

- ←----- AERIAL SURVEY ROUTE
- ←..... GROUND SURVEY ROUTE
- CANDIDATE SITE

□ SITE RECONNAISSANCE ROUTE ATTACHMENT I

ATTACHMENT 2

HEARING RECORD

THROUGH

SITE RECONNAISSANCE

CONTENTS

	Page
1. Meeting with NIOC's Personnel	1
2. Meeting with Authorities Concerned	2
3. Meeting with Personnels of the Atomic Power Plant	5
4. Meeting with Authority of Ministry of Road	7
5. Meeting with Port Authority	9

1. Meeting with NIOC's Personnel

Place : NIOC Bushehr Office
Date : June 17 (Sat.) '78 9:00 - 11:00
Interviewer : Mr. Akghar (NIOC Representative at Bushehr)

The import of the meeting:

- Explanation of site survey purpose and items.
- Confirmation of appointments to government officials.

2. Meeting with Authorities Concerned

Place : Government General Office

Date : June 17 (Sat.) '78 11:00 - 13:00

Interviewer:

- 1) **Mr. Behnamfar**
(Deputy Governor General)
- 2) **Mr. Akghar**
(Head NIOC Bushehr)
- 3) **Colonel Etehadieh**
(Ground Force)
- 4) **Captain Arjomandzadeh**
(Navy)
- 5) **Captain Haghnia**
(Police)
- 6) **Captain Shamshegi**
(Air Force)
- 7) **Dr. Fanaii**
(Head of Port Administration)
- 8) **Mr. Navaii**
(Head of Ministry of Road Bushehr)
- 9) **Mr. Hormozi**
(Atomic Power Organization Representative in Bushehr)
- 10) **Mr. Bahraini**
(Governor of Suburbs of Bushehr)
- 11) **Mr. Afandi**
(Environmental Department)

The import of the meeting:

1) Arrangement of the survey

- The navy and the army will accompany the aerial and ground surveys respectively.
- Photographing on land is permitted.
- The meetings with personnels of the atomic power station, Ministry of Roads, and Port Administration are arranged.

2) Information of Bushehr area

- Population 60,000
 10 years before 3,000
 10 years after 500,000
- Industries
 - . Ship building
 - . Fishing
 - . Trading (export and import)
 - . Agriculture
- Facilities of education and public welfare
- The development plan of Bushehr city is included in the 6th 5-years plan.
- Executing big project
 - . Atomic power station is under construction.
 No.1 and No.2 generators will be started in end of 1980 and end of 1981 respectively.
 Include 200,000 m³/day desalination plant.
 - . Alminum factory is under planning
- Labor force

Many laborers are gathered from the whole country for construction of the atomic power station, but only general laborers are available in Bushehr itself.

- Comments on the candidate sites proposed by Japanese party.

. A-1, A-2 areas

Under control of Hunting Organization and Environmental Organization

. B,C areas

Neighborhood of Choghadak and Ahmadi is owned by the government.

3. Meeting with Personnel of the Atomic Power Plant

Place : Field Construction Office of the Atomic Power Plant

Date : June 18 (Sun.) '78 8:30 - 10:30

Interviewers:

- 1) Mr. Iraj - Hormazi
(Atomic Power Organization Representative in Bushehr)
- 2) Mr. K. Thieme
(Civil Engineer, Supervisor)

Information obtained related to the construction:

- Capacity of generators and desalination plant

No.1 Generator	1,300 MW
No.2 Generator	1,200 MW
Desalination plant	100,000 m ³ /day x 2 units

- Design condition

. Seismic factor

Iranian Building Design Code	10% G
Atomic Power Plant (Major)	50% G

. Sea water temperature

Water temperature through the year is 20 - 30°C and the maximum is about 35°C.

Service temperature is assumed as 28°C

. Wind

Main direction	North West
Wind velocity	45 - 50 mile/hr (Max. 70 mile/hr)

. Foundation construction

Non pile foundation on stiff clay

. Cooling water system

Once through

Discharges 1 Km offshore

- Procurement

. Cement

In the early stage of the construction, it was purchased from Shiraz and others, but changed over to imports later.

A cement factory is under planning.

. Steel materials

The total of about 100,000 tons was imported.

. Aggregate and stones

A exclusive crusher plant was prepared and they were collected at Borajau and Aharam.

- Unloading and transportation

General cargo : from Bushehr port

Heavy cargo : from exclusive jetty using barges

Max. weight handled: The 500 tons reactor

- Labor mobilization

Laborers total : 7,000 - 8,000 (at peak)

Local laborers : 4,500 (general laborer)

Expatriates : Eastern European countries,
Pakistan, Afganistan, Turkey, Iraq, etc.

Direct hire base (Invited through advertisements)

- Camp accommodation, catering

2/3 of Iranian Laborers are induced to live in camps. Catering is done on a subcontracting basis.

4. Meeting with Authority of Ministry of Road

Place : Ministry of Road in Bushehr

Date : June 19 (Mon.) '78 11:00 - 12:30

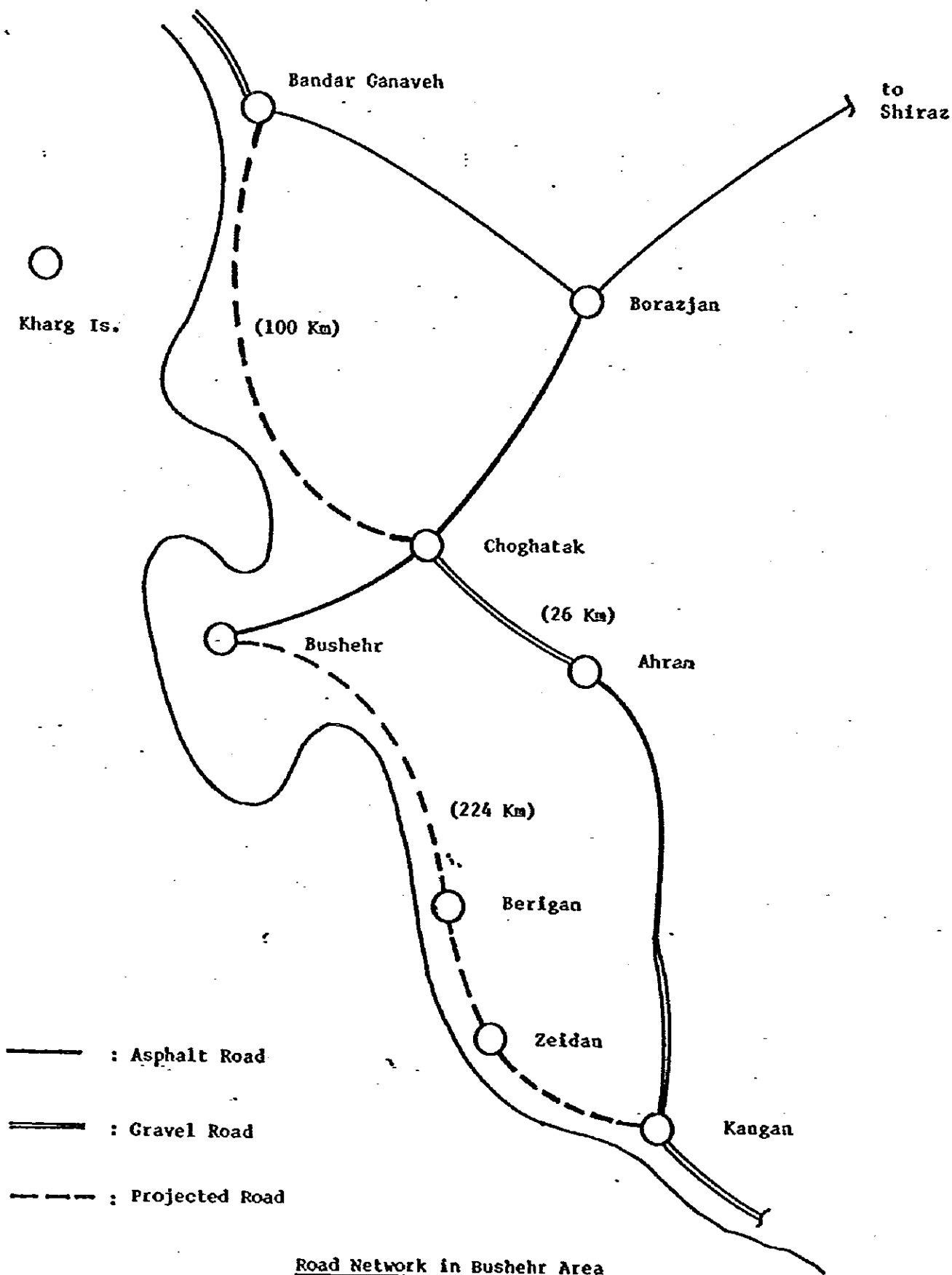
Interviewer : Mr. Navaii (Head of Ministry of Road, Bushehr)

Information obtained:

- Road network (refer to the Figure attached)
- Strength of bridges

All the bridges around Bushehr are designed on the criterion of 30 tons/axle.

- Height of road banking: 1.0 - 1.2 m



Road Network in Bushehr Area

5. Meeting with Port Authority

Date : June 19 (Mon.) '78 18:30 - 19:30

Interviewer : Dr. Fanali (Head of Port Administration)

Information obtained:

- Berthes (refer to the Figure attached)

. Number of berthes

Navy	1 berth
Public	2 berthes

. Dimensions of public berth

Length	170 m x 2
Depth	29'6"

. Strength of platform : 4 ton/m²

. Structure : RC structure

. Water channel

Width	140' - 150'
Depth	30' - 33'

. Annual operation day

All the year round available

- Unloading facilities

. Unloading equipment

50 tons mobile crane 3 units

. Cargo handling capacity

Design	250,000 F. ton/annum
Actual results	Max. 900,000 F. ton/annum (2,500 F. ton/day) Ave. 1,800 - 2,000 F. ton/day

. Unloading capacity

Max. actual result 300 tons/piece
Pipe: 80 m long, 1.5 m diameter

. Warehouse

900 m² x 3 buildings

450 m² x 8 buildings

. Storage area 125,000 m²

- Sea condition

. Range of tide

Bushehr: about 1.5 m

. Soil of the sea bed

Blasting was not used.

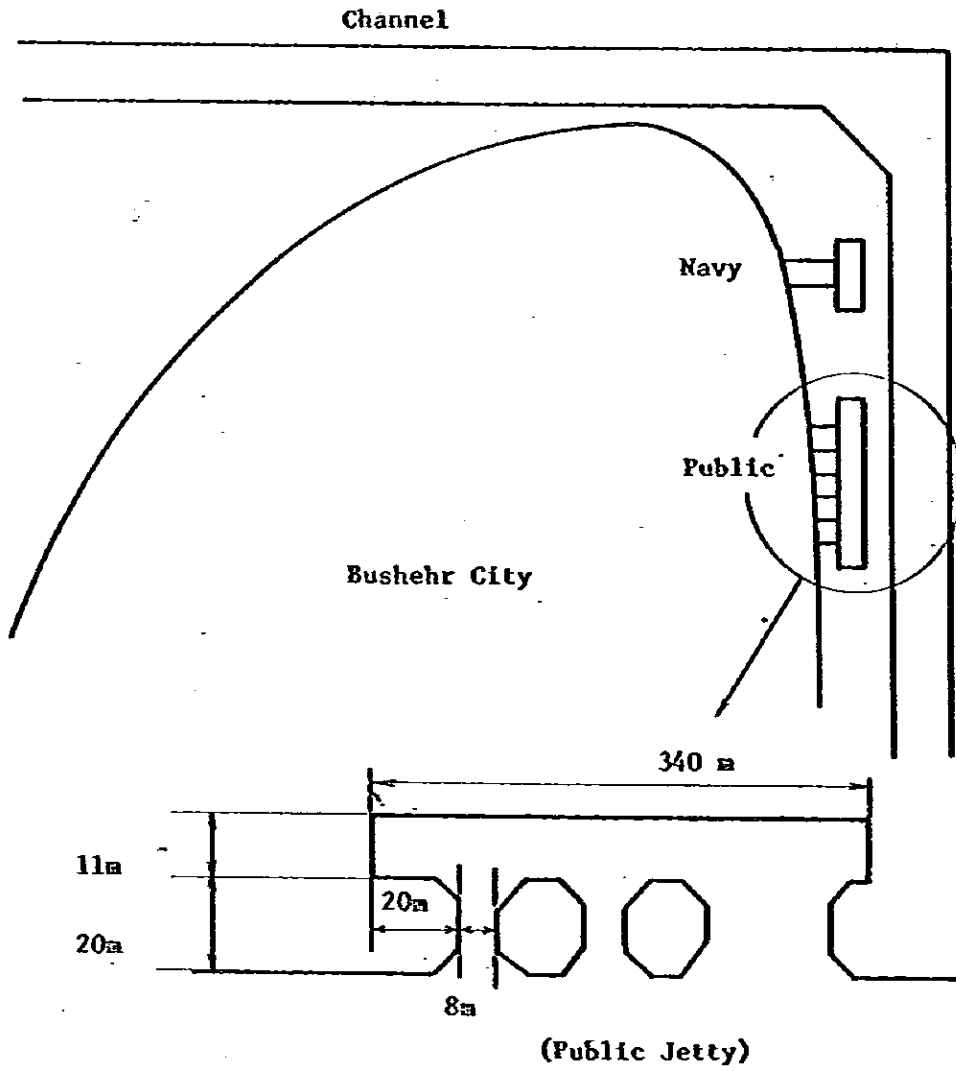
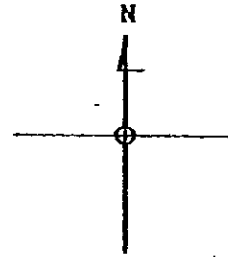
Dredging work was accomplished by ordinary dredging machinery

Sediment accumulation 1 ft/year

Dredging is continuing all the time without suspending cargo
handling in the port.

- Expansion plan

4 berth and 3 warehouse



Jetties at Bushehr Port

ATTACHMENT 3

REPORT

**GEOTECHNICAL SITE RECONNAISSANCE
PROPOSED BUSHEHR EXPORT REFINERY
BUSHEHR, IRAN**

TABLE OF CONTENTS

<u>REPORT</u>	<u>PAGE</u>
1.0 INTRODUCTION.....	1
1.1 PROPOSED CONSTRUCTION.....	1
1.2 PURPOSE.....	2
1.3 SCOPE OF WORK.....	2
1.4 GENERAL SOILS CONDITIONS AT BUSHEHR AREA.....	3
2.0 RESULTS.....	4
2.1 MOHAMMAD AMERI AREA.....	4
2.1.1 Access.....	4
2.1.2 Site Around Boring No. 1.....	5
A- Location.....	5
B- Surface Conditions.....	5
C- Subsurface Conditions.....	6
2.1.3 Site Around Boring No. 2.....	6
A- Location.....	6
B- Surface Conditions.....	6
C- Subsurface Conditions.....	7
2.1.4 Site Around Boring No. 3.....	8
A- Location.....	8
B- Surface Conditions.....	8
C- Subsurface Conditions.....	8
2.1.5 Site Around Boring No. 4.....	9
A- Location.....	9

TABLE OF CONTENTS (CONT.)

<u>REPORT</u>	<u>PAGE</u>
B- Surface Conditions.....	9
C- Subsurface Conditions.....	10
2.2 CHAH TALKH-E-PAIN AREA.....	10
2.2.1 Access.....	11
2.2.2 Site Around Boring No. 5.....	11
A- Location.....	11
B- Surface Conditions.....	11
C- Subsurface Conditions.....	12
2.3 CHOGHADAK AREA.....	12
2.3.1 Access.....	12
2.3.2 Site Around Boring No. 6.....	13
A- Location.....	13
B- Surface Conditions.....	13
C- Subsurface Conditions.....	14
2.3.3 Site Around Boring No. 7.....	14
A- Location.....	14
B- Surface Conditions.....	14
C- Subsurface Conditions.....	15
2.3.4 Site Around Boring No. 8.....	15
A- Location.....	15
B- Surface Conditions.....	16
C- Subsurface Conditions.....	16

TABLE OF CONTENTS (CONT.)

<u>REPORT</u>	<u>PAGE</u>
2.4 HELLEH RIVER AREA.....	17
2.4.1 Access.....	17
2.4.2 Site Around Boring No. 9.....	18
A- Location.....	18
B- Surface Conditions.....	18
C- Subsurface Conditions.....	18
3.0 CONCLUSIONS AND RECOMMENDATIONS.....	19
LIST OF PLATES.....	20
 <u>APPENDIX</u>	
FIELD EXPLORATIONS AND LABORATORY TESTING.....	A-1
A- FIELD EXPLORATIONS.....	A-1
B- LABORATORY TESTING.....	A-2
Moisture Contents.....	A-2
Grain Size Analysis.....	A-2
Atterberg Limits.....	A-3
Specific Gravity Tests.....	A-3
Soil Chemical Tests.....	A-3
LIST OF PLATES.....	A-3

REPORT
GEOTECHNICAL SITE RECONNAISSANCE
PROPOSED BUSHEHR EXPORT REFINERY
BUSHEHR, IRAN

1.0 INTRODUCTION

In this report we present the results of our preliminary soils investigation for the proposed Export Refinery to be constructed near Bushehr.

A total of 9 boring points, clustered in 4 general areas of Mohammad Ameri, Chah Talkh-e-Pain, Choghadak and Ferageh were selected for this reconnaissance study. The selection was made after a visit to the general Bushehr area.

One reconnaissance boring was drilled at each potential site. The general boring locations are shown on Plate 1, Vicinity Map. Details of boring locations in each of the four areas are shown on Plates 1-A through 1-C, Boring Locations.

No boring was drilled at Ameri during this study. Previous Site Selection and Site Validation studies by Dames & Moore for nuclear power plants in that area indicated favorable foundation conditions.

1.1 PROPOSED CONSTRUCTION

We understand that for this preliminary study the proposed Grass-Roots refinery will have a capacity of 500,000 barrels per day. In addition to the main refinery, the planned construction would also include a crude oil pipeline from Gurreh

Station; product pipelines from the refinery to an offshore loading facility; an offshore loading facility; housing and related facilities and an all-weather highway to the refinery.

1.2 PURPOSE

The purpose of this reconnaissance study was to evaluate these 9 boring locations from a geotechnical viewpoint and rank them in order of foundation suitability.

1.3 SCOPE OF WORK

In accordance with your request, the scope of our work consisted of the following;

1. Participation in a field reconnaissance trip to select boring locations;
2. Drilling and sampling of a total of 9 borings, all to depth of 30 meters. The sampling for this reconnaissance study was requested to be carried out at one meter intervals and Standard Penetration Tests only. No undisturbed sampling and testing was planned for this phase of the study;
3. Grain size analysis of 90 samples (10 per boring);
4. Preparation of a written report consisting of boring logs, a description of field methods and a brief discussion of conditions at each boring location.

1.4 GENERAL SOILS CONDITIONS AT BUSHEHR AREA

The soils at the general Bushehr area vary from very soft muds and loose sands to hard clays, very dense sands, gravelly soils, sandstones and coral limestones. Generally speaking, the thickness and extent of softer soils increase towards the shore while more competent deposits prevail as one approaches the mountains east of the coast.

The thickness and depth of the soft soil layers vary along the coast from place to place. To the northeast of Bushehr and in the vicinity of Helleh River, soft soils start near ground surface and extent to depths as much as 30 meters. To the south of Bushehr Penninsula, the thickness and extent of these soft soils generally decrease and near Hallileh are basically non existant. In this area very stiff to hard clays and dense sands which are covered with a coraline limestone caprock are present.

The soft soils reappear south of Bushehr Penninsula but their extent is variable and are normally limited to the coastal region. Alluvial sands and gravels are normally encountered shortly to the east of the coast. The thickness and extent of alluvial sands and gravels increase in areas where the shore is close to the mountains. In Ameri area, for example, these alluvial deposits extend from near surface to depths in excess of 50 meters in some places.

The main source of most of the Bushehr area soils is Aghajari Formation which makes up most of the mountains immediately east of the coast. Due to the abundance of gypsum and anhydrite in this formation, nearly all shallow soils of the Bushehr area have high sulfate contents and hence use of sulfate resisting cement is a must for all concrete in contact with soils.

2.0 RESULTS

The surface and subsurface conditions encountered in each of the boring locations are presented in this section. A detailed description of field exploration methods and laboratory testing procedures are presented in the Appendix.

2.1 MOHAMMAD AMERI AREA

A total of 4 borings were drilled at four separate sites in this general area. The location of this area relative to Bushehr is shown on Plate 1, Vicinity Map. Details of boring locations in this area are presented on Plate 1-A. The conditions encountered in each boring locations are described in the following paragraphs:

2.1.1 ACCESS

The access to this area is through the main Choghadak-Ameri road. The road from Bushehr to the junction of Choghadak-Ameri road is about 24 km long and is paved. This is the main Bushehr-Borazjan road which the Ameri road joins about 2 km, southwest of Choghadak.

The Ameri road is a second class gravel road from this junction, up to a distance of about 19 kilometers. A third class dirt road follows the gravel road and is the main access to the Mohammad Ameri sites and other coastal villages beyond. The gravel section of the road is accessible all-year round while the dirt road that follows may not be usable in some places during wet seasons. When accessible, the Mohammad Ameri

area sites can be reached from Bushehr with a 4-wheel drive vehicle within 1.5 - 2 hours

2.1.2 SITE AROUND BORING NO. 1

A- Location:

This is the farthest site south of Bushehr and at about 63 kilometers (road distance) from it. The site is located between Mohammad Ameri (Medumeri) and Bashi villages and within a kilometer of the Persian Gulf. The boring location of this site (B-1) is shown on Plate 1-A.

B- Surface Conditions:

This site is traversed by several branches of a drainage system. Small bushes and weeds are scattered throughout the site. The ground surface is covered with very fine grained sandy and silty soils. A moving sand dune, of about 600 meters length, 250 meters width and 5-10 meters of crest height is located to the north of the site. The dune's movement is in an easterly direction.

According to local residents, the lower (western) part of the site is occasionally flooded for short periods. Based on the same source, the flood depth has not been observed to exceed 0.5 meter over most of the area, except in the drainage channels.

Photographs of this site taken from near boring No. 1 in north, south, east and west directions are presented on Plate 2-A.

C- Subsurface Conditions:

Details of the soils encountered in the boring drilled at this site (Boring No.1) are presented on Plate A-1A, Log of Boring. A plot of standard penetration resistance versus depth is also shown on the same Plate.

Based on this boring alone, the foundation conditions at this site are fair, down to a depth of about 8 meters. Below this depth, good foundation conditions prevail. The grain size distribution of selected samples recovered from this boring are presented on Plates A-2A through A-2D.

During the field exploration period, the groundwater level was measured to be 1.85 meters below the ground surface at the boring location.

2.1.3 SITE AROUND BORING NO. 2

A- Location:

This site is located about 1.5 kilometers northeast of site No. 1 and about 61.5 kilometers from Bushehr. The general location of the site is shown on Plate 1. Vicinity Map (B-1) and the location of the boring (B-1) drilled at this site is shown on Plate 1-A.

B- Surface Conditions:

This site is located between two main drainage systems south of Mohammad Ameri. Tributaries of these two drainage systems surround the site on the north, east and south sides.

The ground surface is relatively flat with a gentle westerly slope. Short bushes are scattered over the site.

The ground near the western end of the site and close to the Mohammad Ameri - Bashi road is occasionally cultivated by local farmers. The land, however, is cultivated only during rainy years and is not owned by any private party.

According to local residents, flooding has not been observed at the site in the past 15 years. During the rainy season, the drainage channels around the site remove most of the flood water.

Photographs of this site taken from near boring No. 2 in north, south, east and west directions are presented on Plate 2-B.

C- Subsurface Conditions:

The soils encountered in the boring drilled at this site (Boring No. 2) are described in detail on Plate A-1B, Log of Boring. A plot of standard penetration resistance versus depth is also shown on the same Plate.

As seen from the boring log, the soils underlying the site are predominantly sandy and clayey in nature. The grain size characteristics of selected samples recovered from this boring are presented on Plates A-2E through A-2G.

The soils encountered in the boring drilled at this site indicate good foundation conditions.

The groundwater was measured to be 3.60 meters below

ground surface at the boring location.

2.1.4. SITE AROUND BORING NO. 3

A- Location:

This site is located about 3 kilometers northwest of Mohammad Ameri village and is about 58 kilometers from Bushehr. Its location with respect to the Bushehr area is shown on Plate 1, Vicinity Map (Marked as B-3). The location of the boring (B-3) that was drilled at this site is shown on Plate 1-A.

B- Surface Conditions:

The ground surface at this site is nearly flat, with an estimated maximum difference in elevations over the entire site of about 1-2 meters. Some parts of the site are cultivated irregularly. The land, however, is not owned by anyone.

Based on local residents, the site is occasionally flooded but the depth of water has not been observed to exceed 0.3 meter at the deepest.

A general view of the site can be seen on Plate 2-C.

C- Subsurface Conditions:

Details of the soils encountered in the boring drilled at this site, along with a plot of the standard penetration resistances are presented on Plate A-1C.

This boring revealed dense silty and clayey sands extending to a depth of about 5 meters. From this depth down to about 7.5 meters, a soft clay underlies the site. Firm sandy and clayey soils extent from 7.5 meters down to the maximum depth drilled (30.0 meters).

The grain size characteristics of selected soils samples recovered from this boring are presented on Plates A-2H through A-2J.

The groundwater was measured to be 1.50 meters below ground surface at this boring location.

2.1.5 SITE AROUND BORING NO. 4

A- Location:

This site is located about 2 kilometers northeast of Mohammad Ameri and about 59 kilometers from Bushehr. The general location of the site (B-4) with respect to its neighborhood is illustrated on Plate 1, Vicinity Map. The as-drilled boring location of this site is shown on Plate 1-A.

B- Surface Conditions:

The ground surface at this site is relatively flat with a few shallow (0.5 - 1 m deep) gullies which form a drainage system, crossing the site. The ground has a gentle westerly slope and is covered with clayey soils.

The land has been cultivated in the past but it has not been used in recent years. The land is not owned by anyone.

Based on local information, portions of the eastern and northern parts of the site become flooded during heavy rainfalls for short periods but the observed flood depth has not exceeded 0.5 meter.

Photographs of this site, taken from near boring No. 4 in a north, south, east and west direction are presented on Plate 2-D.

C- Subsurface Conditions:

The soils encountered in the boring drilled at this site are presented in detail on Plate A-1D. A plot of standard penetration resistance versus depth is also shown on the same Plate.

Based on this boring, sandy and clayey soils representing fair to good foundation conditions extend to a depth of about 16.5 meters. Below this depth very firm soils underly the site down to the maximum depth explored.

The grain size distribution of selected samples that were recovered from this boring are presented on Plate A-2K through A-2M.

The groundwater was measured to be 7.50 meters below ground surface at the boring location.

2.2 CHAH TALKH-E-PAIIN AREA

One boring was drilled in this area for the reconnaissance study. The general location of this area with respect to Bushehr is illustrated on Plate 1, Vicinity Map. The detailed location

of the boring drilled in this area is shown on Plate 1-B.

2.2.1 ACCESS

This area is fairly easily accessible from Bushehr. The access is through the main Choghadak-Ameri and Bushehr-Borazjan roads. The site is located about 17 kilometers from the junction of Choghadak-Ameri and Bushehr-Borazjan roads. Its total distance from Bushehr is about 41 kilometers and the site can be reached within an hour or so, all year round.

2.2.2 SITE AROUND BORING NO. 5

A- Location:

This site is adjacent to and lies to the west of the Choghadak-Ameri gravel road. The general location of the site (B-5) is shown on Plate 1, Vicinity Map and the as-drilled boring location is shown on Plate 1-B.

B- Surface Conditions:

The ground surface at this site is nearly flat with a gentle westerly slope. The site is covered with many short bushes.

Based on information from local inhabitants, the site is occasionally flooded to a depth not exceeding 0.7 meter.

The land is not cultivated and is not owned by anyone.

Photographs of this site are presented on Plate 2-E.

C- Subsurface Conditions:

The soils encountered in this area are presented in detail on Plate A-1E. The variation of standard penetration resistance with depth is also presented on the same Plate.

Based on the boring drilled at this site, a relatively poor soils condition prevails down to a depth of about 7 meters. The foundation conditions improve below 7 meters and become fair to good down to a depth of 12.5 meters. Below 12.5 meters and down to a depth of 30.0 meters, excellent foundation conditions prevail.

The grain size characteristics of selected soil samples recovered from this area are presented on Plates A-2N through A-2P.

The groundwater level inside the boring was measured to be 1.10 meters below ground surface.

2.3 CHOGHADAK AREA

A total of 3 borings were drilled in this general area (borings 6, 7 and 8). The location of this area relative to Bushehr is shown on Plate 1, Vicinity Map. The as-drilled boring locations of this area are presented on Plate 1-B.

2.3.1 ACCESS

The access to this area is by the main paved Bushehr-Borazjan road up to Choghadak and then over dirt tracks to each site.

The main paved road is usable all year round and Choghadak can be reached from Bushehr with any vehicle within half an hour. However, the tracks which depart from Choghadak to each of the 3 sites in this area, are not accessible during wet season because of flooding. At the time of the field exploration, all sites were easily accessible within less than 10 minutes from Choghadak.

2.3.2 SITE AROUND BORING NO. 6

A- Location:

This site is located about 2 kilometers east of the Bushehr-Borazjan road and approximately 1 kilometer south of the Choghadak Ameri gravel road. The general site location (B-6) is shown on Plate 1, Vicinity Map and the as-drilled boring location of this site (B-6) is illustrated on Plate 1-B.

B- Surface Conditions:

The ground surface at this site is nearly flat and is covered with scattered short bushes and weeds. Some areas in the northern and eastern parts of the site are occasionally cultivated, but the land is not owned by anyone.

Based on local data, it appears that the site is flooded almost every year. The flood depth in some places is as great as 1.2 meters.

Photographs of this site are presented on Plate 2-F.

C- Subsurface Conditions:

Details of the soils encountered in the boring drilled at this site are presented on Plate A-1F. A plot of standard penetration resistance versus depth is also presented on the same Plate.

From ground surface down to a depth of about 6 meters, the site was underlain by medium stiff clayey soils, which make a fair foundation condition. Below 6 meters very dense sands were encountered at the site, representing good foundation condition.

The grain size characteristics of selected soil samples recovered from this area are presented on Plates A-2Q through A-2S.

The groundwater level was measured to be 2.75 meters below the ground surface during the field exploration period.

2.3.3 SITE AROUND BORING NO. 7

A- Location:

This site is located about 2 kilometers west of the Bushehr-Borazjan road. The general location of the site (B-7) is shown on Plate 1, Vicinity Map and the as-drilled boring location at this site is presented on Plate 1-B.

B- Surface Conditions:

The ground surface is nearly flat at this site. The maximum difference in elevations over the entire site is estimated to be less than 1 meter.

Small bushes are scattered over the site. The land is not owned by any private party.

Based on local information, the site is apparently flooded almost every year during the wet season. The depth of observed flooding in some places exceeds 1.5 meters.

Photographs of the site are presented on Plate 2-G.

C- Subsurface Conditions:

The soils encountered in the boring drilled at this site (Boring No. 7) are presented in detail on Plate A-1G. The variation of standard penetration resistances with depth is also presented on the same plate.

Medium stiff clays extend from near the ground surface down to a depth of about 10 meters representing poor foundation conditions. From 10 meters down to 16.5 meters stiff clays, hence fair foundation conditions were encountered. Below 16.5 meters dense sands and hard clays representing good foundation conditions were present at the boring location to the depth explored.

The grain size distribution for selected samples of the soils recovered from this site are presented on Plates A-2T through A-2V.

The groundwater level was measured to be 1.20 meters below ground surface at this location.

2.3.4 SITE AROUND BORING NO. 8

A- Location:

This site is located about 5 kilometers west of site No. 7

and about 7 kilometers west of Choghadak. The general location of this site (B-8) with respect to the Bushehr area is shown on Plate 1, Vicinity Map. The location of the boring drilled at this site (B-8) is shown on Plate 1-B.

B- Surface Conditions:

The ground surface at this site is covered with a thin loose silty soil and is nearly flat. A few very shallow and broad drainage channels cross the site. However, the maximum elevation difference over the entire site is estimated to be less than 1 meter.

The land is not owned by any private party and belongs to the government.

Local inhabitants inform that the site is flooded almost every year. However, no observations have been made of the depth of flooding at this site because of its remote location. Based on observations made in the vicinity of site No. 7 and considering the nearly flat topography, it is estimated that the flood depth at this site could be in excess of 1 meter.

Photographs of this site are presented on Plate 2-H.

C- Subsurface Conditions:

Details of the soils encountered in this area, along with a plot of the variation of penetration resistance with depth are presented on Plate A-1H.

At the boring location, the site is underlain with rather

poor foundation soils down to a depth of about 14.5 meters. Dense to very dense sands and very stiff to hard clays extend from 14.5 meters down to 30.0 meters.

The grain size characteristics of selected soil samples recovered from this site are presented on Plates A-2W through A-2Y.

The groundwater level was measured to be 1.20 meters below ground surface at the boring location.

2.4 HELLEH RIVER AREA

One boring was drilled in this area (Boring No. 9). The general site location with respect to the Bushehr area is shown on Plate 1, Vicinity Map.

2.4.1 ACCESS

This is the farthest site from Bushehr and is about 130 kilometers away from it. The access roads to the site can be divided into 3 sections. From Bushehr up to the Village of Ab-Pakhsh on the main Genaveh road, a distance of about 82 kilometers, the road is paved. A secondary gravel road extends from Ab-Pakhsh down to Mokaberi Village, a distance of about 25 kilometers. This part of the road, like the paved section, is accessible all year round. Dirt tracks extend for a distance of about 23 kilometers from Mokaberi Village down to the site. Some sections of this road are not passable during the wet season. During the field exploration the site was reached from Bushehr with a 4-wheel drive vehicle in about 3 hours.

2.4.2 SITE AROUND BORING NO. 9

A- Location:

The site is located about 2.7 kilometers east of Ferageh village. The general site location with respect to the Bushehr area is shown on Plate 1, Vicinity Map. The location of the boring drilled at this site (B-9) is shown on Plate 1-C.

B- Surface Conditions:

The ground surface at this site is nearly flat. The maximum elevation difference over the entire site is estimated to be less than 1 meter. Several very shallow (less than 0.3 meter deep) and broad drainage channels cross the site. The ground surface is covered with a thin loose silty soil and many short bushes are scattered over the site.

The land is not cultivated and does not belong to any private party.

According to local residents, the site is apparently flooded on occasions, but no information was available on flood depth.

Photographs of this site are presented on Plate 2-I.

C- Subsurface Conditions:

Details of the soils encountered at this site are presented on Plate A-II. A plot of the variation of penetration resistance with depth is also presented on the same Plate.

Very poor foundation soils were encountered down to a depth of about 25.5 meters. Below this depth and down to 30.0 meters in depth, dense to very dense sands and very stiff clays underly the site.

The gradation characteristics of selected soil samples recovered from this area are presented on Plates A-2Z through A-2BB.

The groundwater level, measured one hour after the completion of the boring, was found to be 4.5 meters below ground surface.

3.0 CONCLUSIONS AND RECOMMENDATIONS

Each of the 9 sites investigated have their merits and potential problems. While it should be realized that the amount of information from each boring location is very limited, from the viewpoint of foundation suitability, the sites can be preliminarily ranked, in a decreasing order, as 2, 4, 3, 6, 1, 5, 8, 7 and 9. However, more detailed study is required to evaluate the overall economic and environmental suitability of each site.

We recommend that the potential for flooding, fill and aggregate sources, fresh water resources, and the availability of infra structures such as roads, power lines, etc. be studied in more detail during the next phase of this site selection investigation.

Considering the foundation conditions, estimated site grading and fill requirements, access, and the fact that most

of the known fill and aggregate sources of the Bushehr area are located within short distances from Choghadak, it is our opinion that further detailed investigation should be primarily concentrated in Mohammad Ameri and Choghadak areas.

- * * * * *

The following Plates and Appendix are attached and completed this report:

Plate 1	Vicinity Map
Plate 1-A	Boring Locations, Mohammad Ameri Area
Plate 1-B	Boring Locations, Choghadak/Chah Talkh Area
Plate 1-C	Boring Location, Helleh River Area
Plate 2-A	Site No. 1 Photographs
Plate 2-B	Site No. 2 Photographs
Plate 2-C	Site No. 3 Photographs
Plate 2-D	Site No. 4 Photographs
Plate 2-E	Site No. 5 Photographs
Plate 2-F	Site No. 6 Photographs
Plate 2-G	Site No. 7 Photographs
Plate 2-H	Site No. 8 Photographs
Plate 2-I	Site No. 9 Photographs

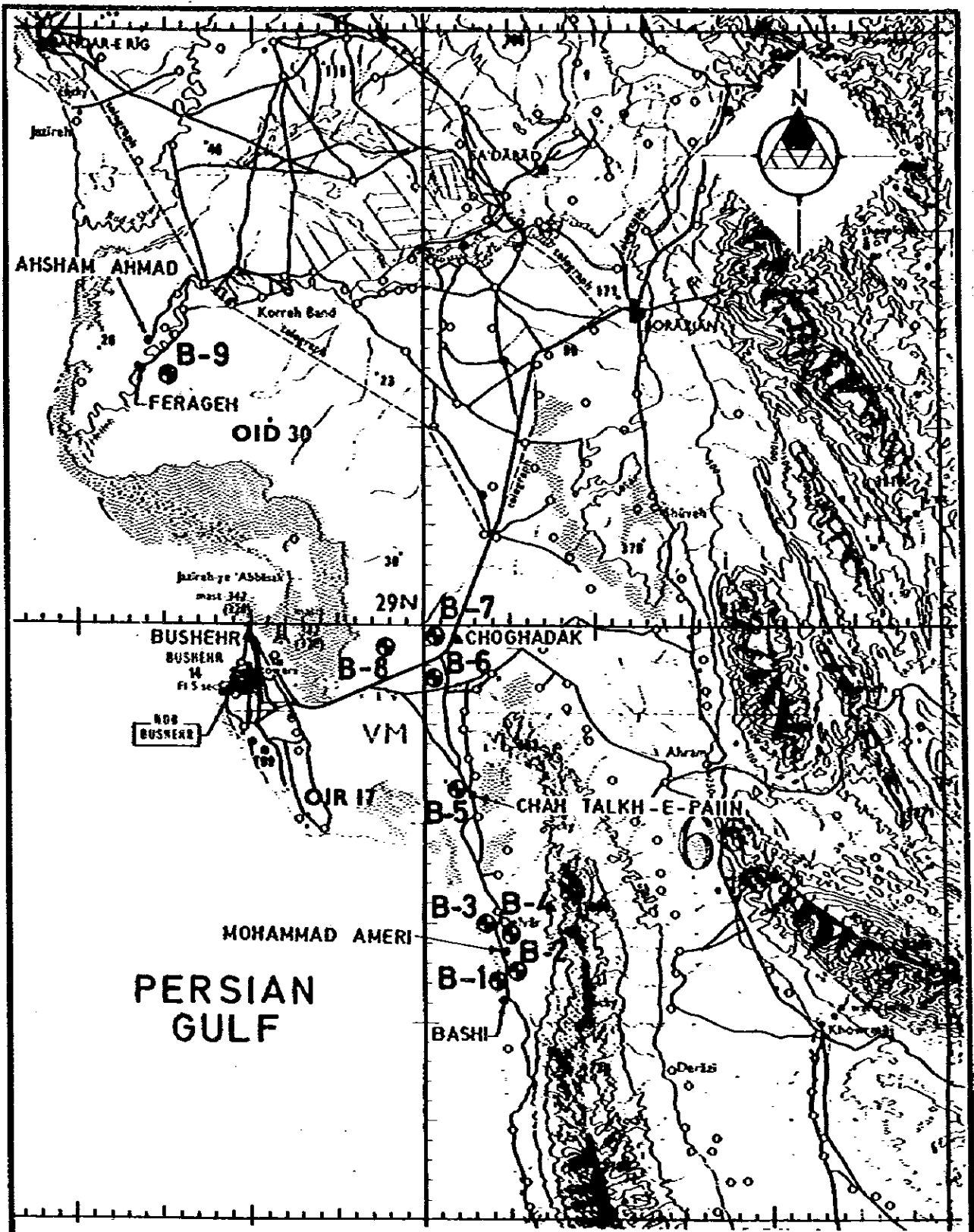
Appendix

DRAWN BY _____ DATE _____
CHECKED BY _____ DATE _____

REVISION 2
BY _____ DATE _____

REVISION 1
BY _____ DATE _____

FILE 2265-172-50



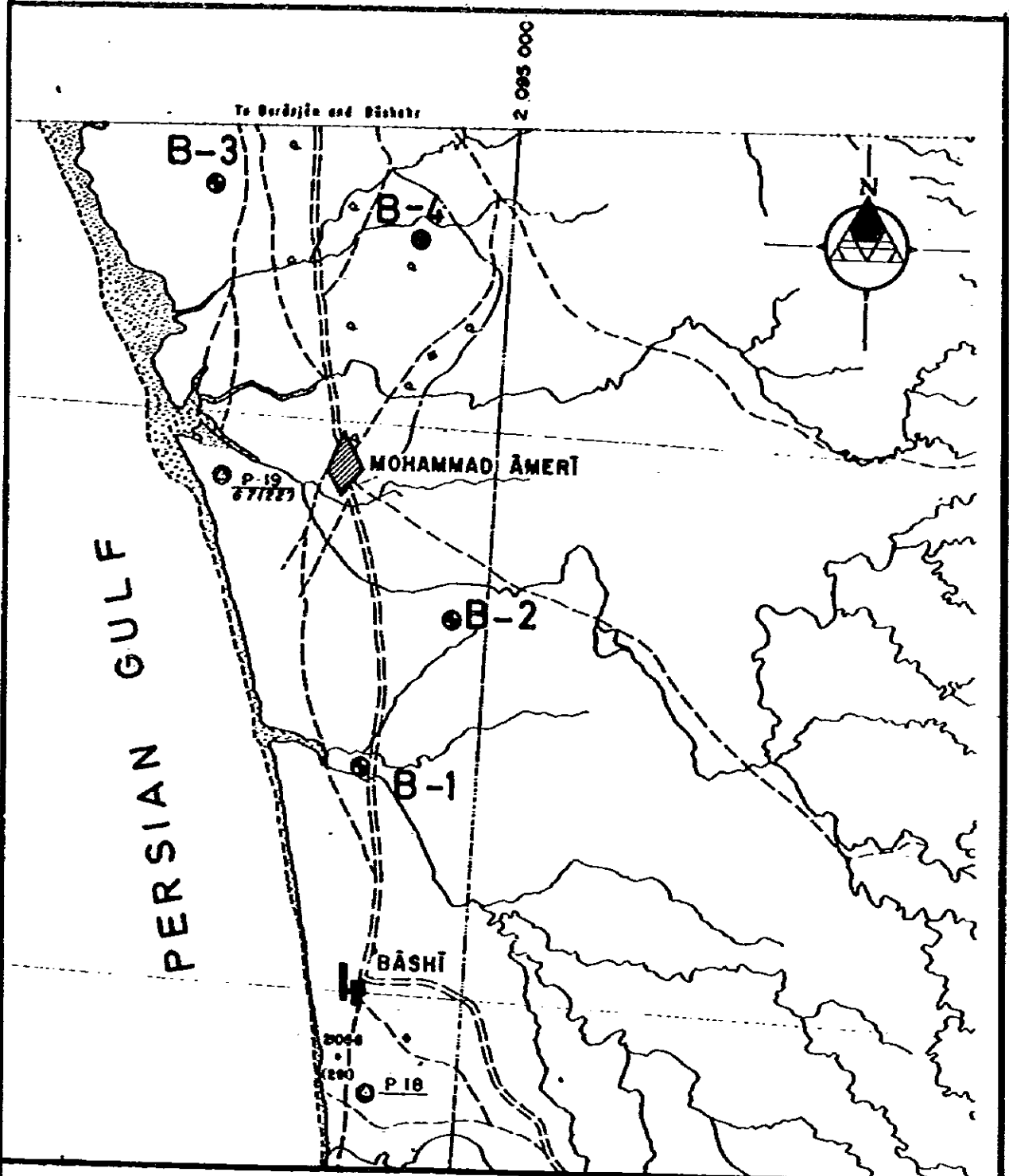
VICINITY MAP

SCALE 1:500,000

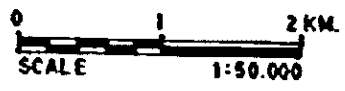
● BORING LOCATIONS

DAMES & MOORE

PLATE 1



**BORING LOCATIONS
MOHAMMAD AMERI AREA**



BARNS & BROS

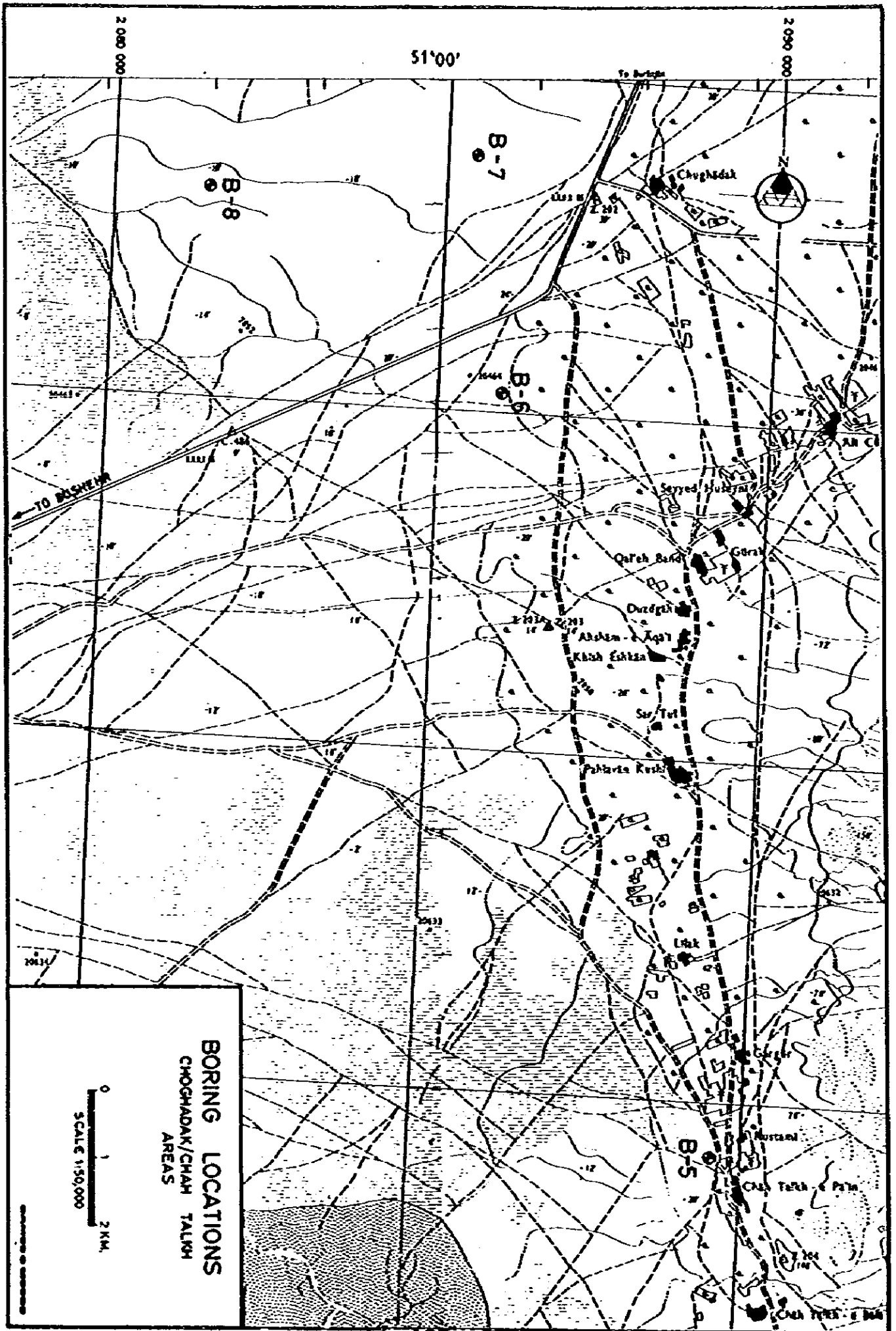
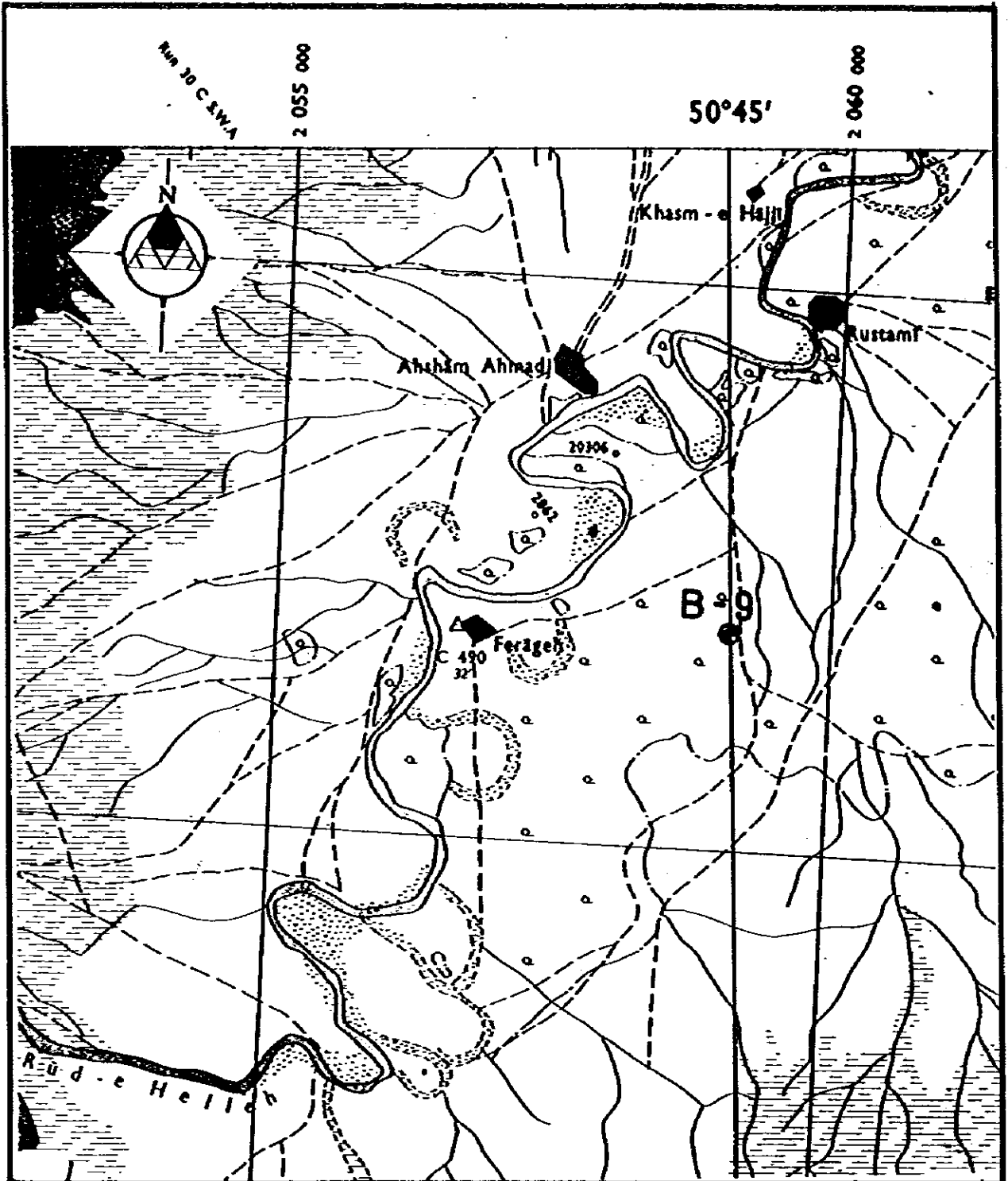
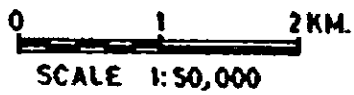


PLATE 1-8

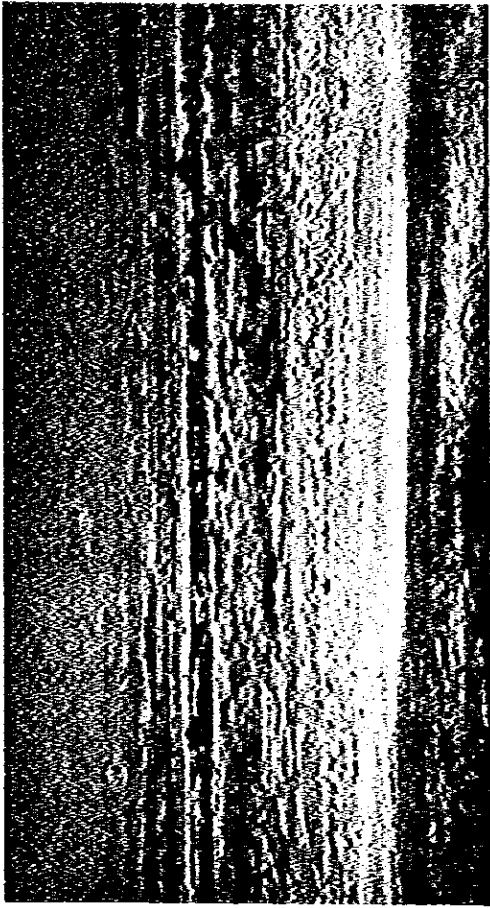


**BORING LOCATIONS
HELIEH RIVER AREA**

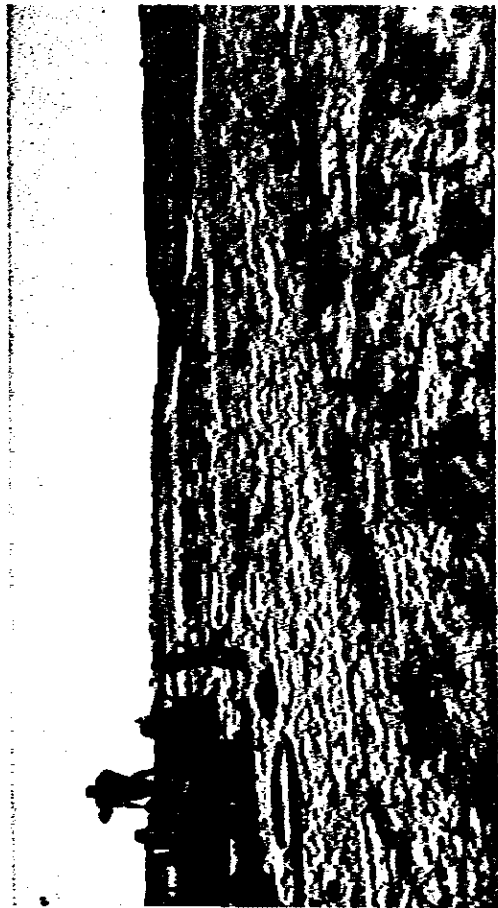


DAMES & MOORE

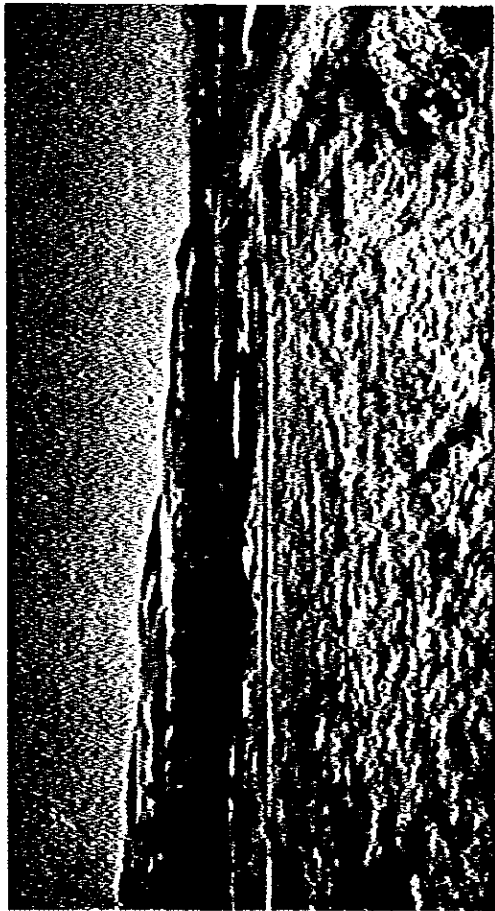
PLATE 1-C



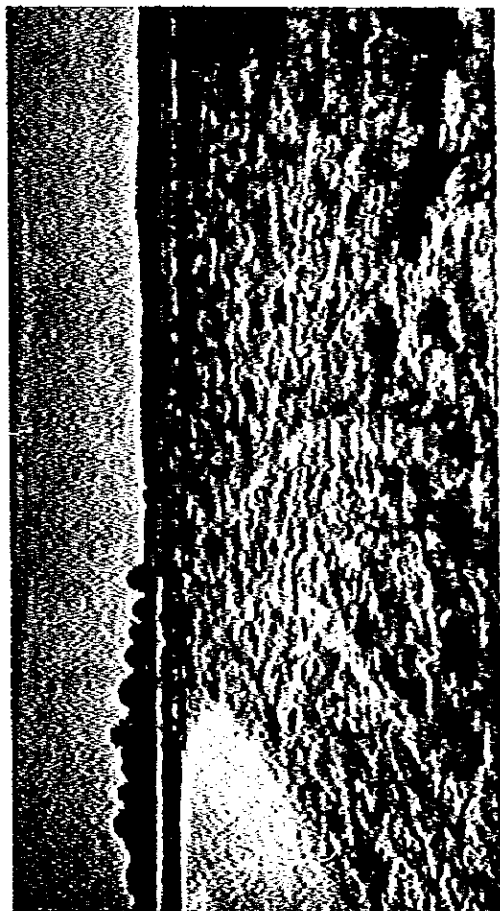
EAST



WEST

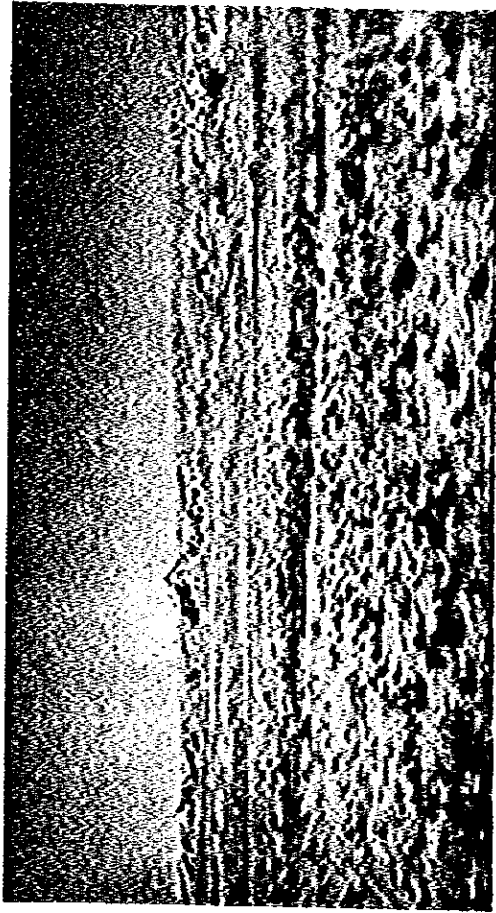


NORTH

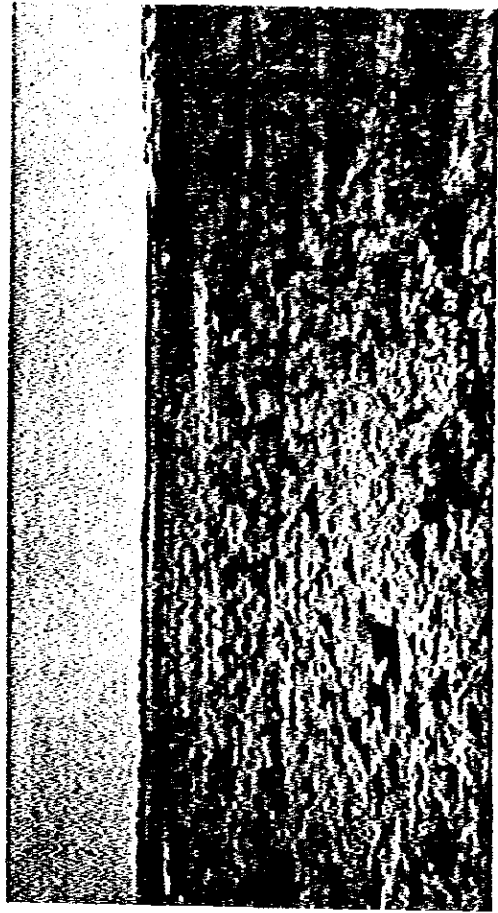


SOUTH

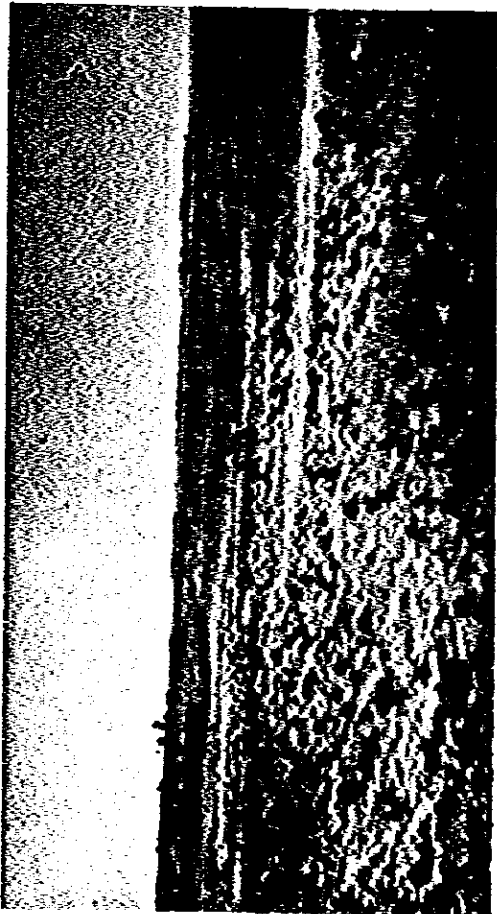
SITE NO. 1 PHOTOGRAPHS



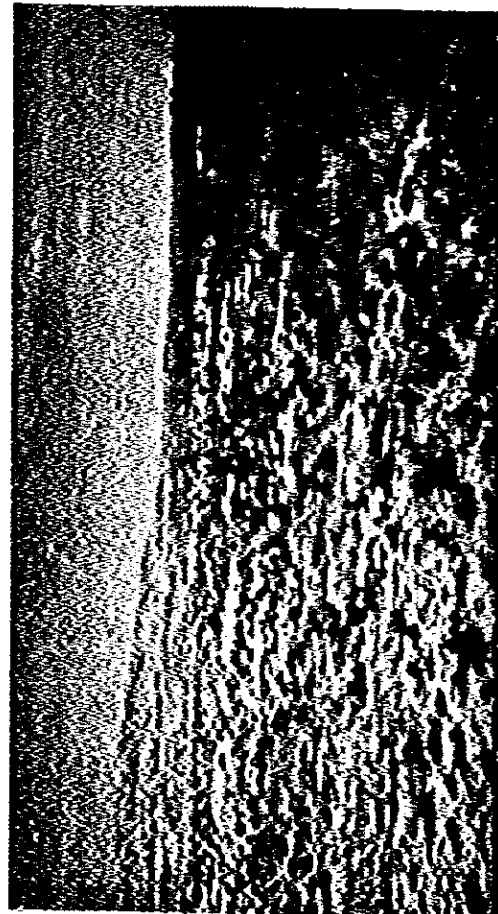
EAST



WEST

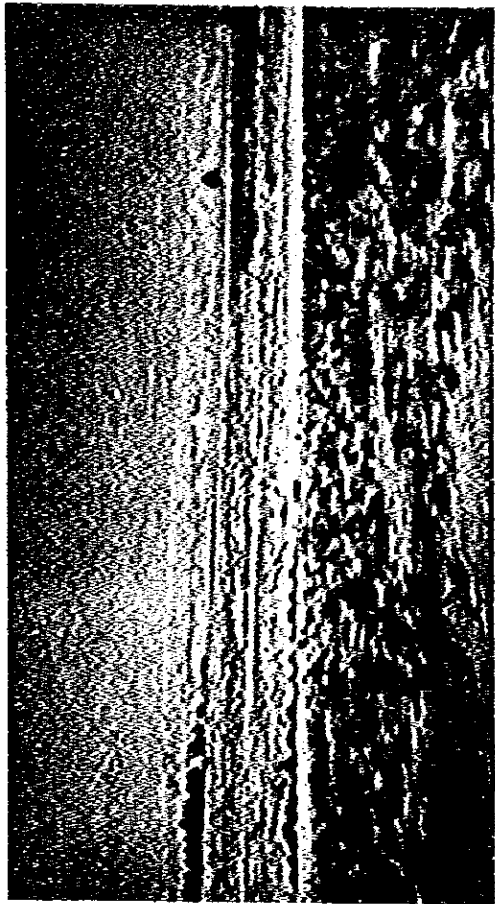


NORTH

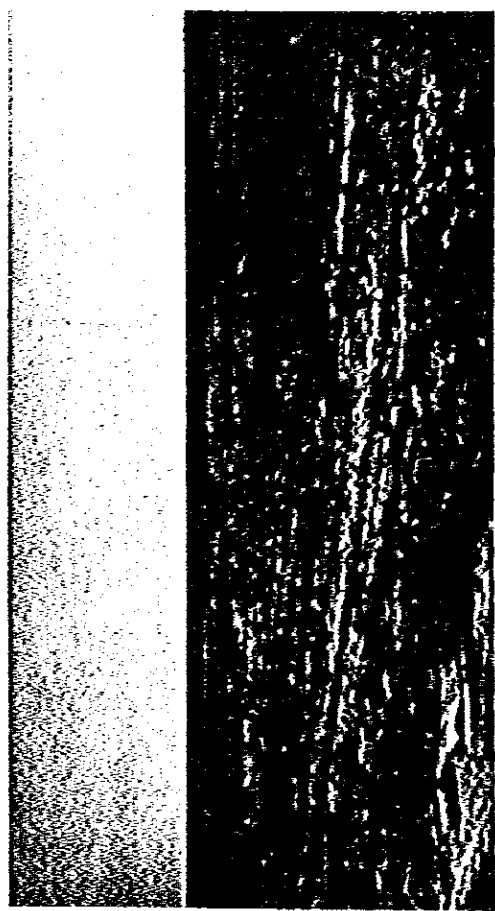


SOUTH

SITE NO. 2 PHOTOGRAPHS



EAST



WEST

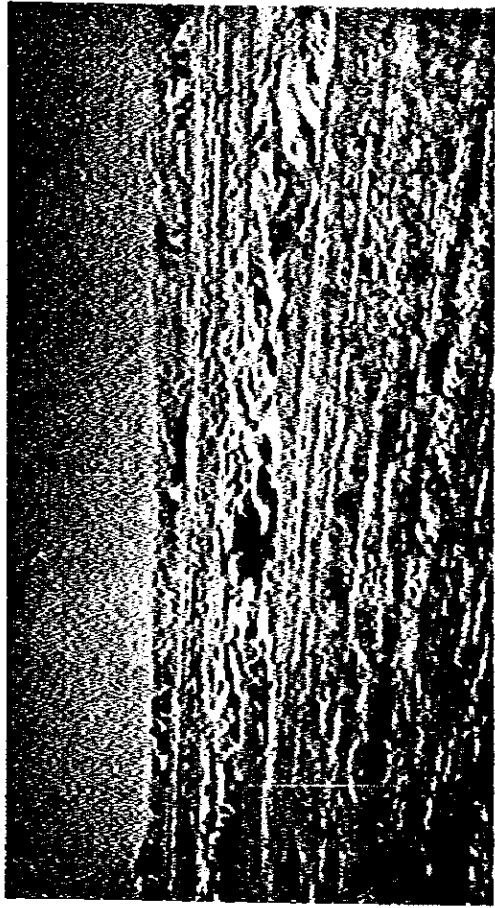


NORTH

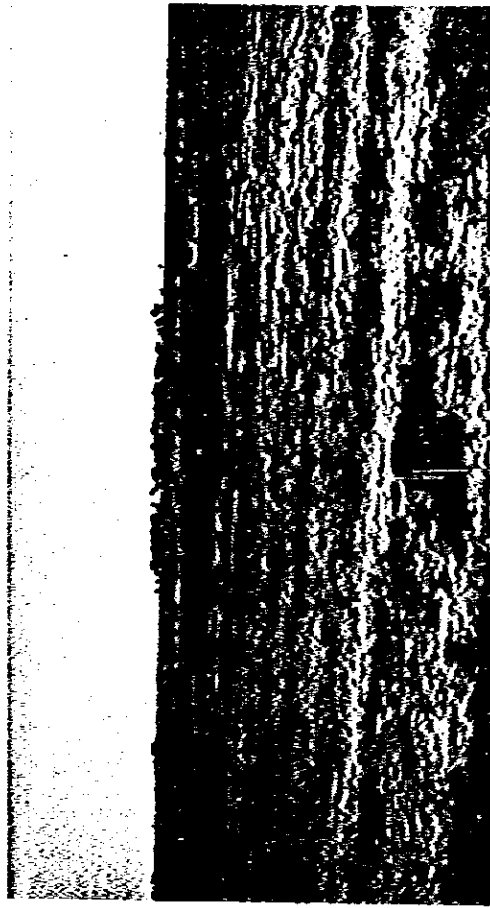


SOUTH

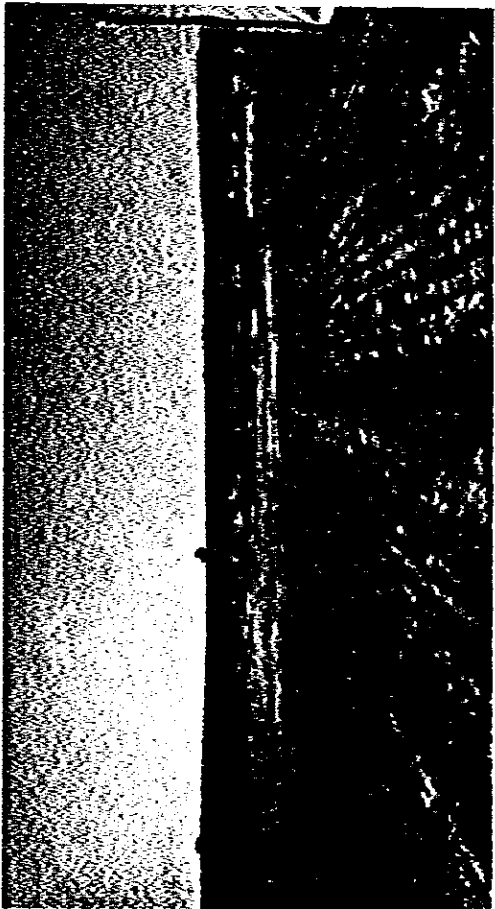
SITE NO. 3 PHOTOGRAPHS



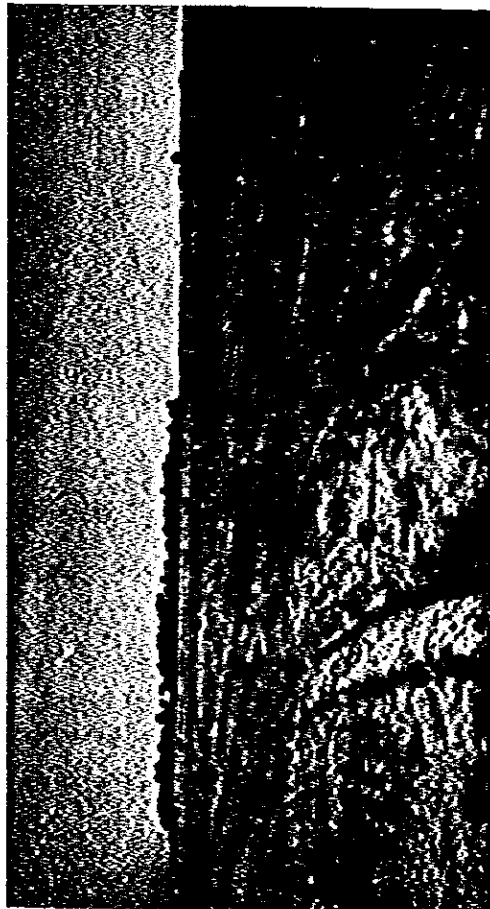
EAST



WEST

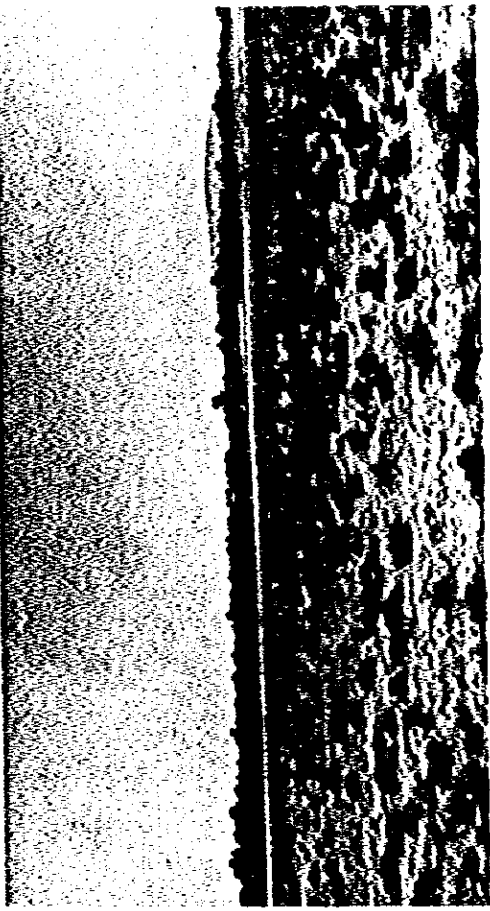


NORTH

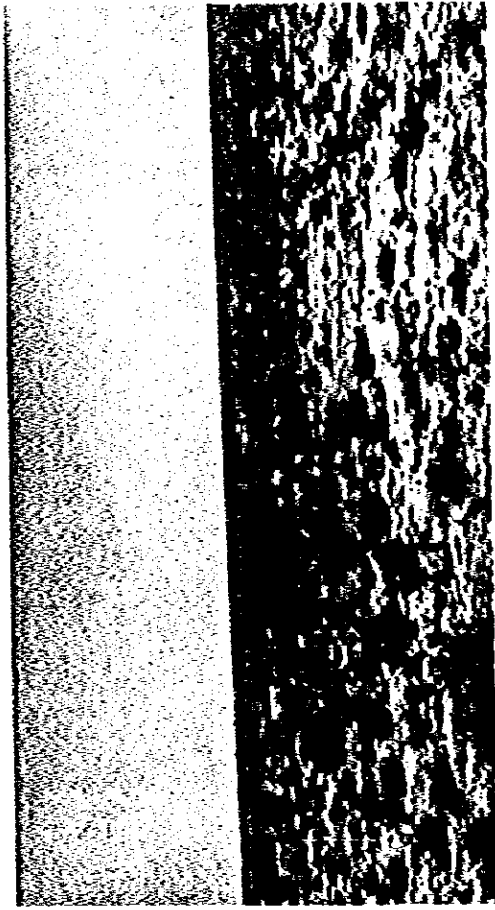


SOUTH

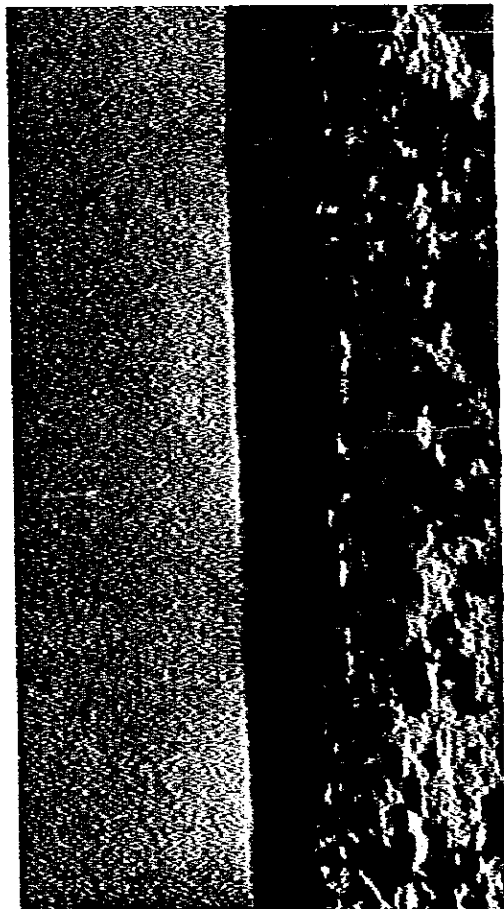
SITE NO. 4 PHOTOGRAPHS



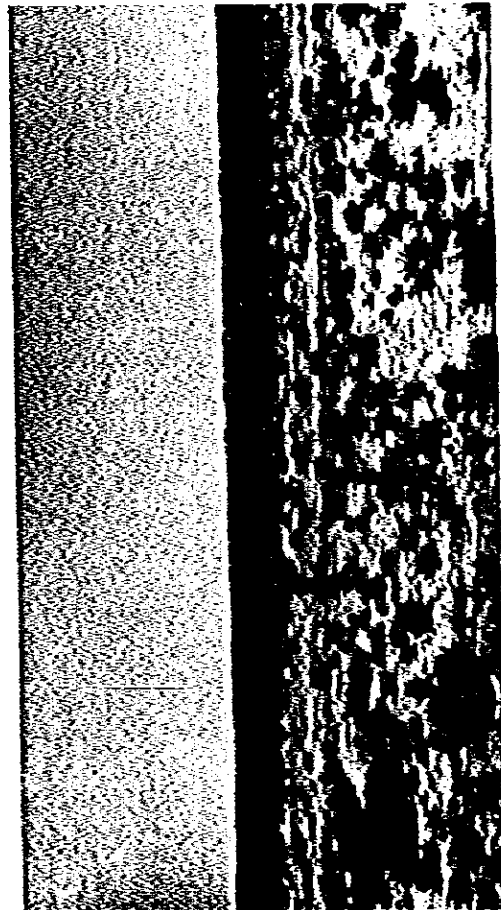
EAST



WEST

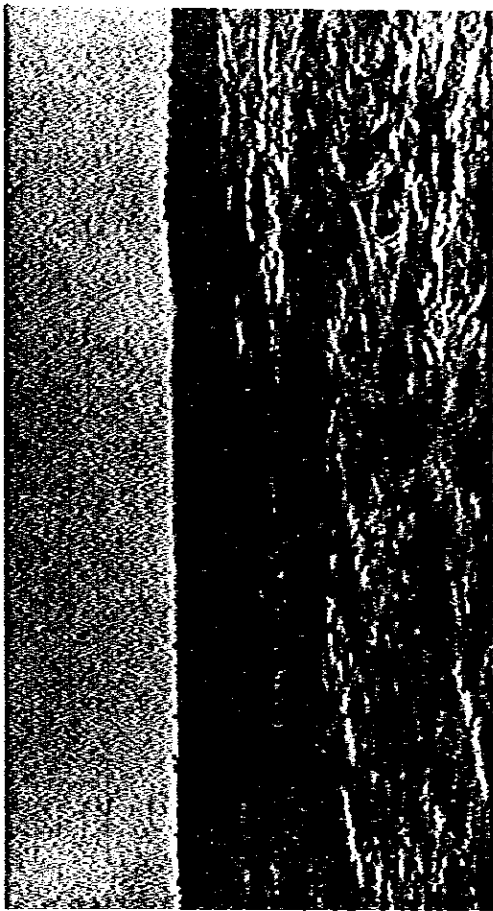


NORTH

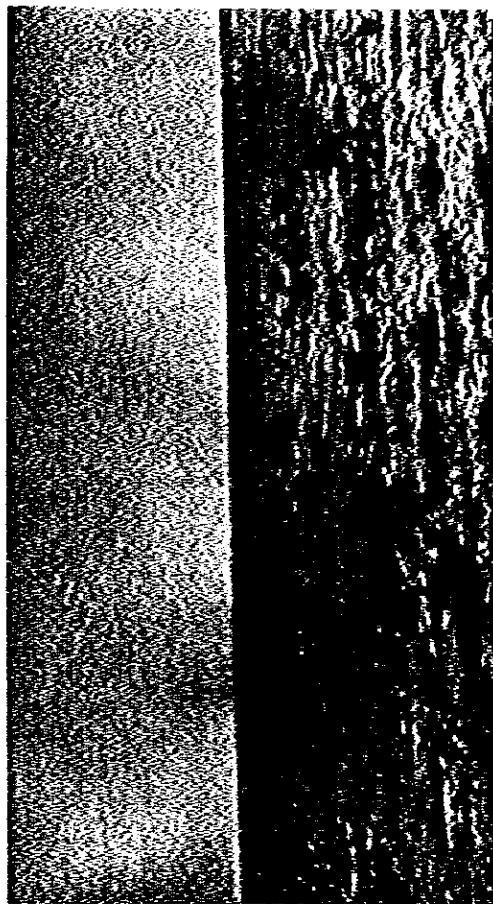


SOUTH

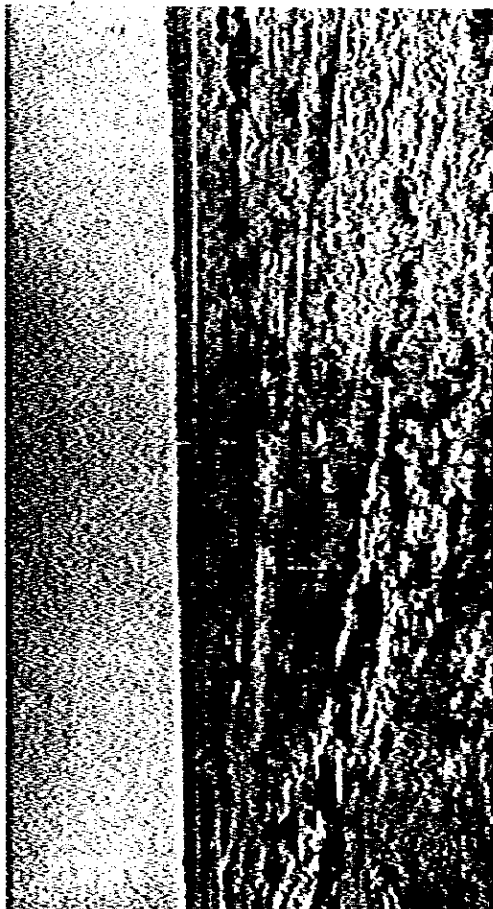
SITE NO. 5 PHOTOGRAPHS



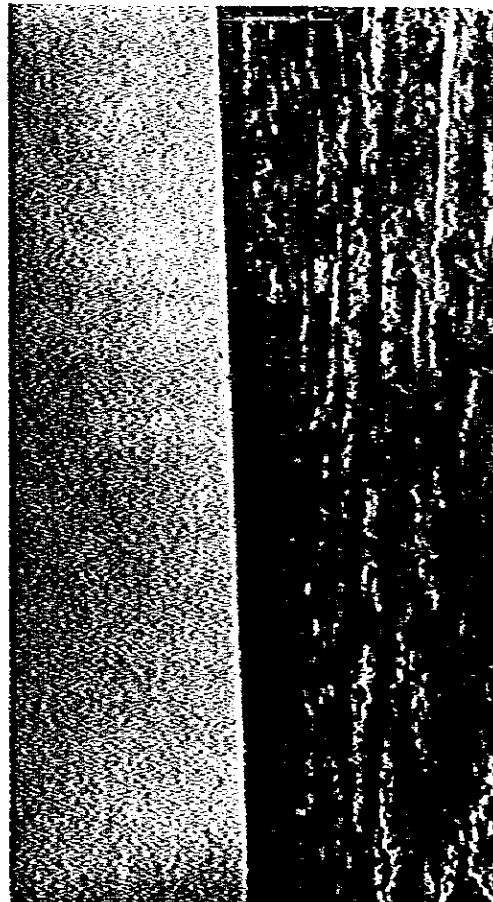
EAST



WEST

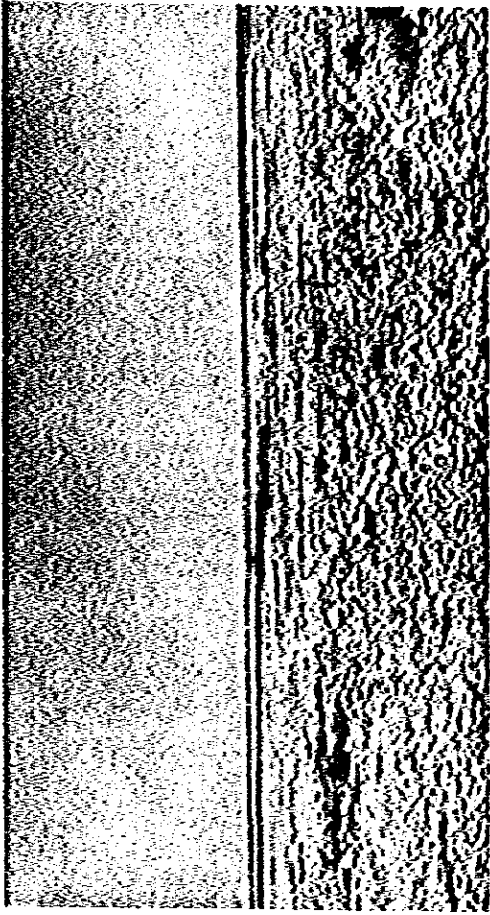


NORTH

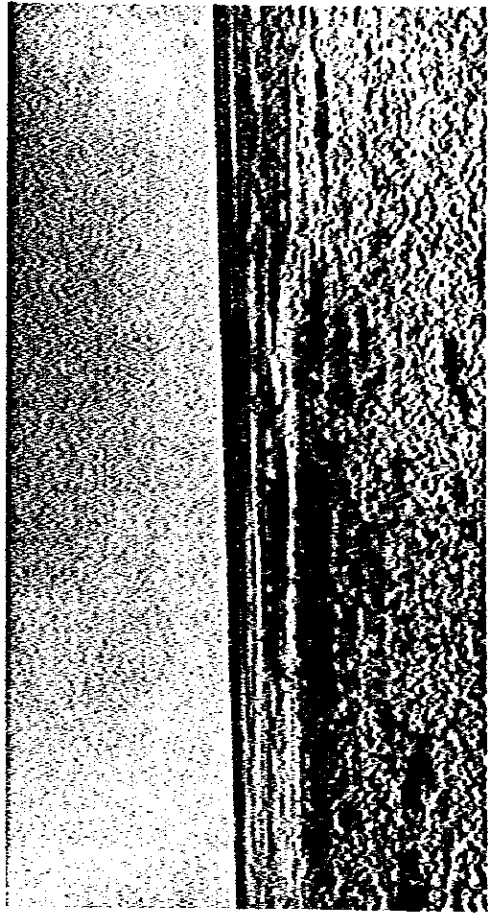


SOUTH

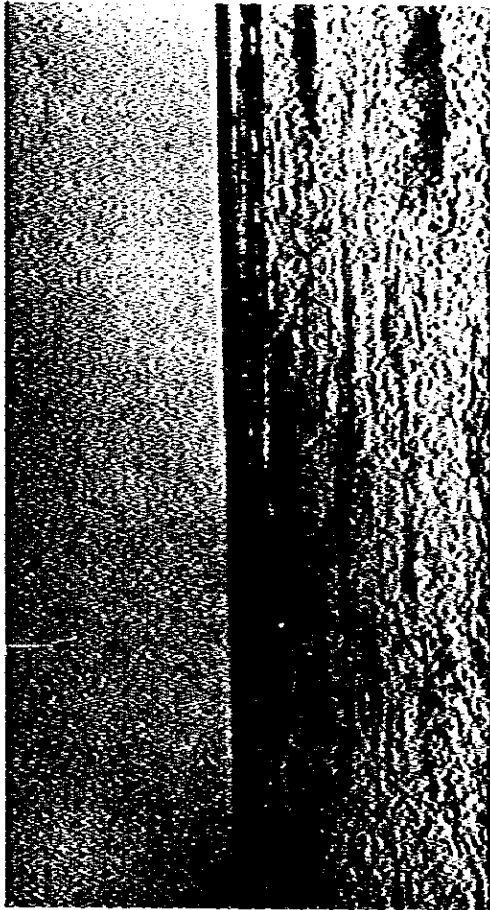
SITE NO. 6 PHOTOGRAPHS



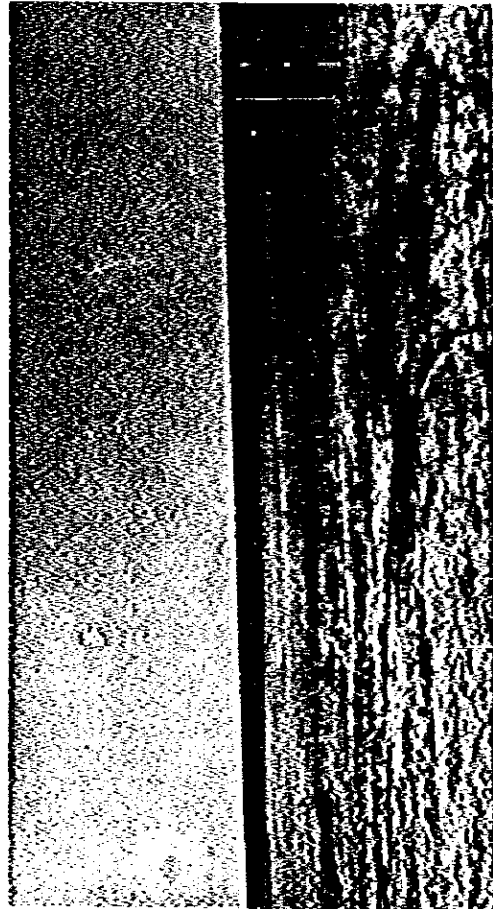
EAST



WEST

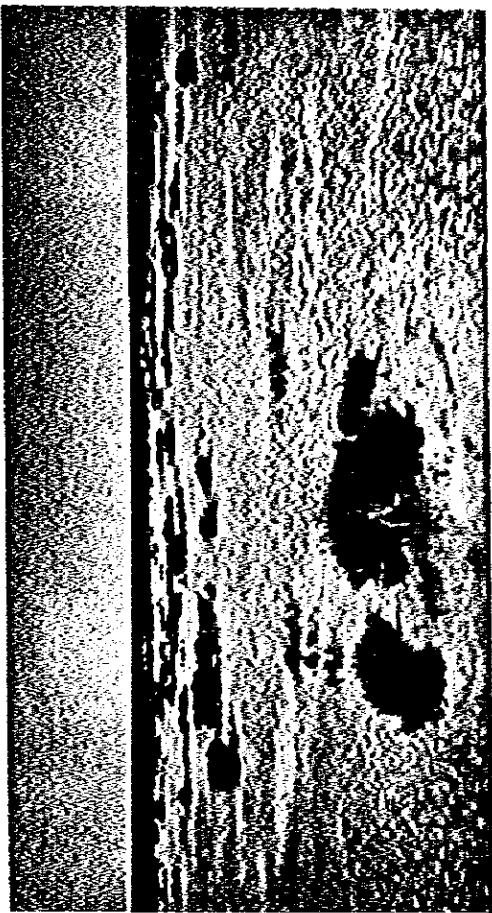


NORTH

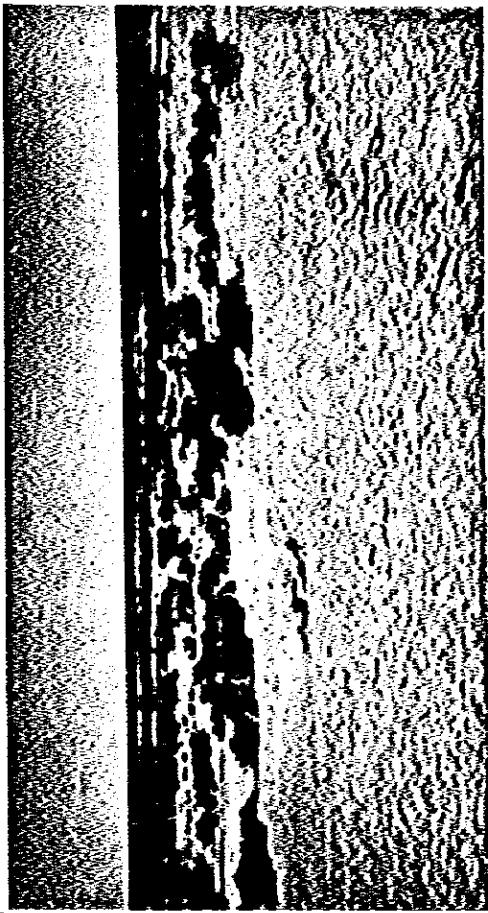


SOUTH

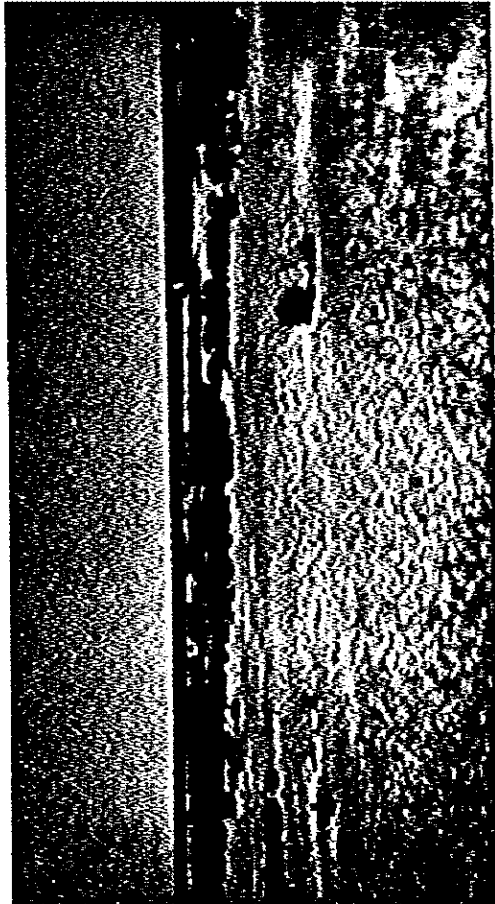
SITE NO. 7 PHOTOGRAPHS



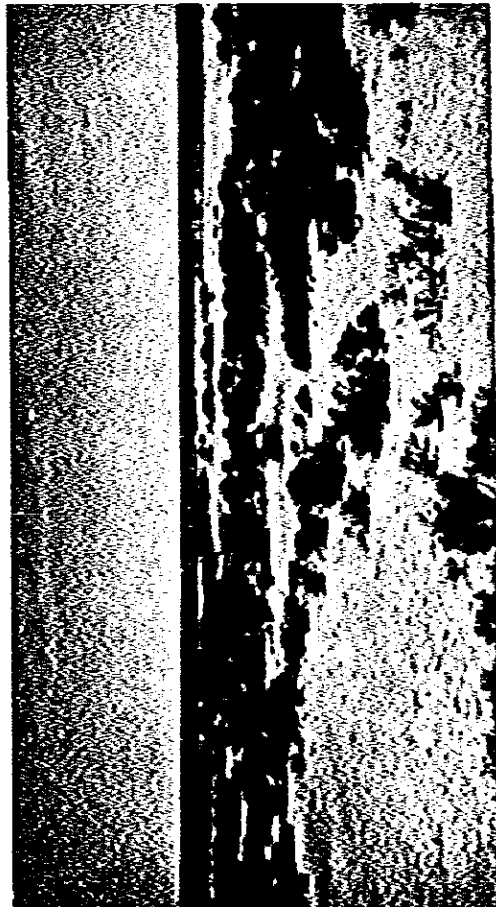
EAST



WEST

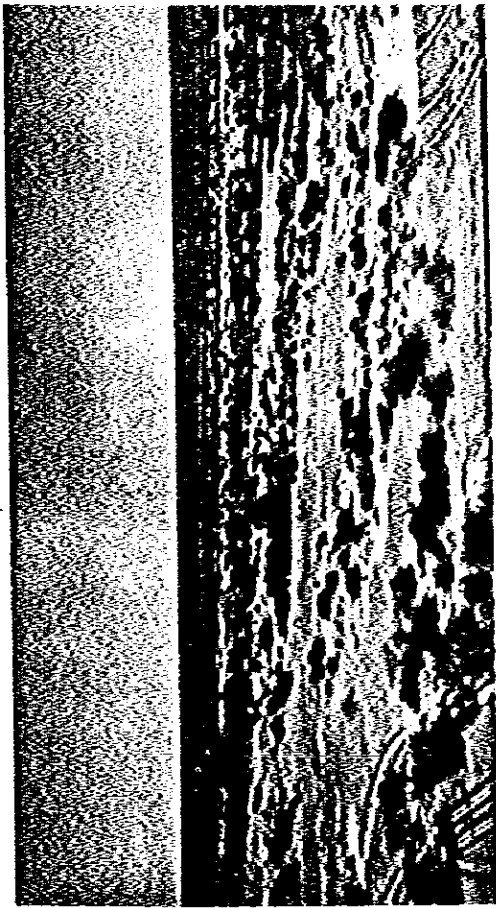


NORTH

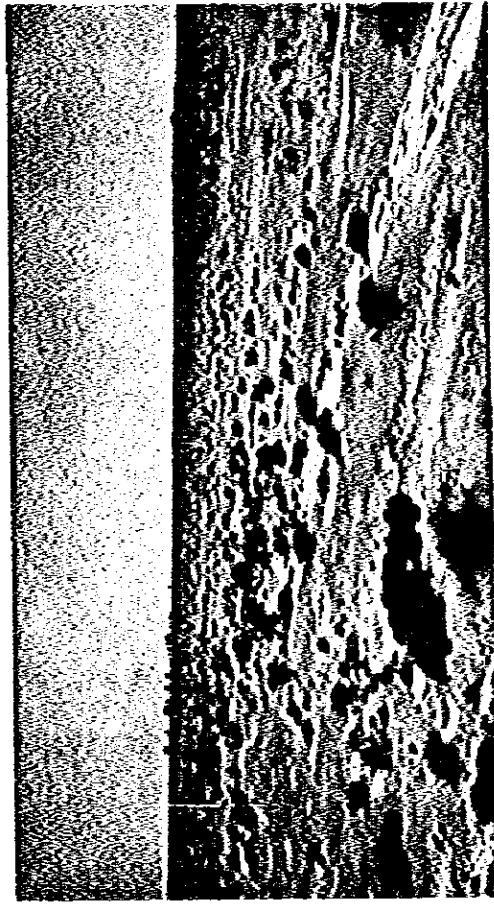


SOUTH

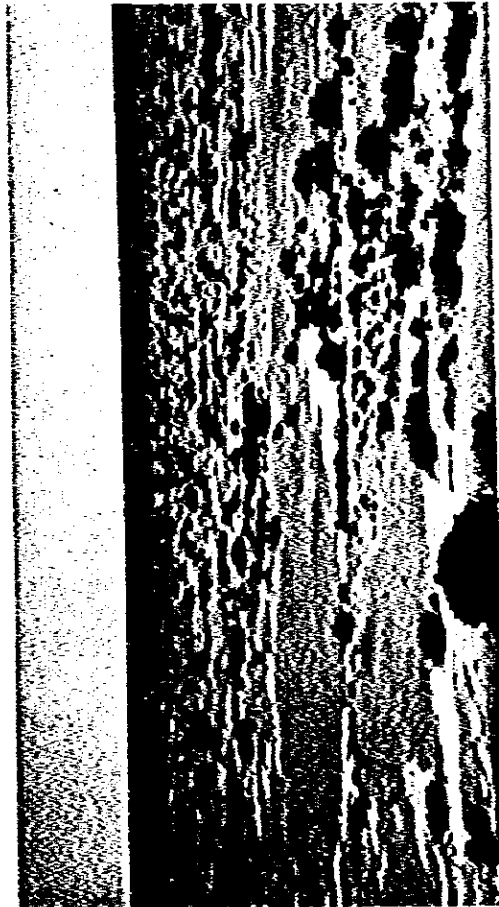
SITE NO. 8 PHOTOGRAPHS



EAST



WEST



NORTH



SOUTH

SITE NO. 9 PHOTOGRAPHS

APPENDIX
FIELD EXPLORATIONS AND
LABORATORY TESTING

A- FIELD EXPLORATIONS

The purpose of the field exploration for this preliminary phase of site selection study was to evaluate the general sub-surface soils conditions at the potential site locations.

A total of 9 boring locations were selected after a field reconnaissance trip to the Bushehr area. All borings were drilled to a depth of 30 meters using a Mayhew-500 rotary drilling rig. Standard penetration tests (SPT) were performed at one meter intervals and the recovered samples were collected for further laboratory testing. A standard split-spoon sampler was used for this investigation. The sampler was driven with a 63 kg hammer dropped from a 75-centimeter height and the number of blows required for 30 centimeters of penetration were recorded.

All drilling operations were supervised by one of our experienced soils engineers who maintained detailed log of each boring, classified recovered soils, recorded the penetration resistances, measured water levels in the borings and documented pertinent site information.

All recovered soil samples were classified in accordance with the Unified Soil Classification System, a description of which is presented on Plate A-4.

B- LABORATORY TESTING

For the purpose of this preliminary phase and per Japan International Cooperation Agency's request, laboratory testing consisted mainly of grain size analysis. However, a few natural moisture contents, Atterberg Limits, specific gravity and chemical tests were also performed in addition to our scope of work in order to have more data as a basis for this phase of the site selection study.

Details of each test method are briefly described in the following paragraphs:

Moisture Contents:

The natural moisture content of some of the samples were evaluated. The test was run in accordance with ASTM* Designation D-2216-66. The results are presented on Plates A-1A through A-1I.

Grain Size Analysis:

This test was the main test specified in the scope of work for this phase of the investigation. A total of 90 samples (10 from each boring) were selected and tested to evaluate their grain size distribution. The test was performed in accordance with ASTM Designation D-422-63. The test results are presented on Plates A-2A through A-2BB, Grain Size Distribution.

* American Society for Testing and Materials

Atterberg Limits:

The liquid limit, plastic limit and plasticity index of a few of the samples were evaluated in accordance with ASTM Designation D423-66 and D424-59. The results are presented on Plates A-1A through A-1I, Log of Boring.

Specific Gravity Tests:

The specific gravity of selected soil samples were evaluated in accordance with ASTM Designation D854-58. The results are presented on Plate A-3.

Soil Chemical Tests:

Chemical tests were performed on selected samples to evaluate their pH and soluble sulfate content (%SO₄). These tests were performed on a 1:10 soil:water extract. The results are presented on Plate A-3.

- * * * * -

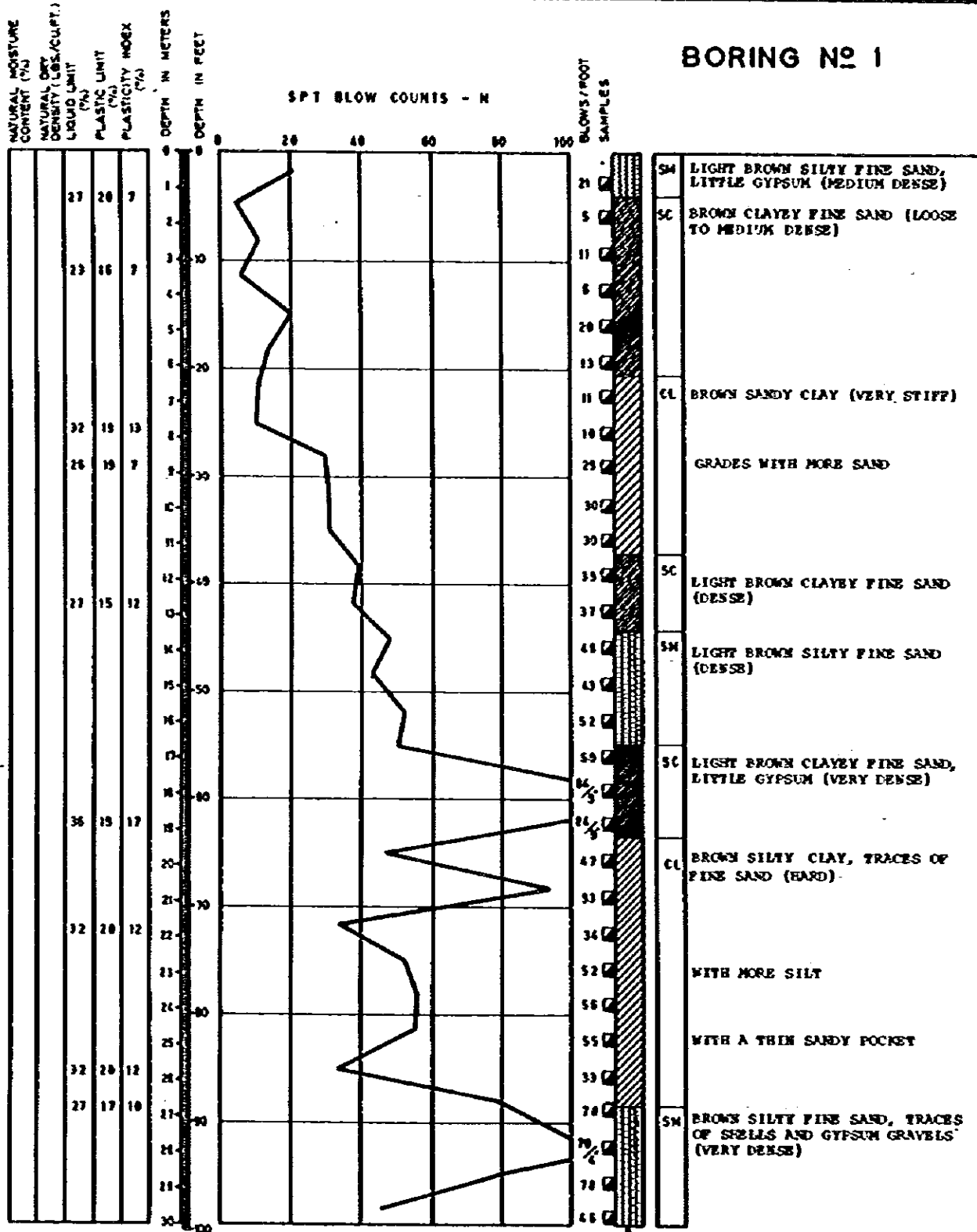
The following Plates are attached and complete this Appendix:

Plates A-1A through A-1I	Log of Boring
Plates A-2A through A-2Z	Grain Size Distribution
Plates A-2AA through A-2BB	Grain Size Distribution
Plate A-3	Specific Gravity & Chemical Test Results
Plate A-4	Unified Soil Classification System.

BORING NO 1

CHECKED BY _____ OF _____

DATE _____

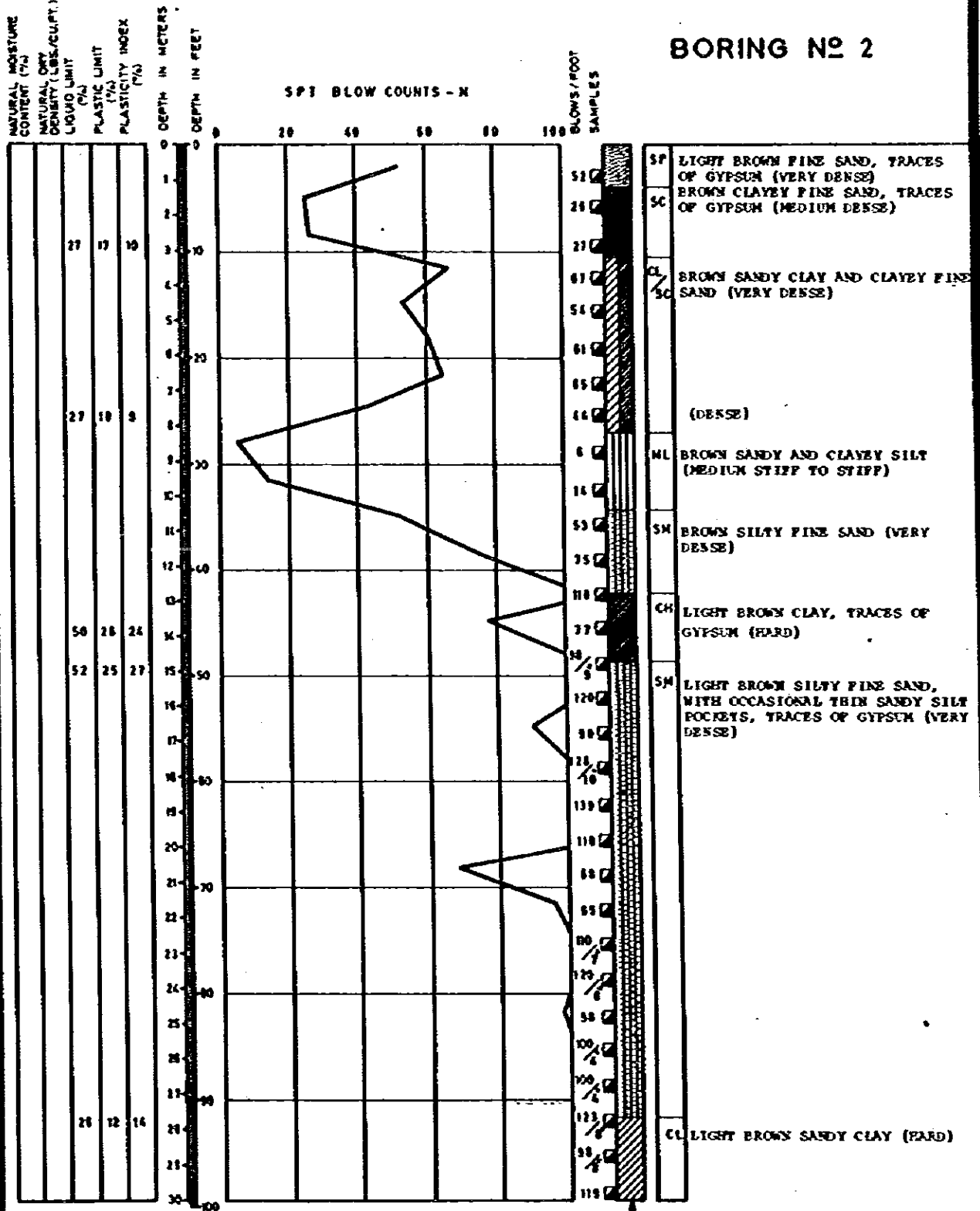


END OF BORING AT 30.0 METERS ON 6-29-78.
WATER LEVEL AT 1.85 M. ON 7-6-78

LOG OF BORING

BORING NO 2

SPT BLOW COUNTS - N



END OF BORING AT 30.0 METERS ON 6-30-78.
WATER LEVEL AT 3.60 M. ON 7-6-78.

LOG OF BORING

DAMES & MOORE

PLATE A-1B

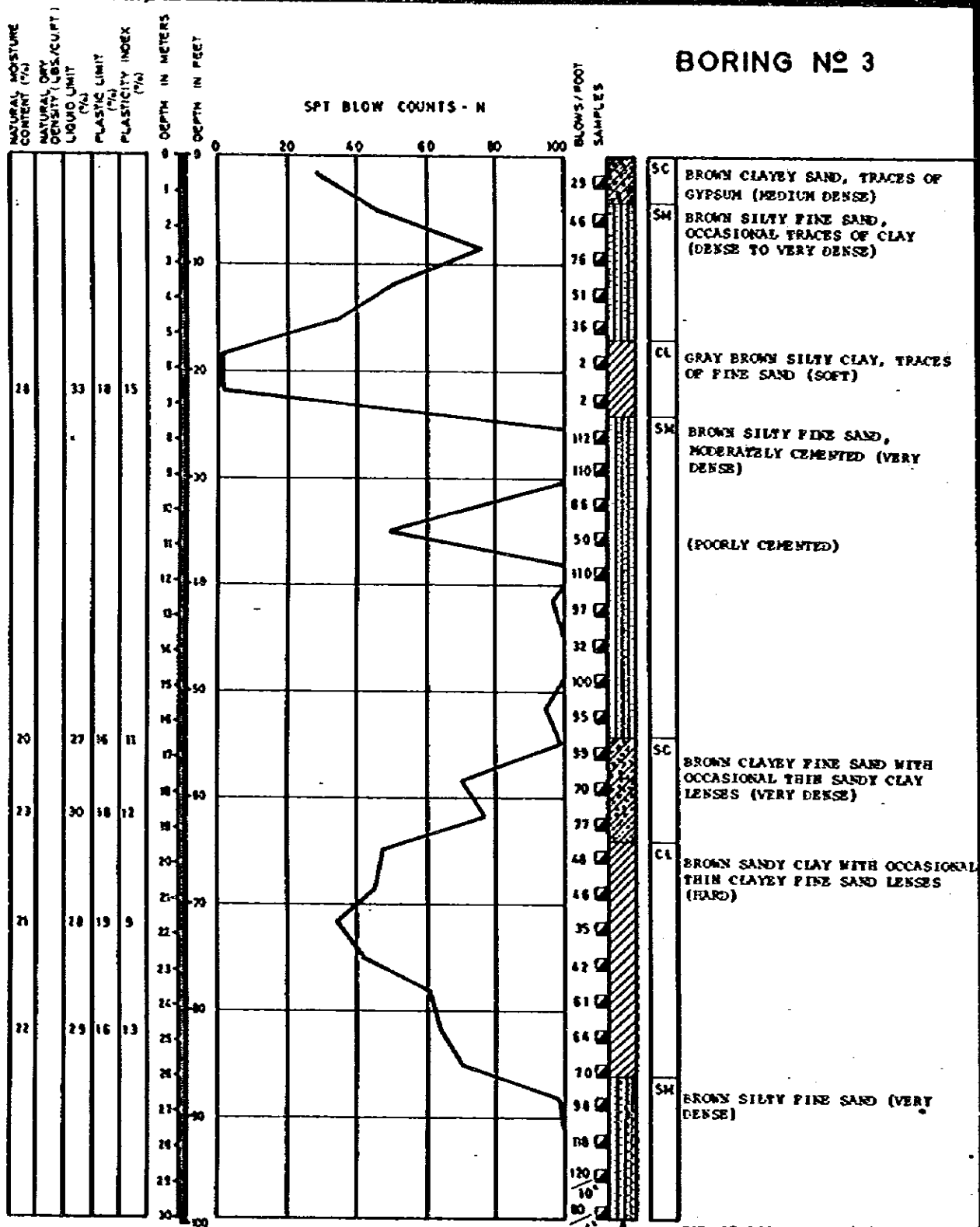
REVISIONS
BY _____ DATE _____
BY _____ DATE _____
PLATE _____ OF _____

FILE NO. _____
BY _____ DATE _____
CHECKED BY _____ DATE _____

BORING NO 3

PLATE _____ OF _____

CHECKED BY _____ DATE _____



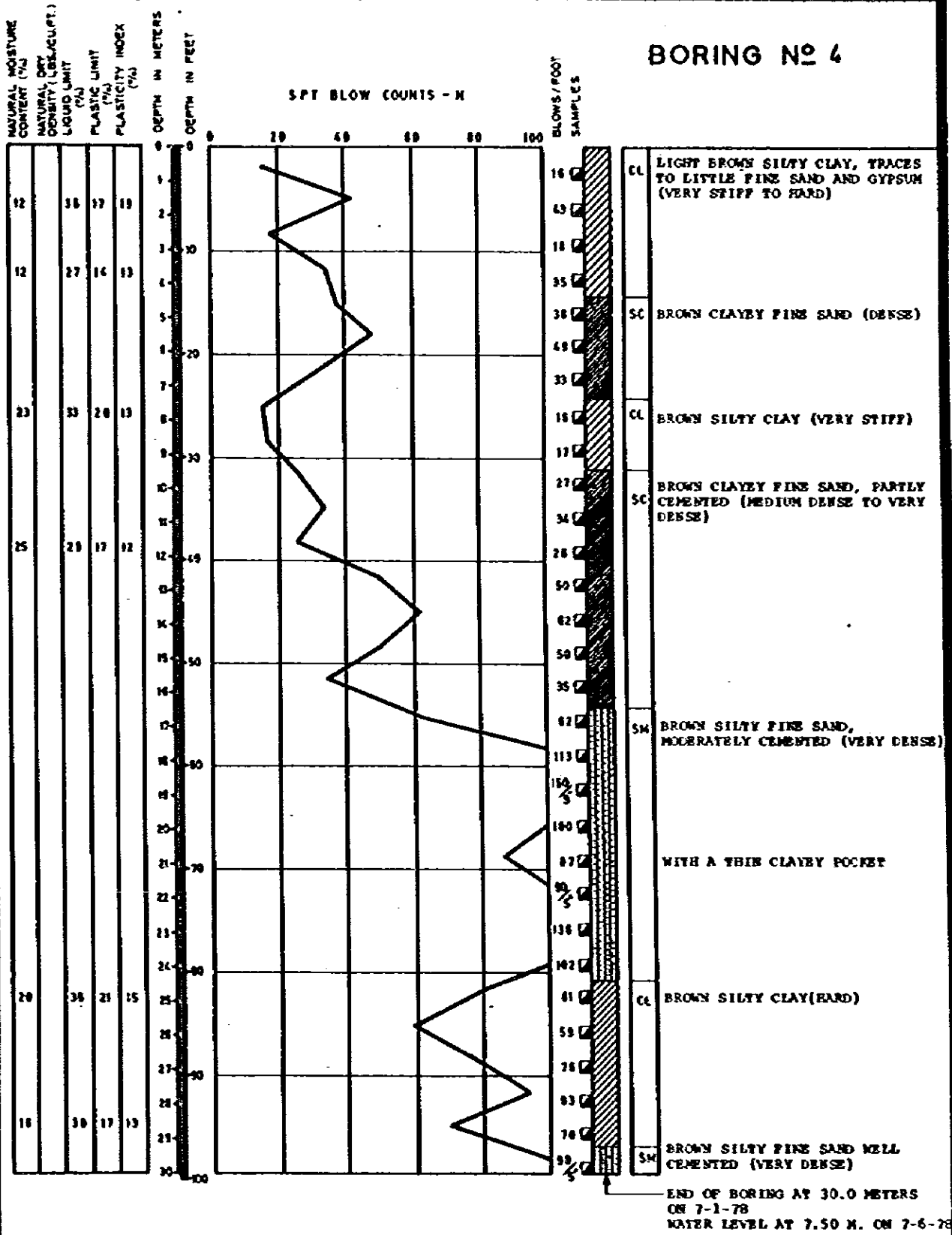
END OF BORING AT 30.0 METERS ON 7-2-78.
WATER LEVEL AT 1.50 M. ON 7-6-78

LOG OF BORING

BORING NO 4

REVISIONS
 BY _____ DATE _____
 BY _____ DATE _____
 PLATE _____ OF _____

FILE _____
 BY _____ DATE _____
 CHECKED BY _____ DATE _____



END OF BORING AT 30.0 METERS ON 7-1-78
 WATER LEVEL AT 7.50 M. ON 7-6-78

LOG OF BORING

BORING NO 5

BY _____ DATE _____
PLATE _____ OF _____

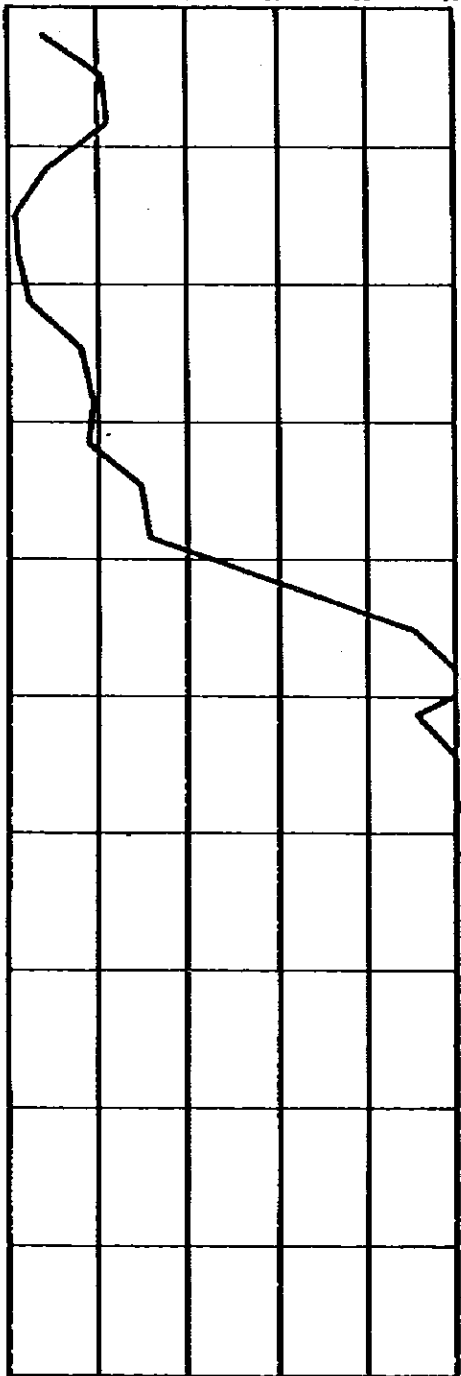
CHECKED BY _____ DATE _____
BY _____ DATE _____

NATURAL MOISTURE
CONTENT (%)
NATURAL DRY
DENSITY (LBS./CU.FT.)
LIQUID LIMIT
(%)
PLASTIC LIMIT
(%)
PLASTICITY INDEX
(%)

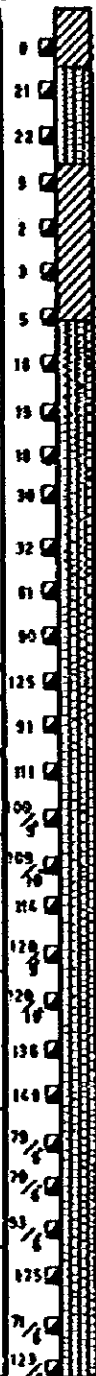
19	18	17	13
23	25	18	5
19			
17	21	18	3

DEPTH IN METERS
DEPTH IN FEET

SPT BLOW COUNTS - N



BLOWS/FOOT
SAMPLES



CL	BROWN SILTY CLAY (MEDIUM STIFF)
SM	BROWN SILTY FINE SAND (MEDIUM DENSE)
CL	BROWN SILTY CLAY, TRACES OF FINE SAND (SOFT TO MEDIUM STIFF)
SM	GRAY TO GRAYISH BROWN SILTY FINE SAND (MEDIUM DENSE)
	CHANGES INTO BROWN SILTY FINE SAND, MODERATELY CEMENTED (VERY DENSE)

END OF BORING AT 30.0 METERS
ON 7-3-78.
WATER LEVEL AT 1.10 M. ON 7-5-78

LOG OF BORING

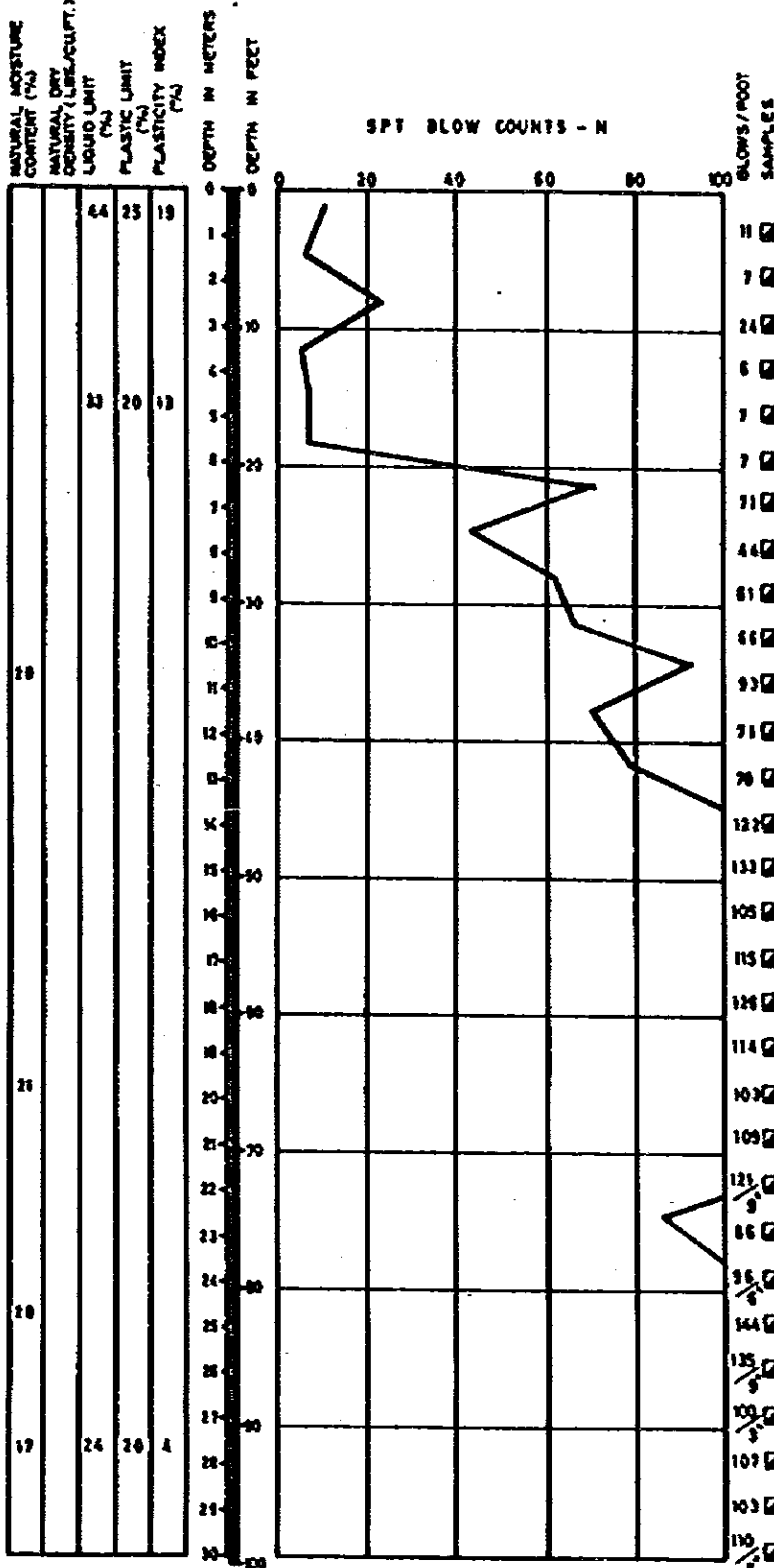
DAMES & MOORE

PLATE A-1E

BORING No 6

REVISIONS
 BY _____ DATE _____
 BY _____ DATE _____
 PLATE _____ OF _____

FILE # 2559-172-80
 BY W. J. MOORE DATE 7-6-78
 CHECKED BY _____ DATE _____



NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (LB./CU.FT.)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)
64	25	13		
33	20	13		
24	16	4		

BLOWS / FOOT SAMPLES

11
7
24
6
7
7
11
44
81
66
93
71
76
122
133
105
115
126
114
103
109
121
86
96
144
135
100
107
103
110

CL
 CL
 SM
 MODERATELY CEMENTED
 WITH MORE SILT
 MEDIUM GRAINED

BROWN SILTY CLAY, TRACES OF FINE SAND (MEDIUM STIFF TO STIFF)
 BROWN SILTY CLAY, LITTLE GYPSUM (MEDIUM STIFF)
 BROWN SILTY FINE SAND, TRACES OF GYPSUM (VERY DENSE)

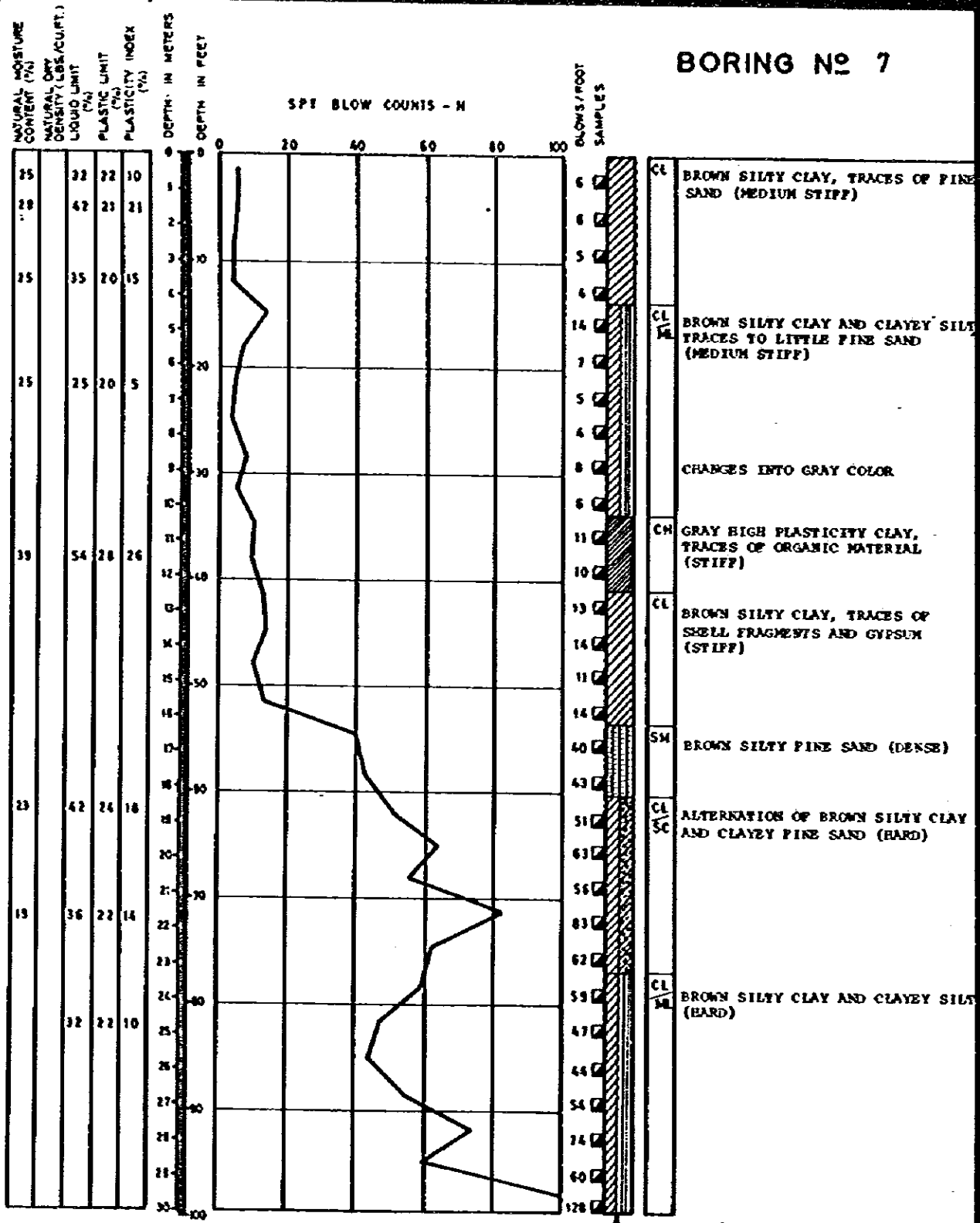
END OF BORING AT 30.0 METERS ON 7-4-78.
 WATER LEVEL AT 2.75 M. ON 7-6-78

LOG OF BORING

BORING NO 7

PLATE _____ OF _____

CHECKED BY _____ DATE _____



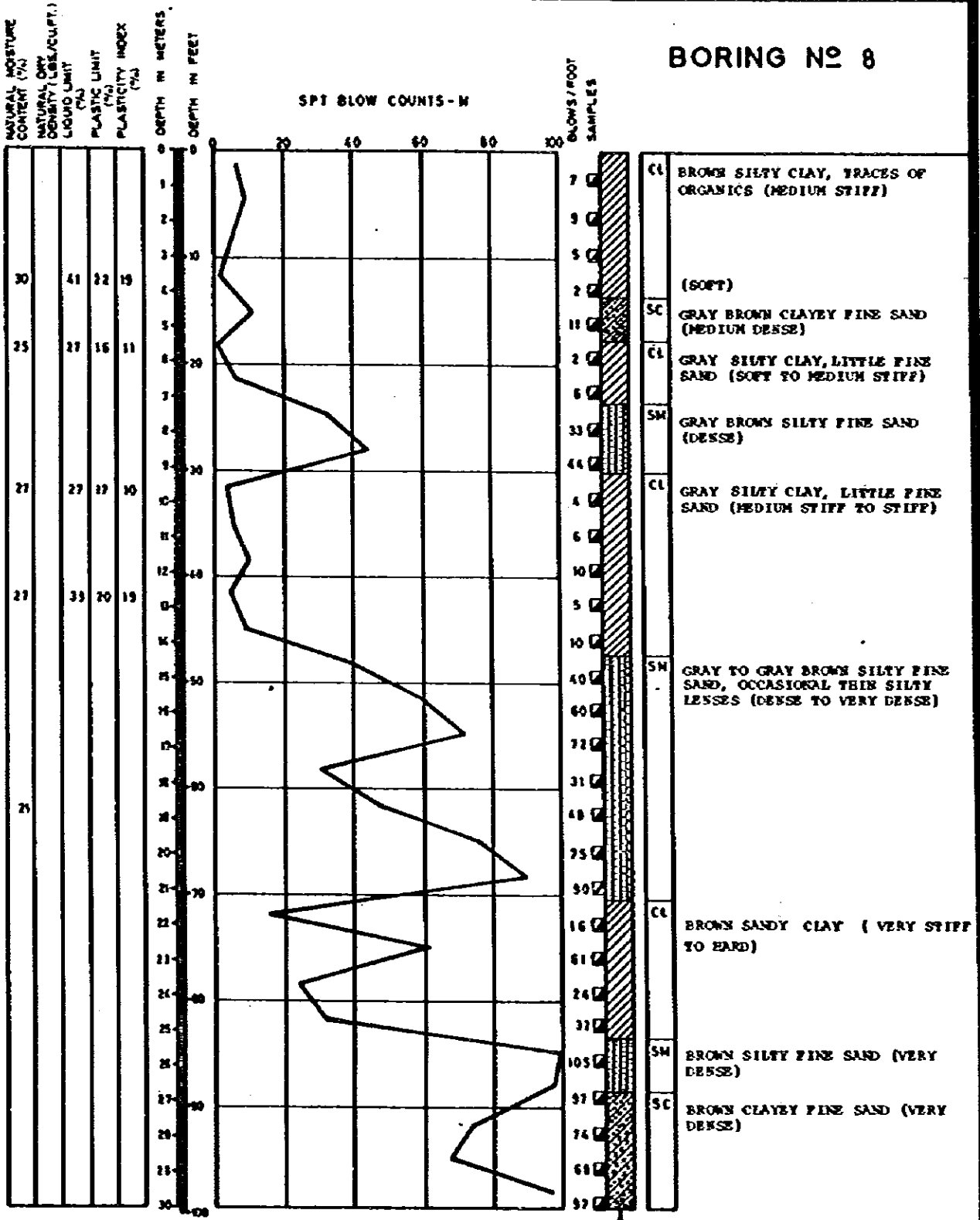
END OF BORING AT 30.0 METERS ON 7-5-78.
WATER LEVEL AT 1.20 M. ON 7-6-78

LOG OF BORING

DAMES & MOORE

PLATE A-16

BORING NO 8



END OF BORING AT 30.0 METERS ON 7-6-78.
WATER LEVEL AT 1.20 M. ON 7-6-78.

LOG OF BORING

DAMES & MOORE

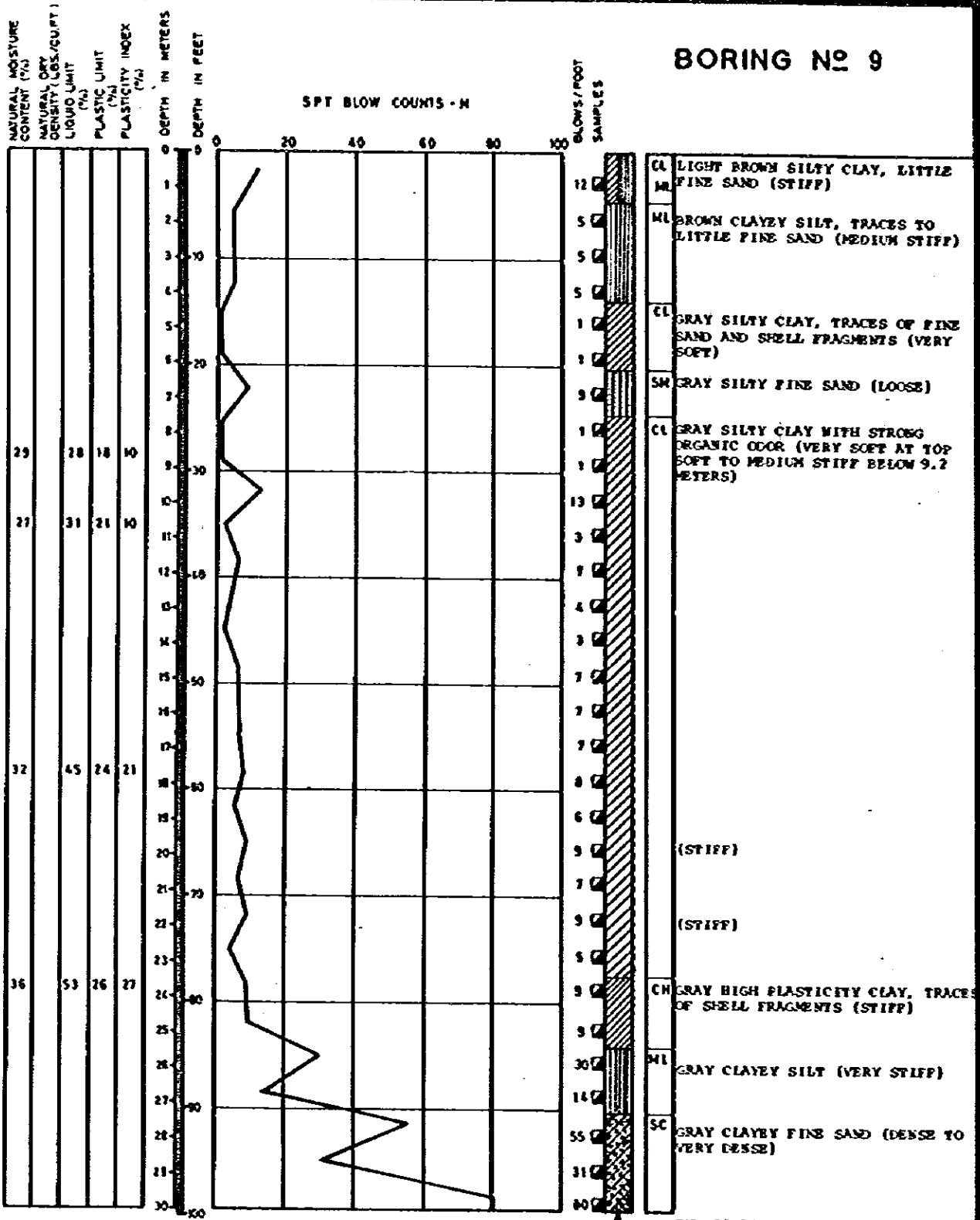
PLATE A-1H

REVISIONS
BY: _____ DATE: _____
BY: _____ DATE: _____
PLATE: _____ OF: _____

FILE: 2222-172-0-0
BY: 2222/2222 DATE: 2/1/77
CHECKED BY: _____ DATE: _____

BORING NO 9

CHECKED BY _____ OF _____ DATE _____

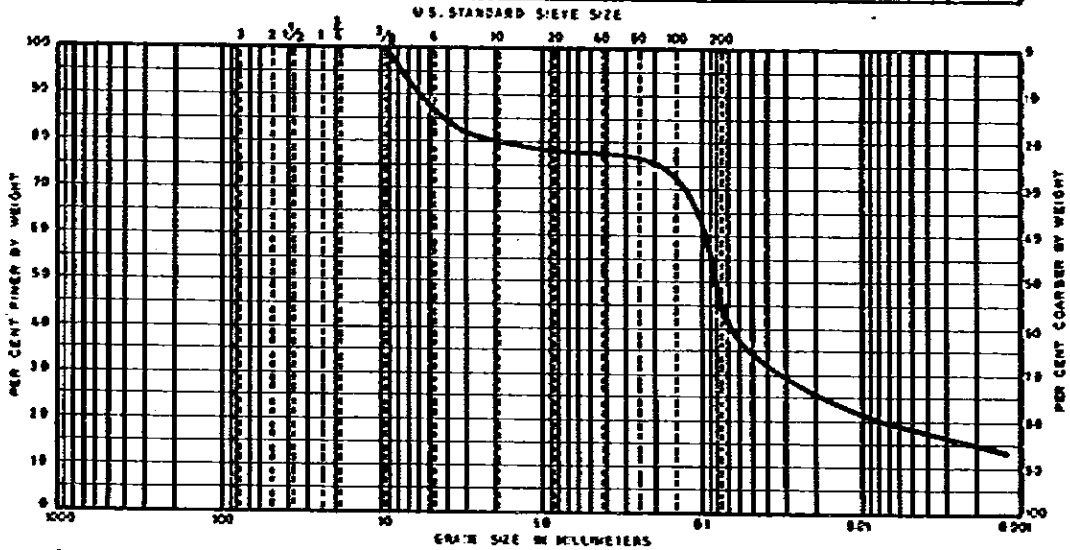


END OF BORING AT 30.0 METERS ON 7-7-78.
WATER LEVEL AT 4.0 M. ON 7-7-78.

LOG OF BORING

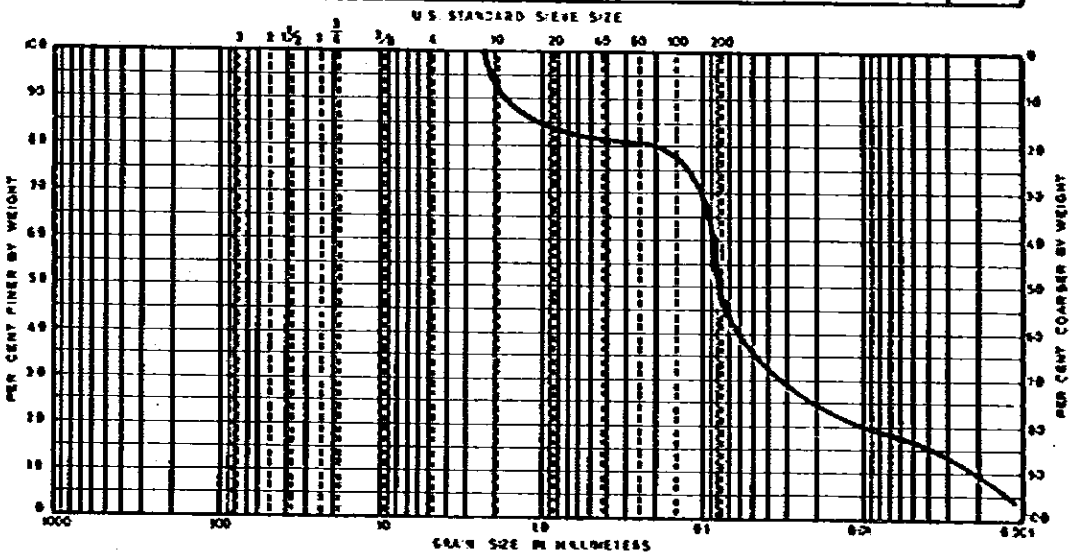
REVISED BY _____ DATE _____
 BY _____ DATE _____
 PLATE _____

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REF.
1	1.5	2	27	20	SC	CLAYEY SAND	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REF.
1	2.5	3			SC	CLAYEY SAND	



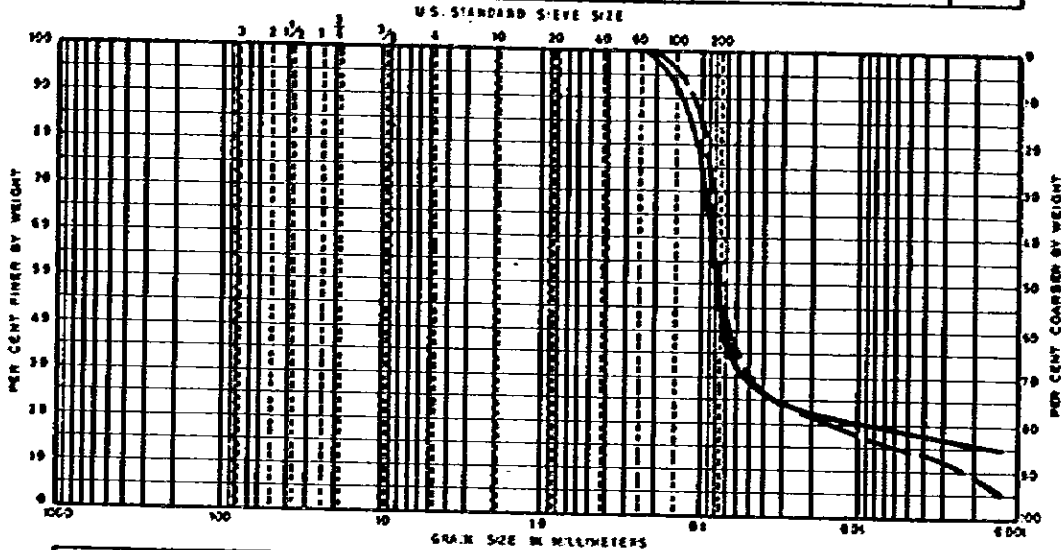
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

FILE 2199-177-50
 BY SA. MORGENTHAU DATE 7-17-78
 CHECKED BY _____ DATE _____

GRAIN-SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

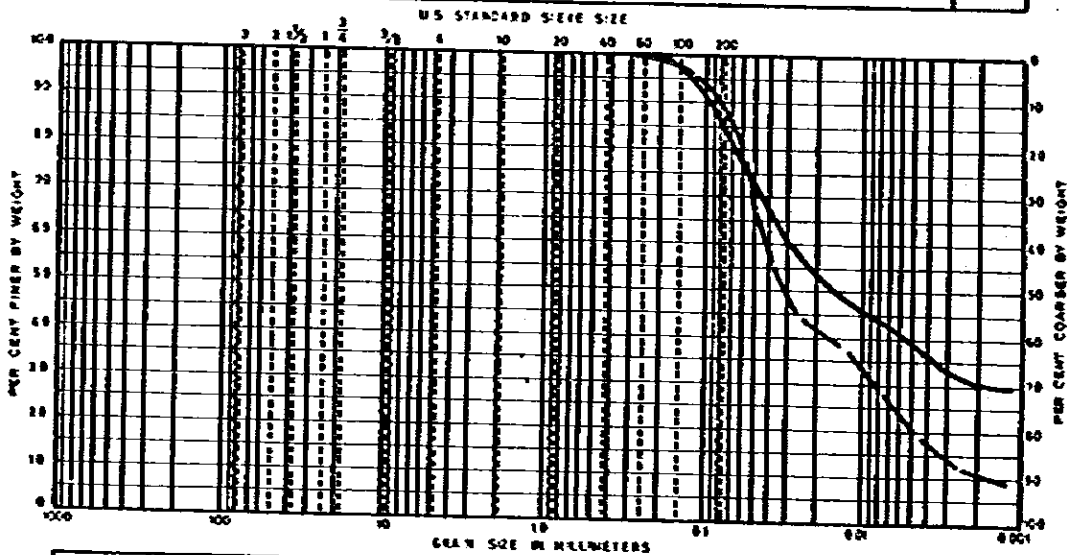
DANES & MOORE

BORING	DEPTH M	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REF
1	4.5	5			SC	CLAYEY FINE SAND	
1	5.5	6			SC	CLAYEY SAND	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH M	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REF
1	7.5	8	32	19	CL	SILTY CLAY	
1	9.5	10			CL	SILTY CLAY	

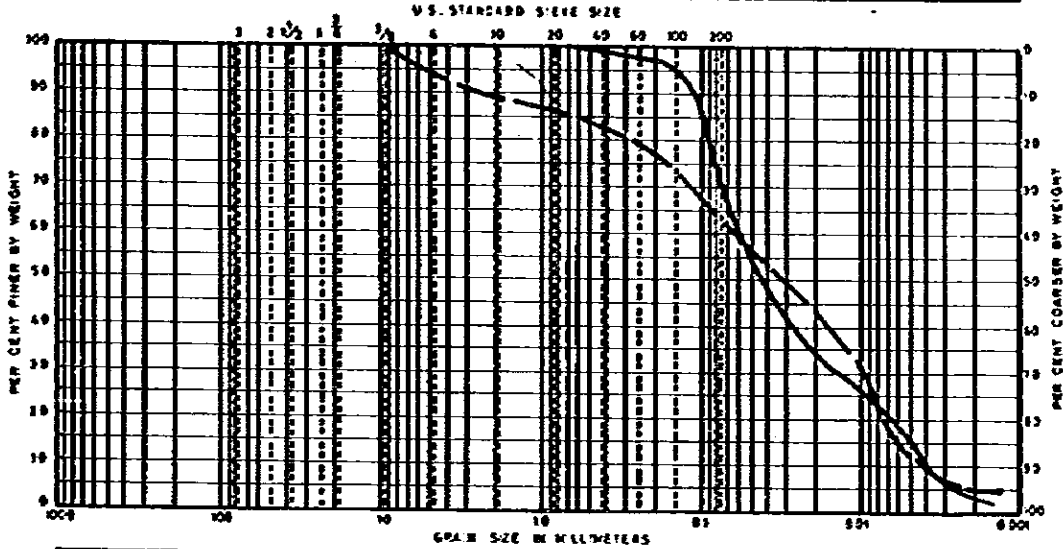


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

GRAIN-SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

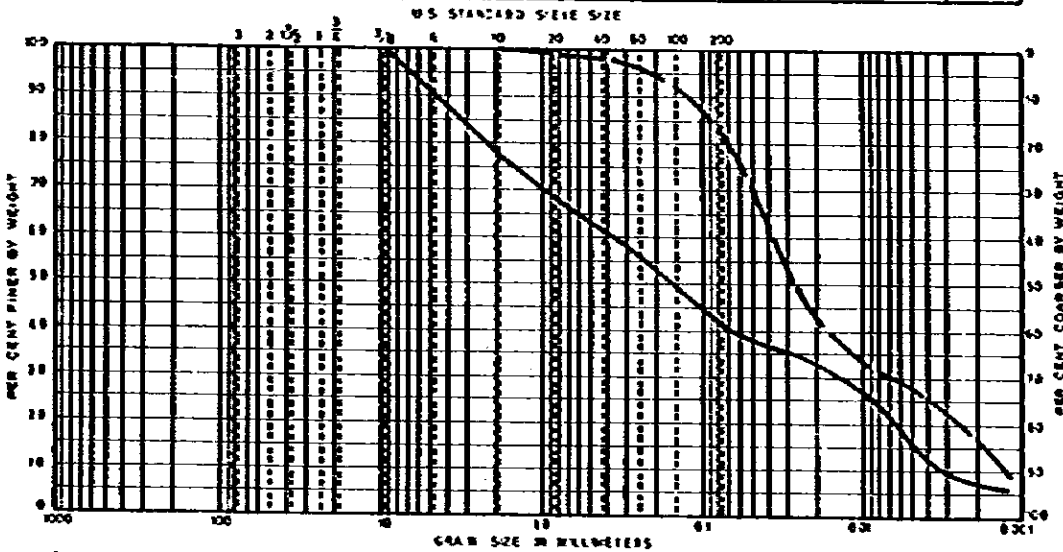
BARNE & MOORE

BORING	DEPTH M	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REF
1	13.5	12			CL	SILTY CLAY	
1	16.5	17			CL	SANDY CLAY	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH M	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REF
1	18.5	19	36	19	SC	CLAYEY SAND	
1	21.5	22	32	20	CL	SILTY CLAY	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

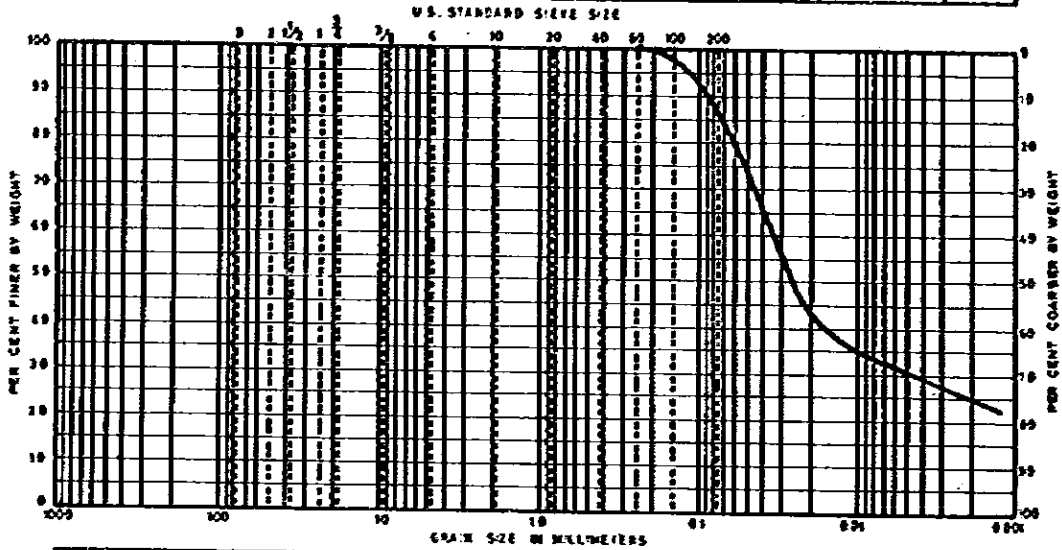
GRAIN-SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

DANES & MOORE

REVISIONS
BY _____ DATE _____
BY _____ DATE _____
PLATE _____ OF _____

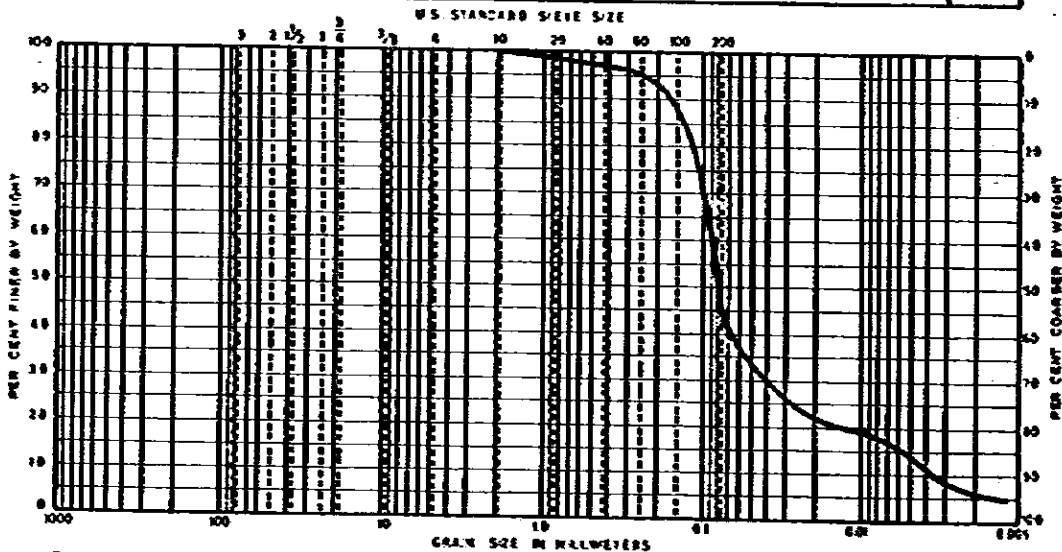
FILE 2000-111-52
BY *[Signature]* DATE 12/11/52
CHECKED BY _____ DATE _____

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REV.
1	25.5	26	32	20	CL	SILTY CLAY	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REV.
1	29.5	29		5P	SM	SILTY FINE SAND	

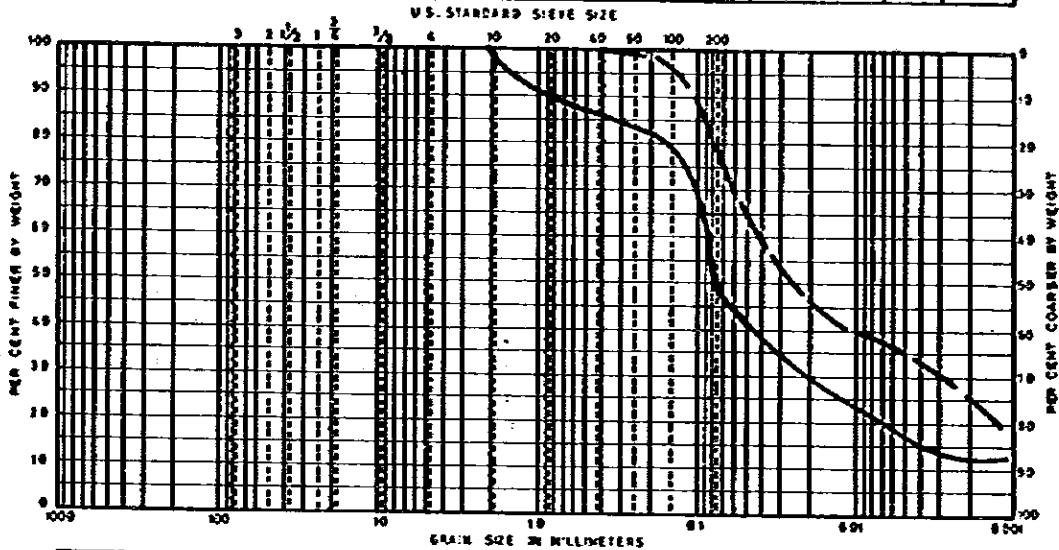


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

GRAIN-SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

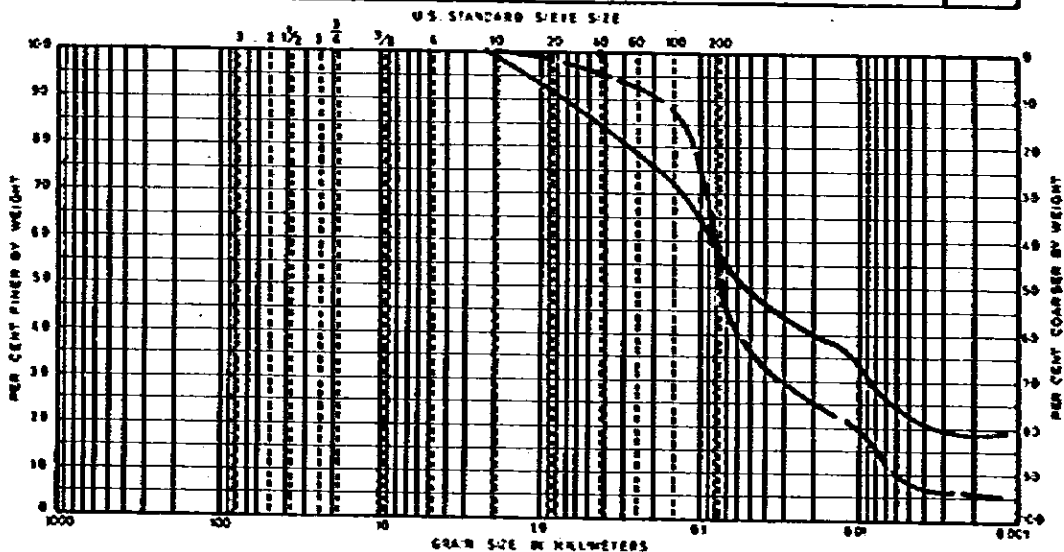
DANES & MOORE

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REV
2	3.5	2			SC	CLAYEY SAND	
2	3.5	4	27	17	CL	SILTY CLAY	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REV
2	4.5	5			CL	SANDY CLAY	
2	6.5	7			SC	CLAYEY FINE SAND	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

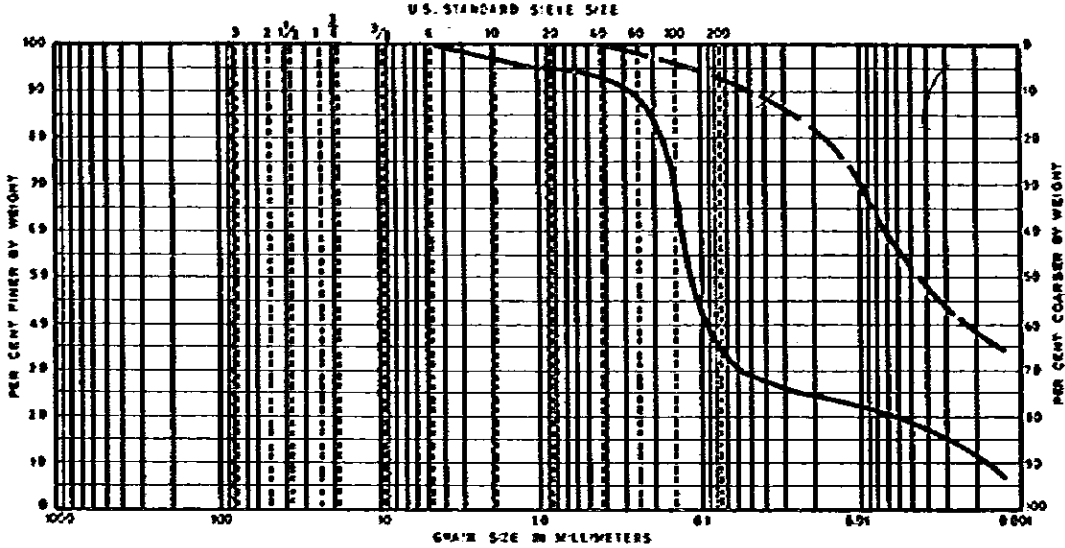
GRAIN-SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

DAMES & MOORE

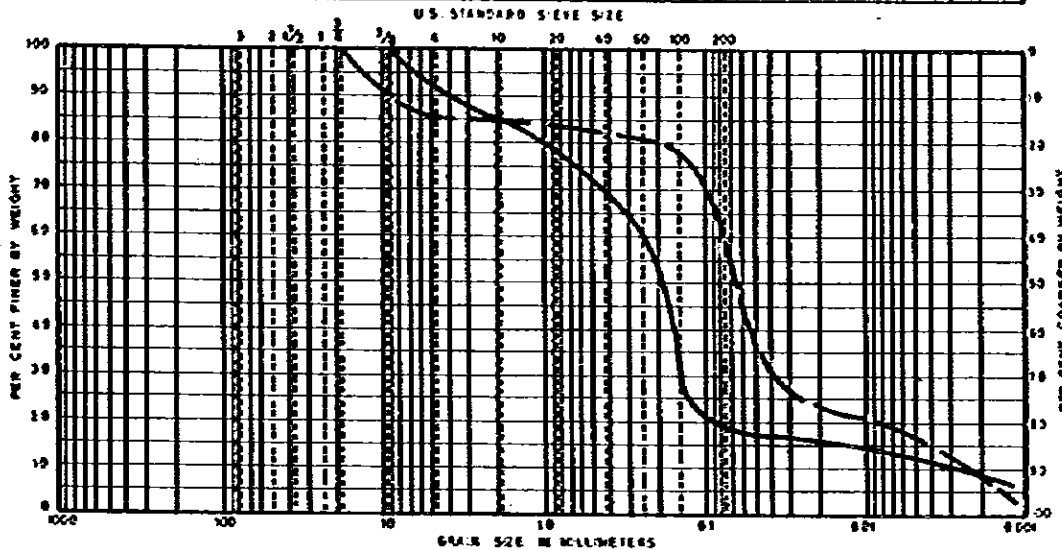
REVISIONS
BY _____ DATE _____
BY _____ DATE _____
PLATE _____ OF _____

FILE 2205-122-100
BY J.H. [unclear] DATE 7/1/78
CHECKED BY _____

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	KEY
2	10.5	11			SK	SILTY FINE SAND	
2	13.5	14	50	26	CH	HIGH PLASTICITY CLAY	

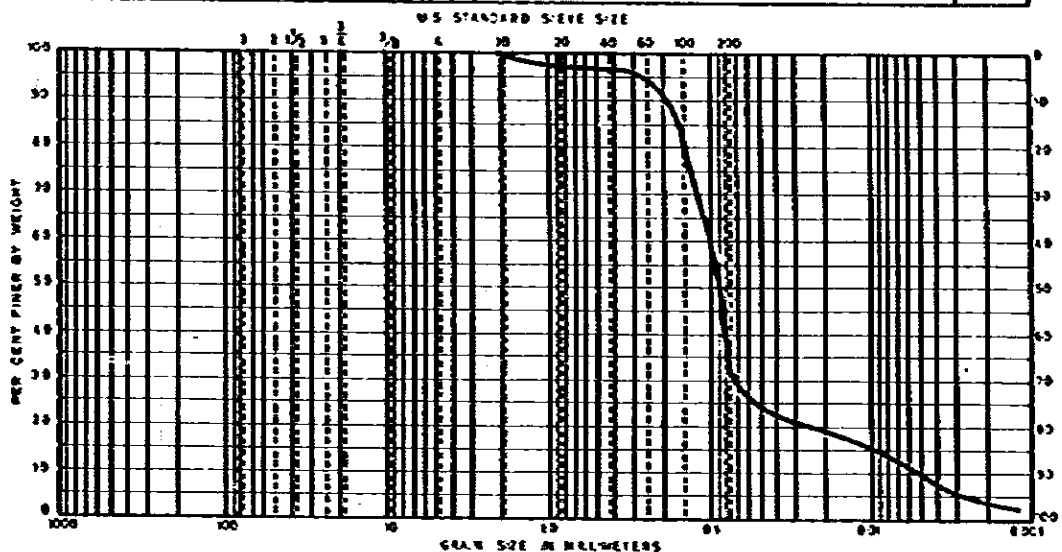


BORING	DEPTH M	SAMPLE	LIQID LMT	PLASTIC LMT	SYMBOL	SOIL DESCRIPTION	REF
2	16.5	19			SM	SILTY SAND	
2	28.5	29	26	12	CL	SANDY CLAY	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH M	SAMPLE	LIQID LMT	PLASTIC LMT	SYMBOL	SOIL DESCRIPTION	REF
2	22.5	23				SILTY FINE SAND	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

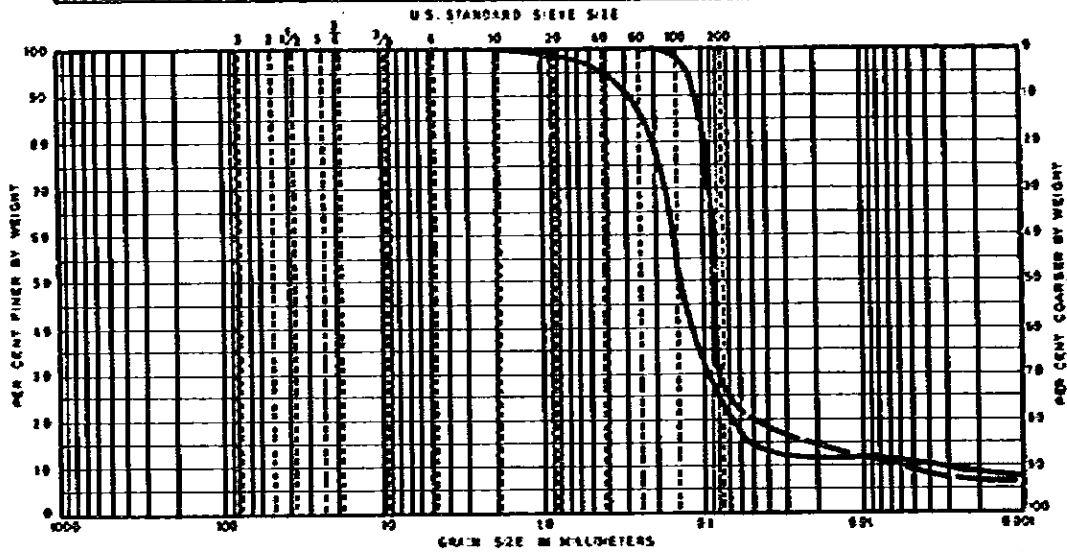
GRAIN-SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

DAMES & MOORE

REVISIONS
BY _____ DATE _____
BY _____ DATE _____
PLATE _____

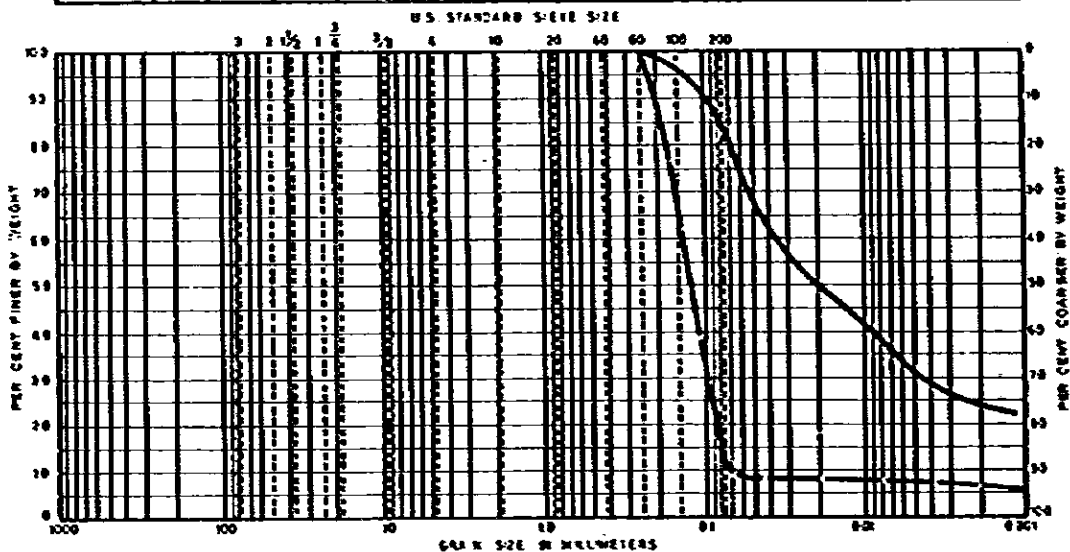
FILE NO. 200-111-208
BY: E. J. MOORE
CHECKED BY: _____ DATE: 7-10-78

BORING	DEPTH M	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REF
3	1.5	2			SM	SILTY FINE SAND	
3	4.5	5			SM	SILTY FINE SAND	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH M	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REF
3	5.5	6	33	18	CL	SILTY CLAY	
3	9.5	10			SM	SILTY FINE SAND	

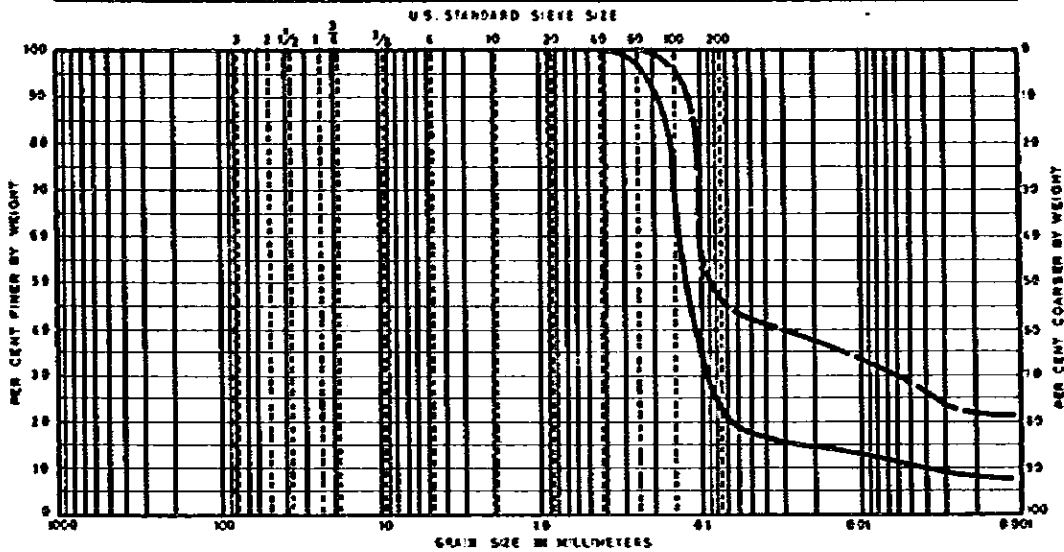


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

GRAIN-SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

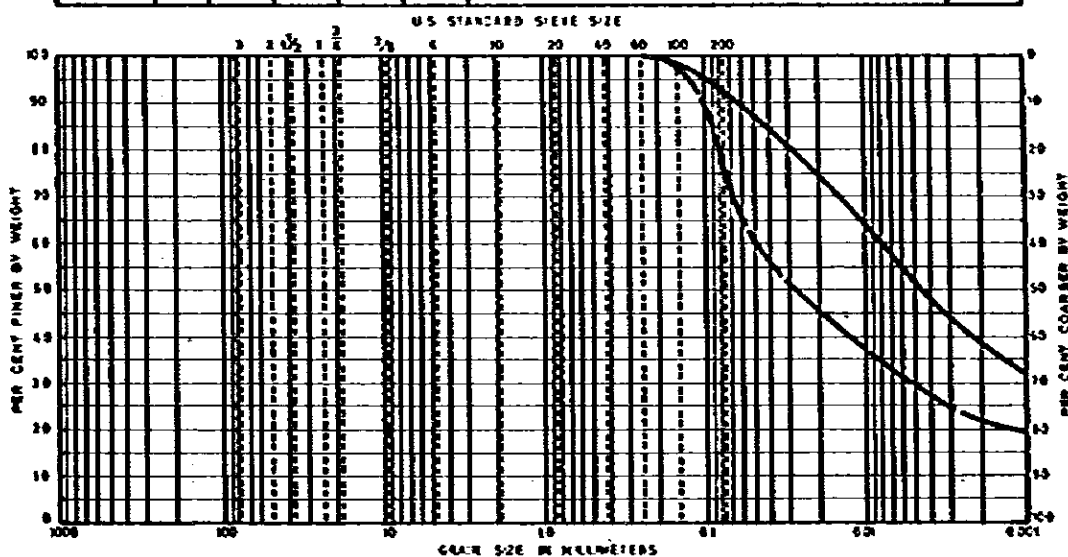
DANES & MOORE

BORING	DEPTH M	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	KEY
3	12.5	13			SM	SILTY FINE SAND	---
3	15.5	16			SM	SILTY FINE SAND	---



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH M	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	KEY
3	18.5	19	30	18	CL	SILTY CLAY	---
3	20.5	21	28	19	CL	SILTY CLAY	---



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

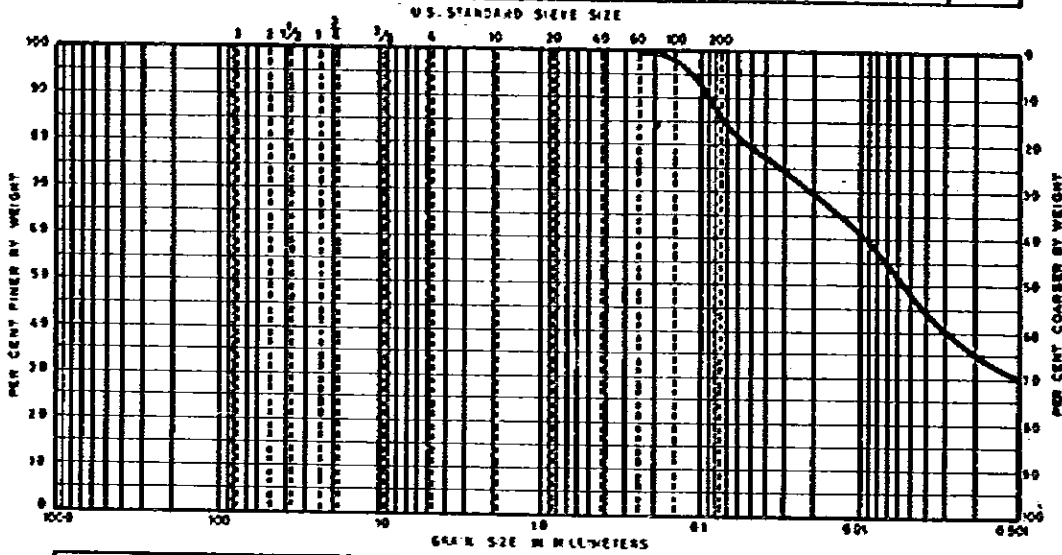
GRAIN-SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

DANES & MOORE

REVISIONS
BY _____ DATE _____
BY _____ DATE _____
PLATE _____ OF _____

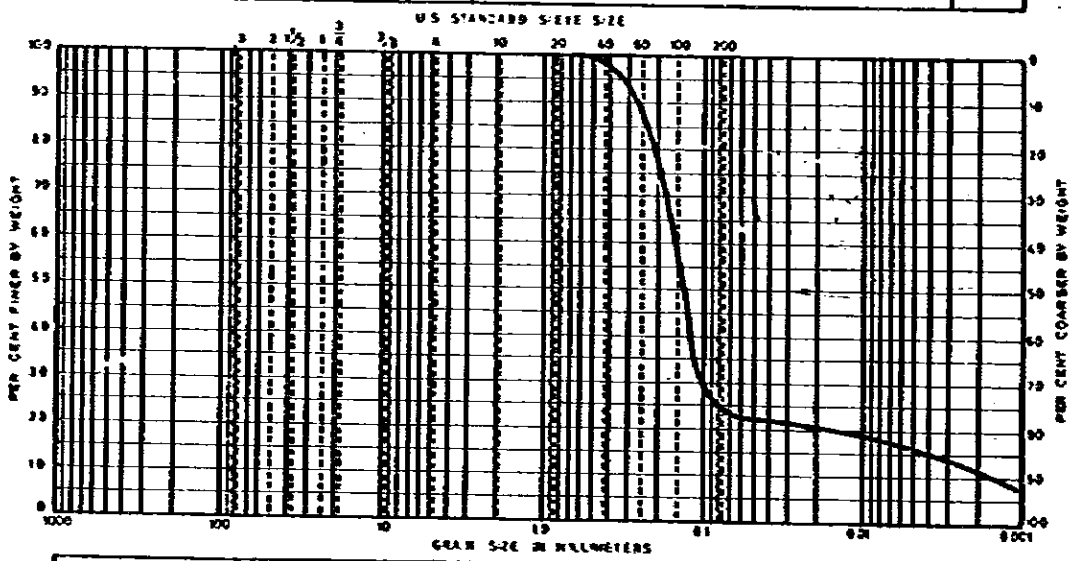
FILE _____
BY _____ DATE _____
CHECKED BY _____ DATE _____

BOR. NO.	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REF.
3	23.5	24	29	16	CL	SILTY CLAY	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BOR. NO.	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REF.
3	28.5	29			SM	SILTY FINE SAND	

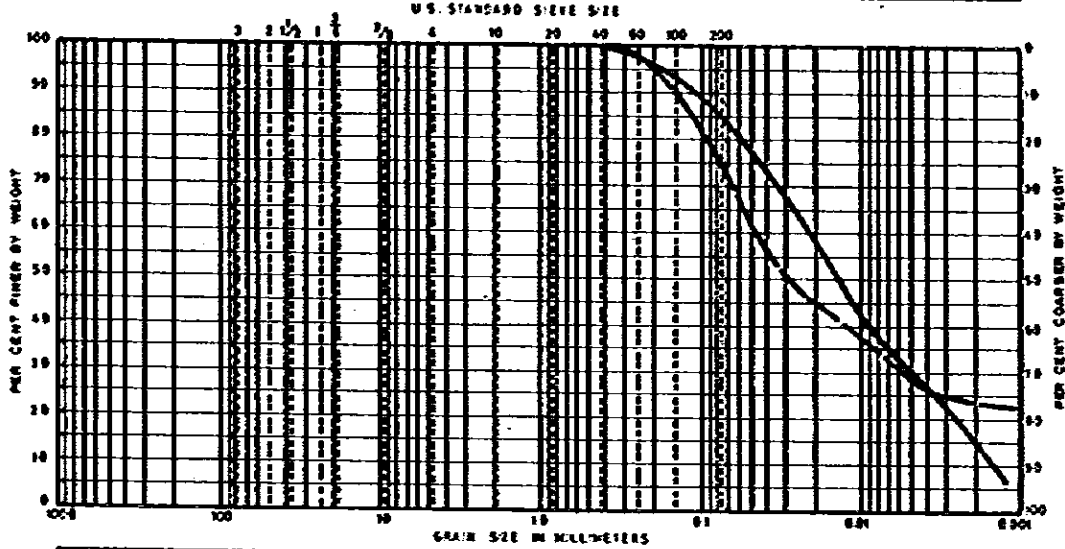


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

GRAIN-SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

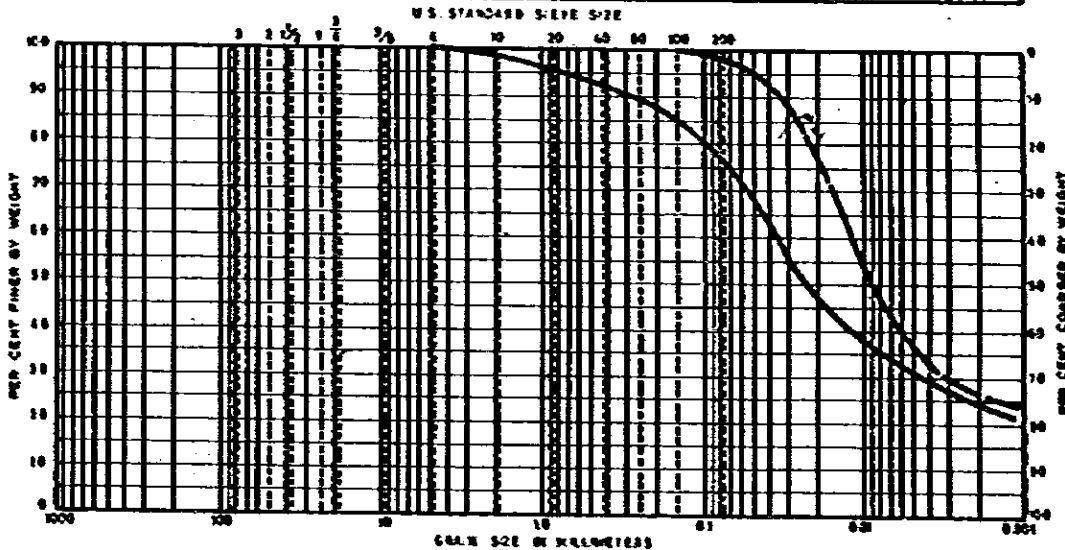
DANES & MOORE

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REV
4	0.5	1	36	17	CL	SILTY CLAY	
4	2.5	3			CL	SILTY CLAY	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REV
4	5.5	6			CL	SANDY CLAY	
4	8.5	9	33	20	CL	SILTY CLAY	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

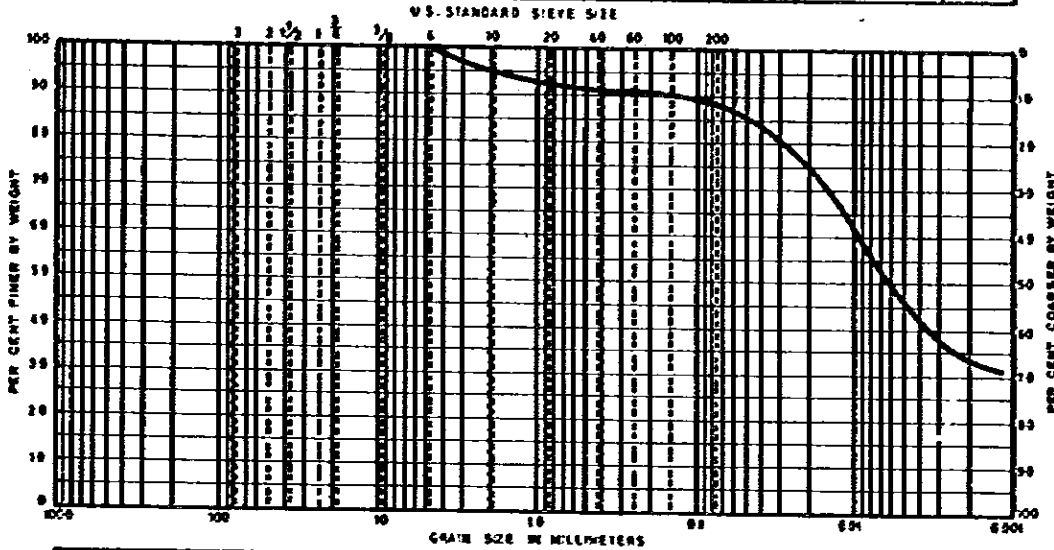
GRAIN-SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

DANES & MOORE

REVISIONS
 BY _____ DATE _____
 BY _____ DATE _____
 PLATE _____ OF _____

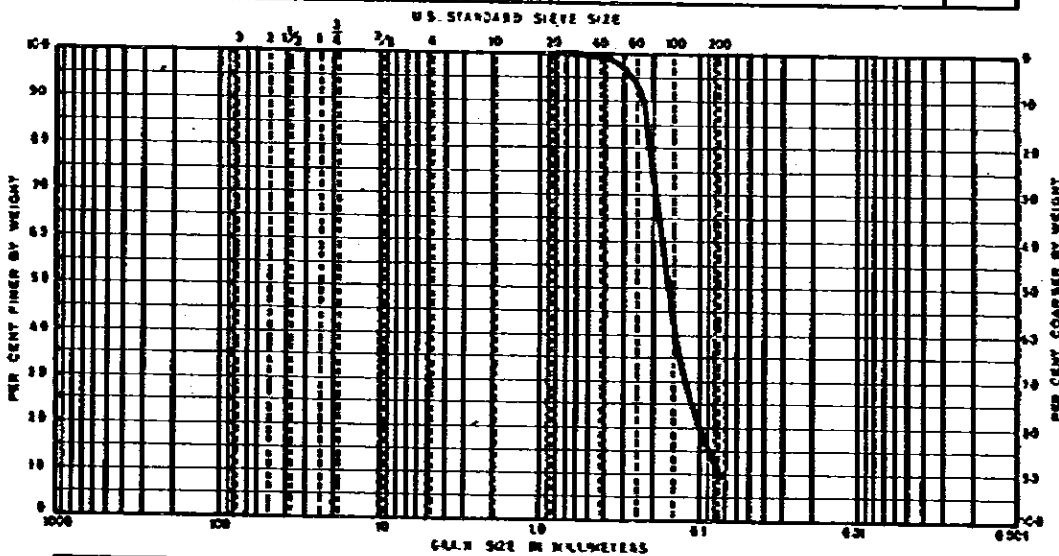
FILE _____
 BY _____ DATE _____
 CHECKED BY _____ DATE _____

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REF
4	25.5	26	36	21	CL	SILTY CLAY	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REF
4	29.5	30			SM	SILTY FINE SAND	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

GRAIN-SIZE DISTRIBUTION

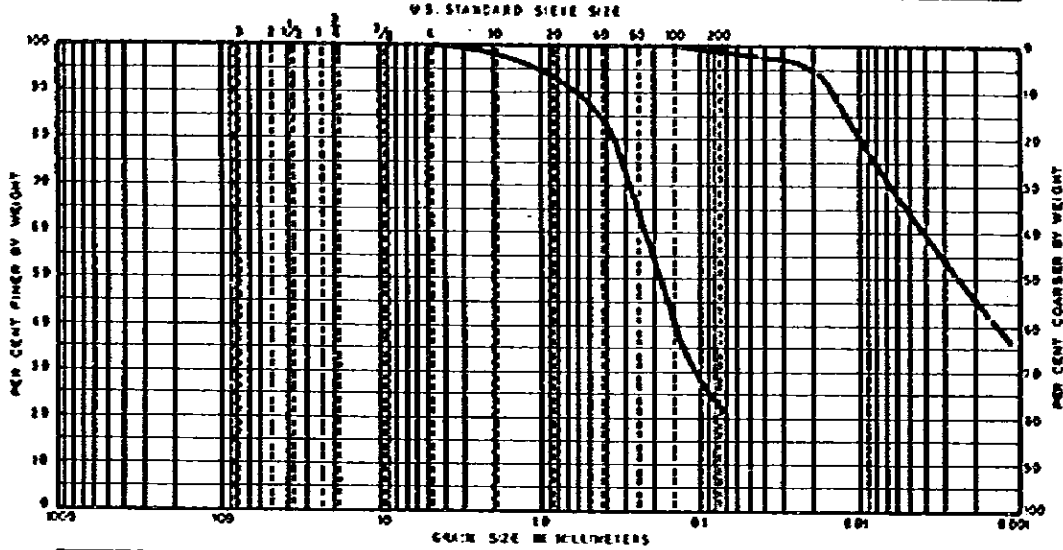
(UNIFIED SOIL CLASSIFICATION SYSTEM)

DAMES & MOORE

REVISIONS
BY _____ DATE _____
BY _____ DATE _____
PLATE _____ OF _____

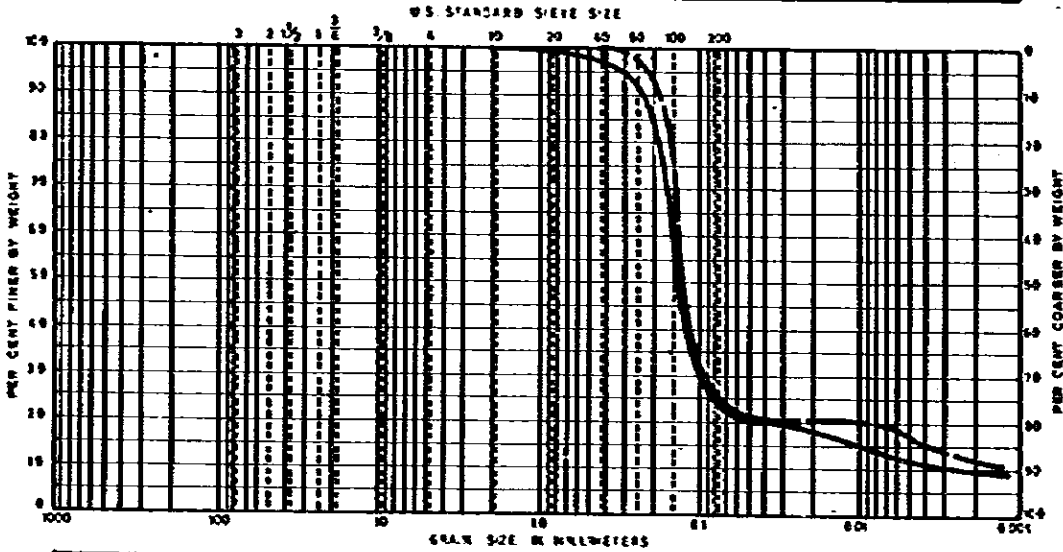
PLATE _____
BY _____ DATE _____
CHECKED BY _____ DATE _____

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	KEY
5	2.5	3			SM	SILTY FINE SAND	———
5	4.5	5			CL	SILTY CLAY	———



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	KEY
5	7.5	8			SM	SILTY FINE SAND	———
5	10.5	11			SM	SILTY FINE SAND	———

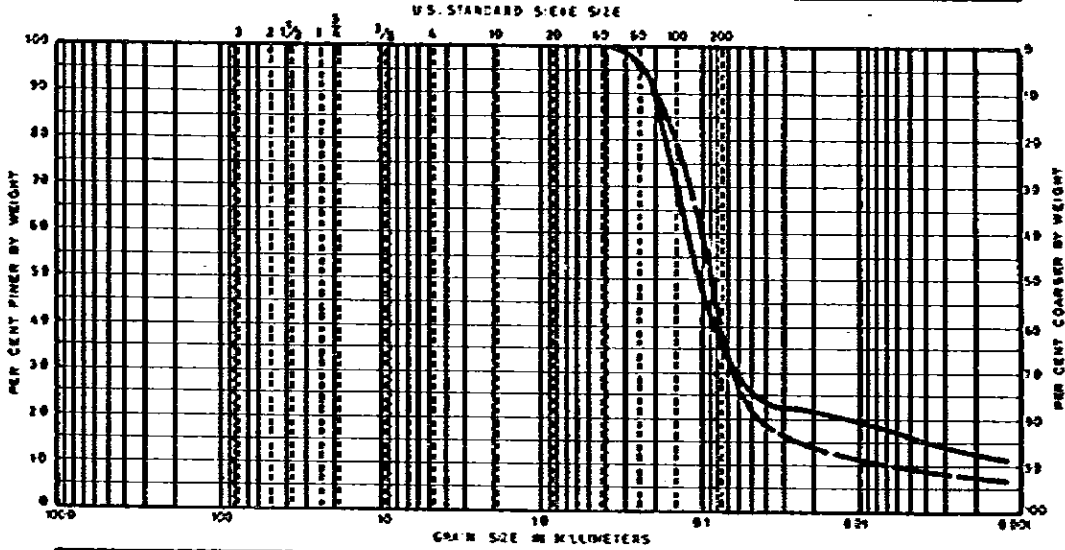


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

GRAIN-SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

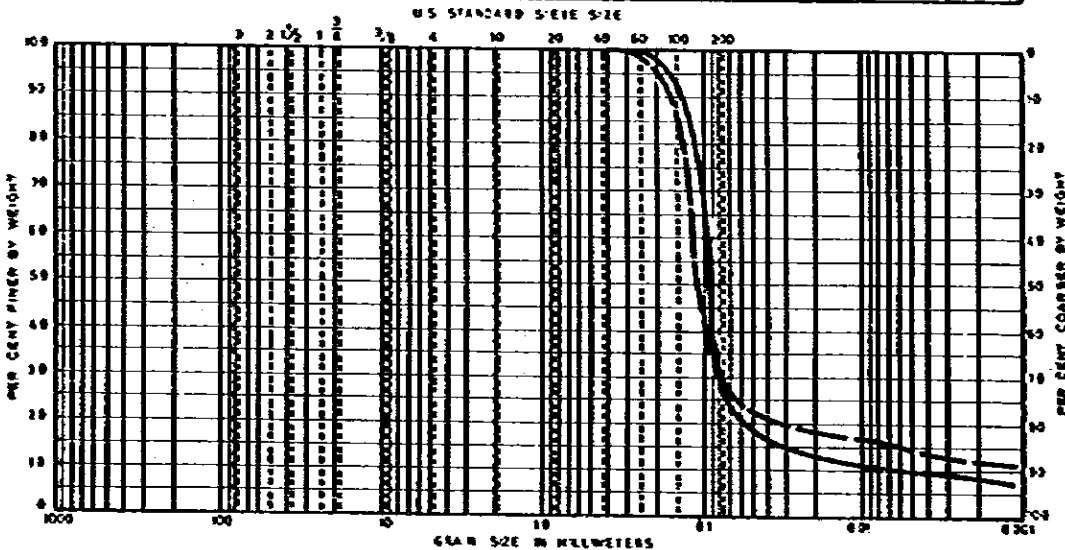
DAMES & MOORE

BORING	DEPTH M	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REF
5	13.5	14			SM	SILTY FINE SAND	---
5	16.5	17			SM	SILTY FINE SAND	---



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH M	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REF
5	19.5	20			SM	SILTY FINE SAND	---
5	25.5	26			SM	SILTY FINE SAND	---



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

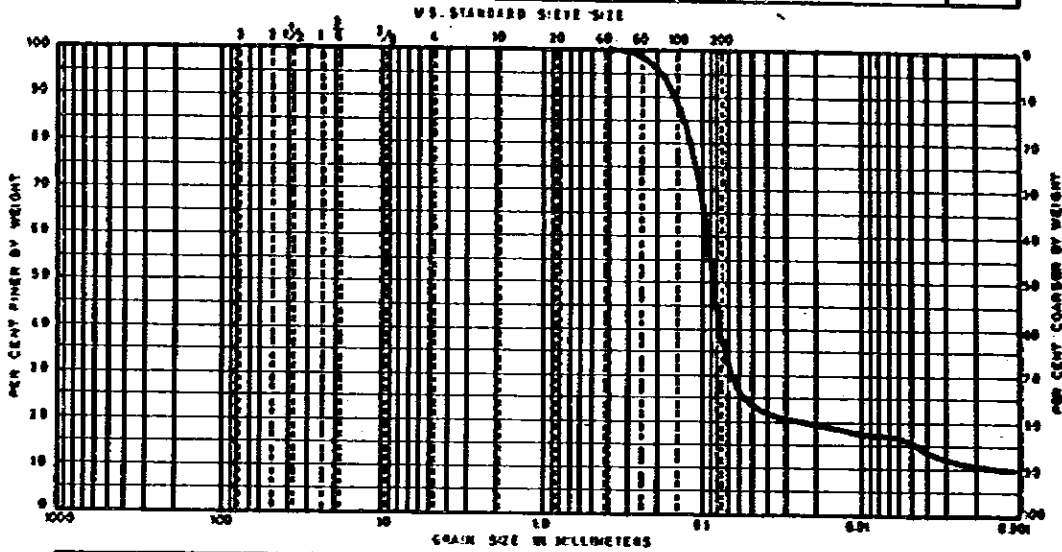
GRAIN-SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

DANES & MOORE

REVISIONS
BY _____ DATE _____
BY _____ DATE _____
PLATE _____ OF _____

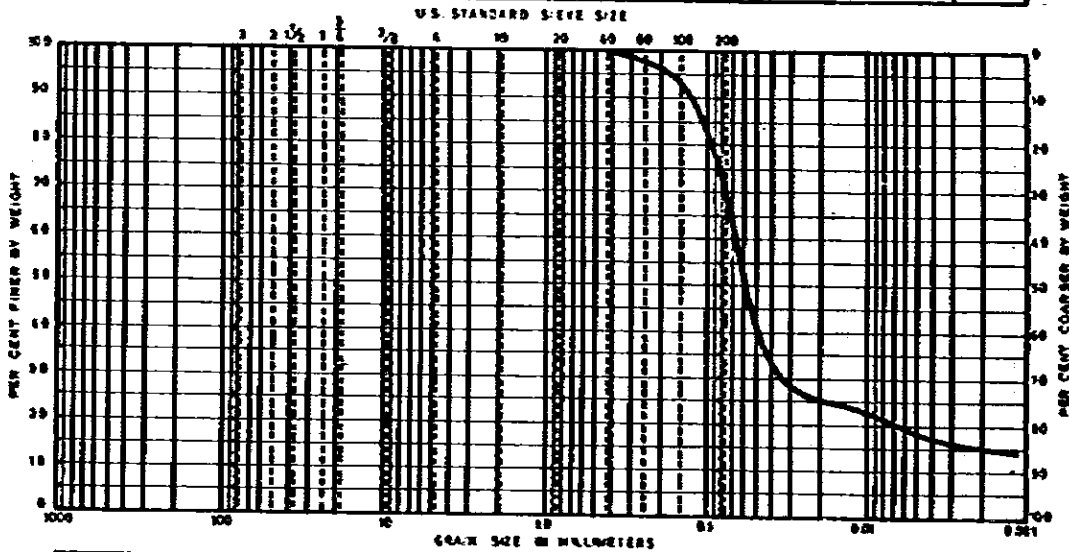
FILE _____
BY _____ DATE _____
CHECKED BY _____ DATE _____

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REF.
5	22.5	23			SK	SILTY FINE SAND	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REF.
5	29.5	30			ML	SANDY SILT	



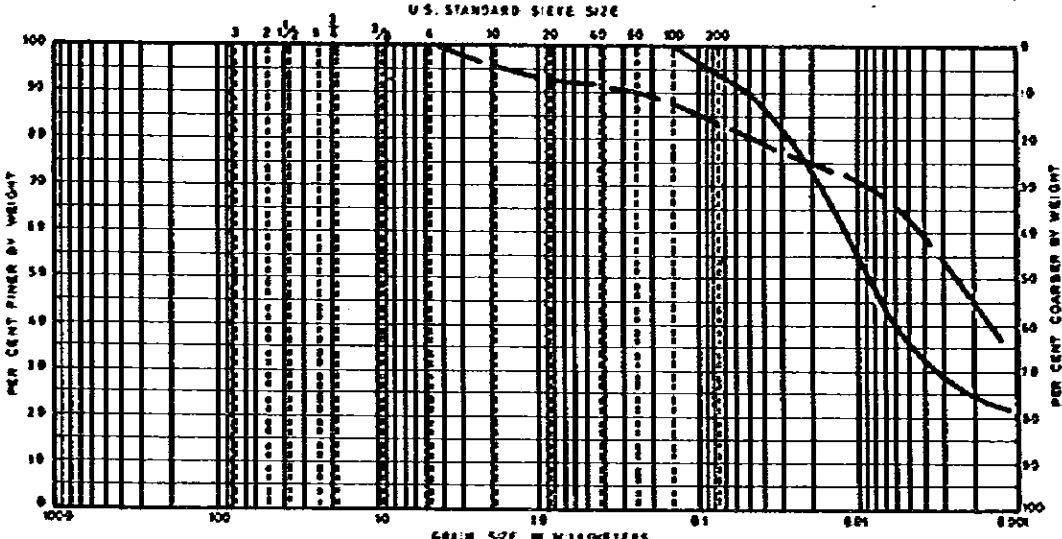
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

GRAIN - SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

EMERY & MOORE

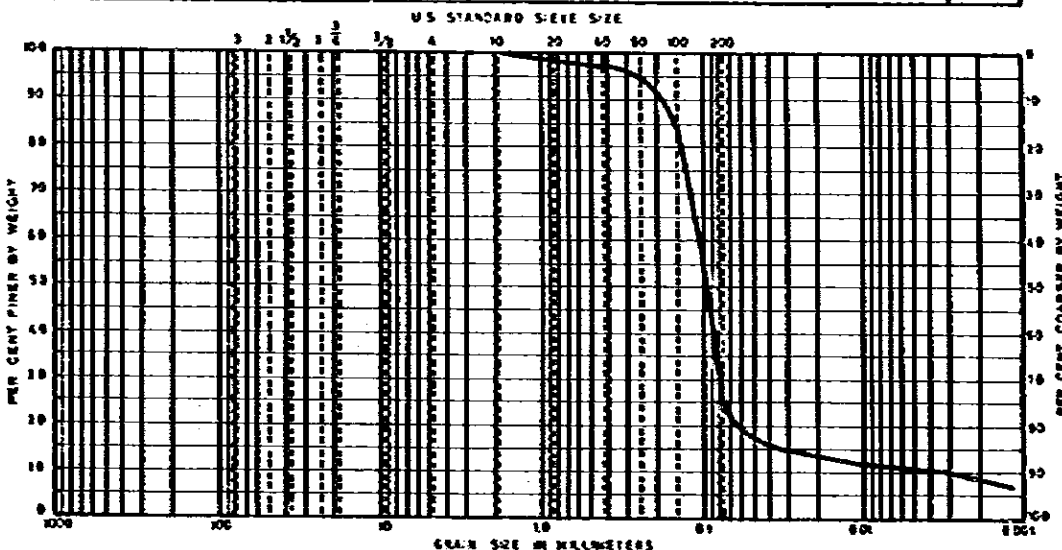
REVISIONS
 BY _____ DATE _____
 BY _____ DATE _____
 PLATE _____ OF _____

BORING	DEPTH IN	SAMPLE	LIQUID LBET	PLASTIC LBET	SYMBOL	SOIL DISCRPTION	REF
6	3.5	2			CL	SILTY CLAY	
6	5.5	6	33	20	CL	SILTY CLAY	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH IN	SAMPLE	LIQUID LBET	PLASTIC LBET	SYMBOL	SOIL DISCRPTION	REF
6	7.5	8			SM	SILTY FINE SAND	



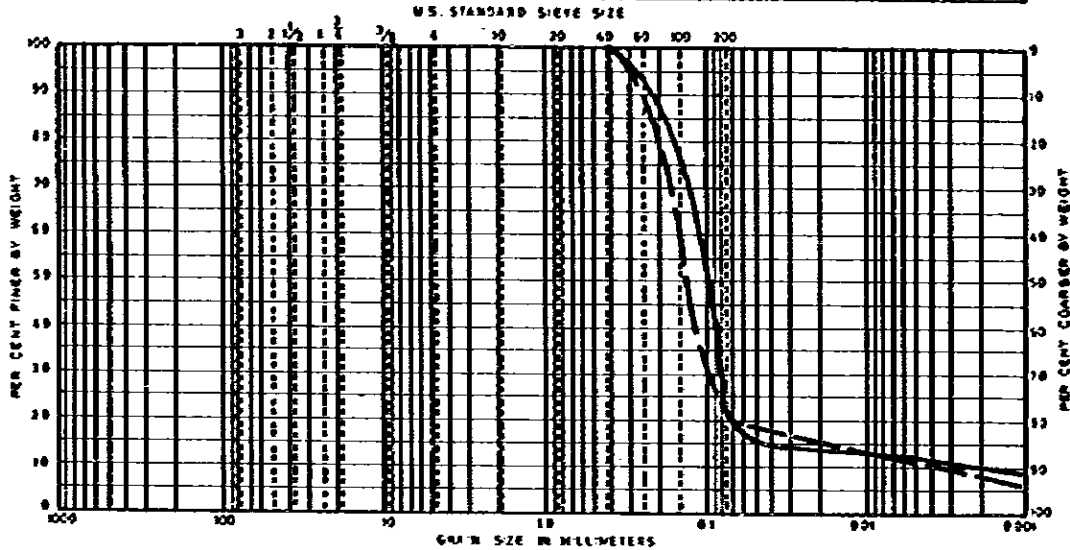
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

FILE 335-171-75
 BY J. HARRISON DATE 2-2-77
 CHECKED BY _____ DATE _____

GRAIN-SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

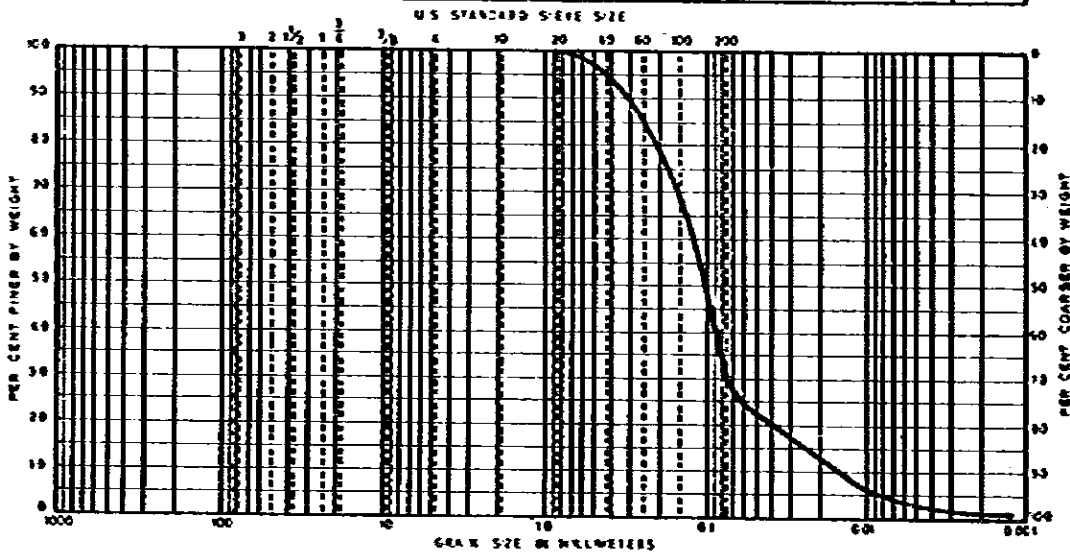
DANES & MOORE

BORING	DEPTH M	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REF
6	13.5	12			SM	SILTY FINE SAND	
6	14.5	15			SM	SILTY FINE SAND	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH M	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REF
6	17.5	18			SM	SILTY FINE SAND	

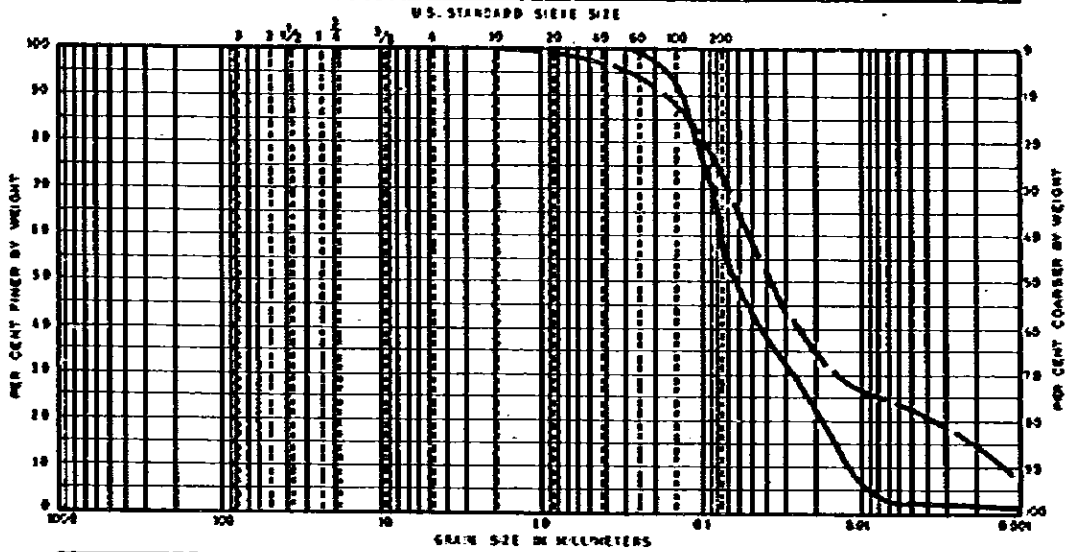


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

GRAIN-SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

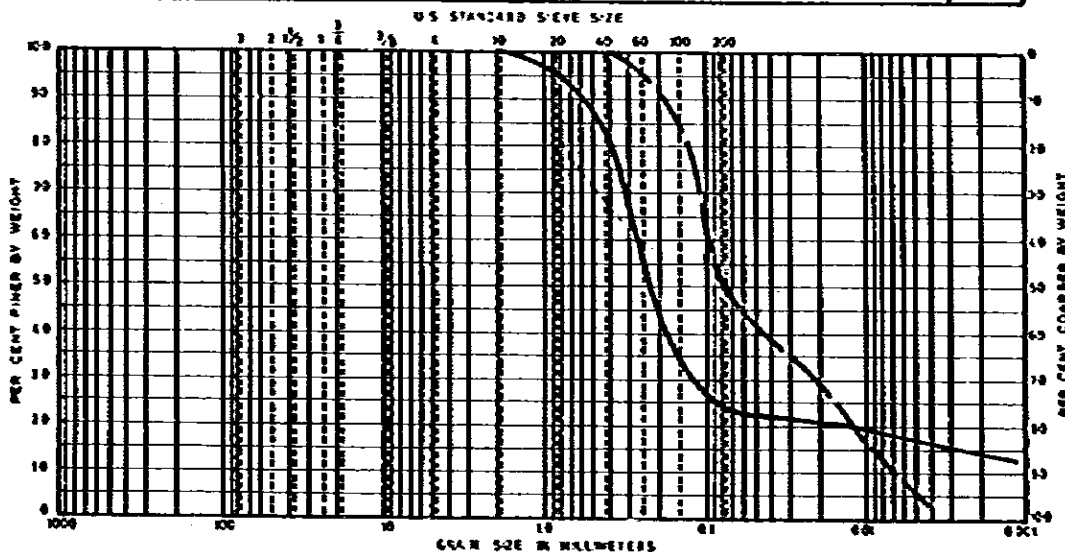
DANES & MOORE

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REV
6	20.5	21			ML	SANDY SILT	
6	22.5	23			ML	SANDY SILT	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REV
6	25.5	25			SM	SILTY FINE SAND	
6	28.5	28	24	20	SM	SILTY FINE SAND	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

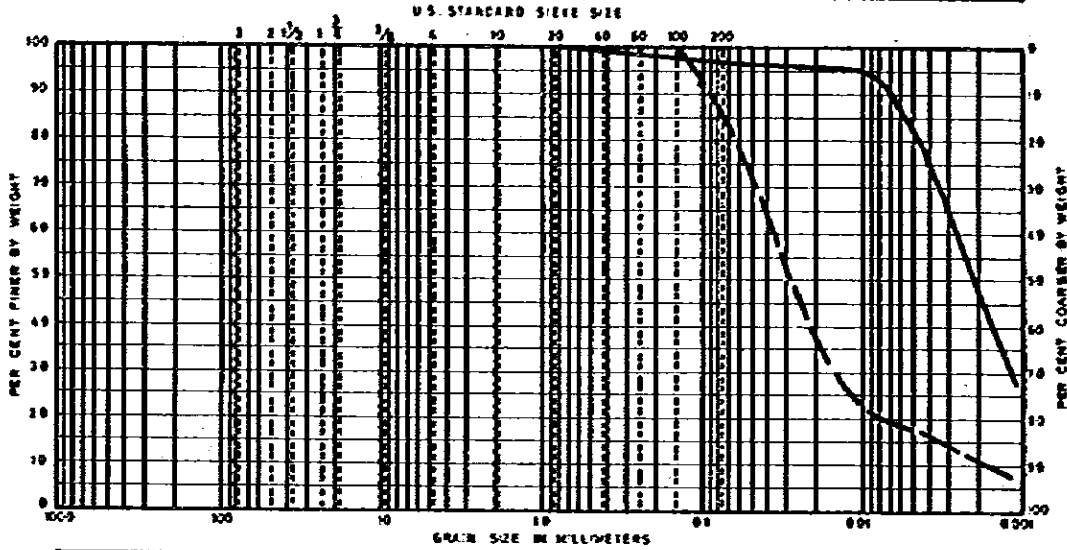
GRAIN - SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

DAMES & MOORE

REVISIONS _____ DATE _____
 BY _____ DATE _____
 CHECKED BY _____ DATE _____

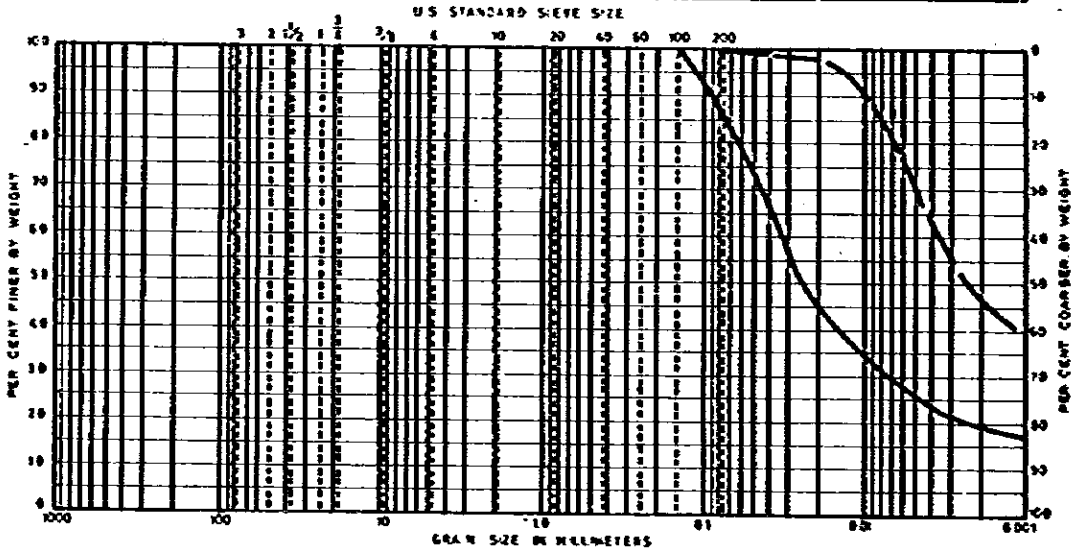
PLATE A-25-1774
 BY JH. BOBOLICH DATE 7-15-78
 CHECKED BY _____ DATE _____

BORING	DEPTH M.	SAMPLE	LIQUID LBMT	PLASTIC LBMT	SYMBOL	SOIL DESCRIPTION	REV
7	2.5	3	42	23	CL	SILTY CLAY	
7	5.5	6	25	20	CL-ML	SILTY CLAY	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MED-UM	FINE	

BORING	DEPTH M.	SAMPLE	LIQUID LBMT	PLASTIC LBMT	SYMBOL	SOIL DESCRIPTION	REV
7	7.5	8			CL	SILTY CLAY	
7	10.5	11	54	28	CH	HIGH PLASTICITY CLAY	

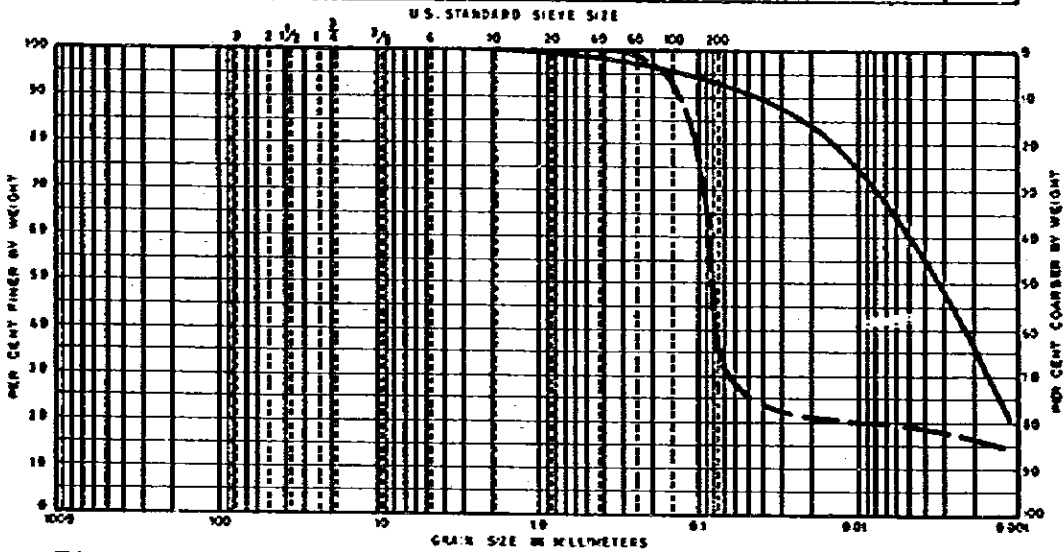


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MED-UM	FINE	

GRAIN - SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

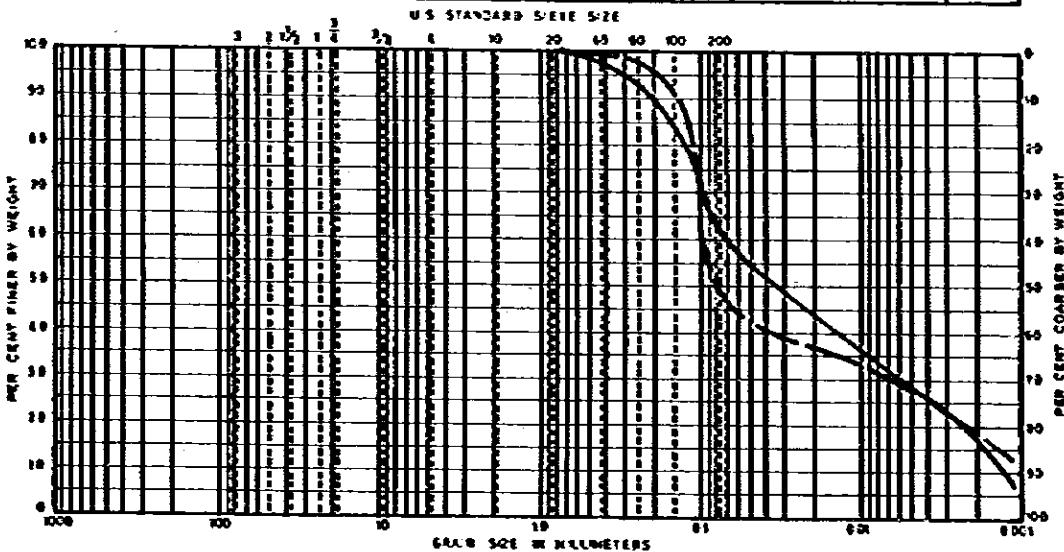
DARRIS & MOORE

BORING	DEPTH M	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	KEY
7	13.5	14			CL	SILTY CLAY	
7	17.5	18			SM	SILTY FINE SAND	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH M	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	KEY
7	19.5	20			CL	SILTY CLAY	
7	22.5	23			SC	CLAYEY FINE SAND	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

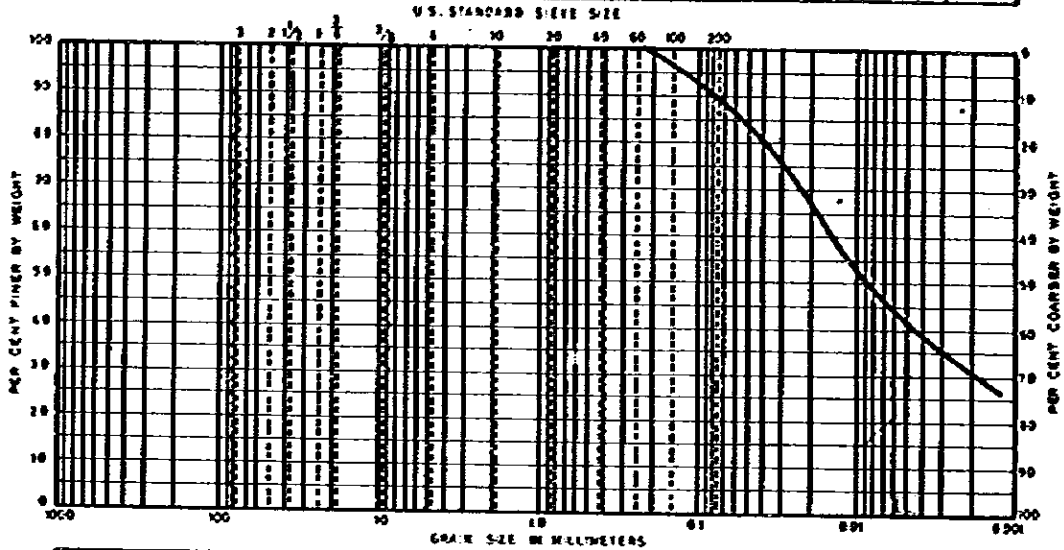
GRAIN-SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

DAMES & MOORE

REVISIONS
 BY _____ DATE _____
 BY _____ DATE _____
 PLATE _____ OF _____

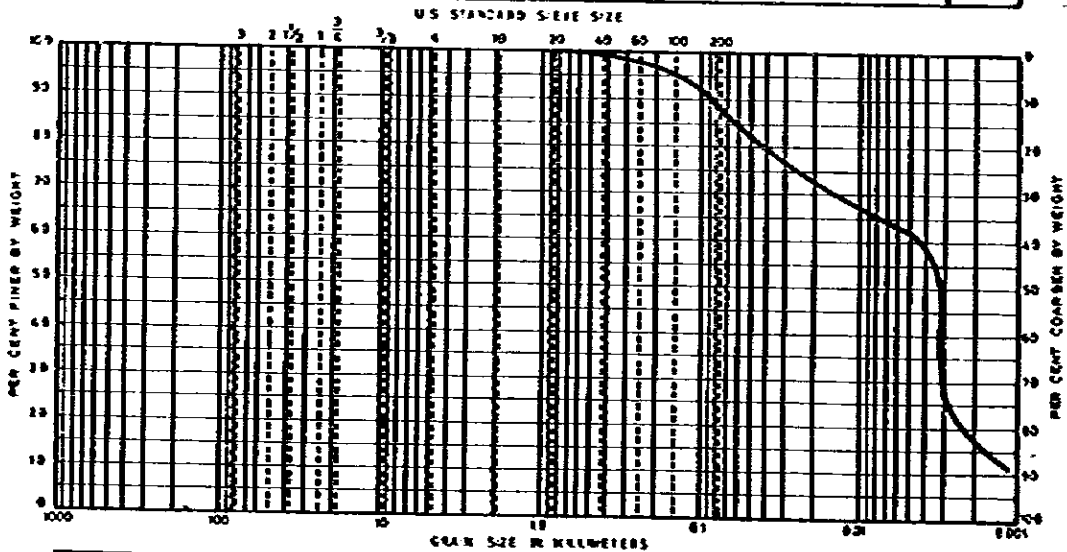
FILE 2001-171-60
 BY H. B. B. DATE 7-19-07
 CHECKED BY _____ DATE _____

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	KEY
7	25.5	26	32	22	CL	SILTY CLAY	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	KEY
7	29.5	30			CL	SILTY CLAY	

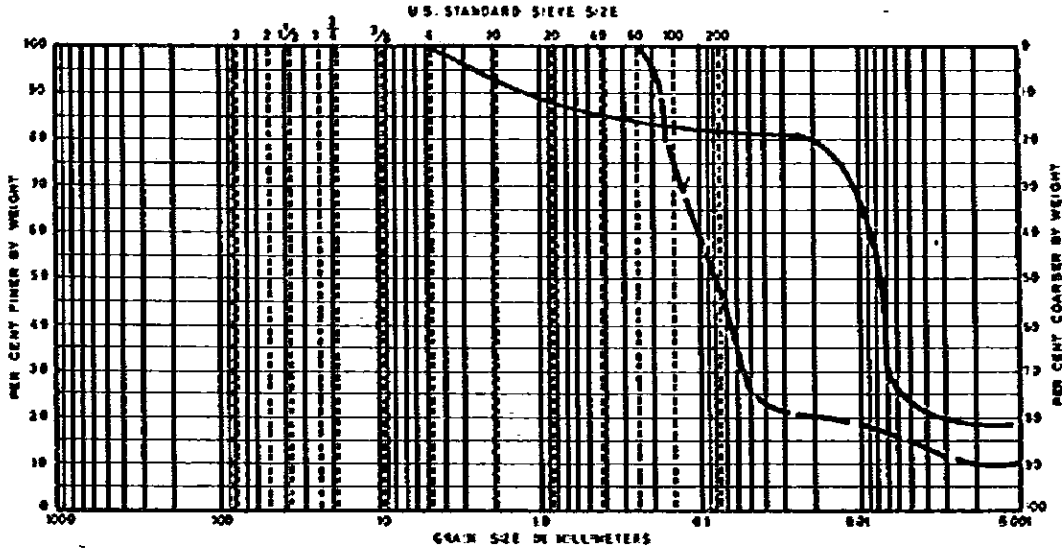


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

GRAIN - SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

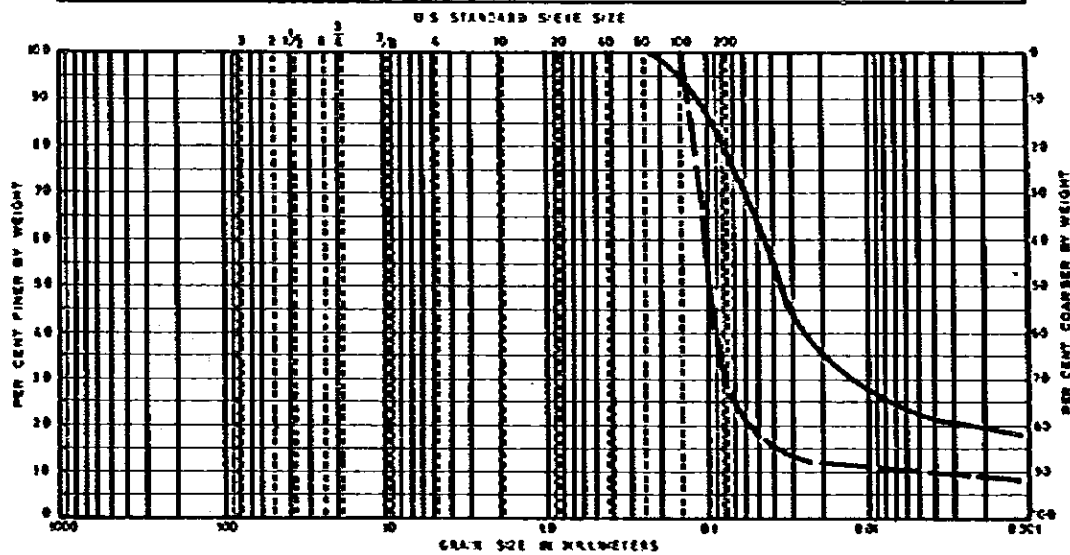
DAMES & MOORE

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	KEY
8	2.5	3			CL	SILTY CLAY	
8	6.5	5	27	16	SC	CLAYEY FINE SAND	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	KEY
8	6.5	7			CL	SILTY CLAY	
8	8.5	9			SM	SILTY FINE SAND	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

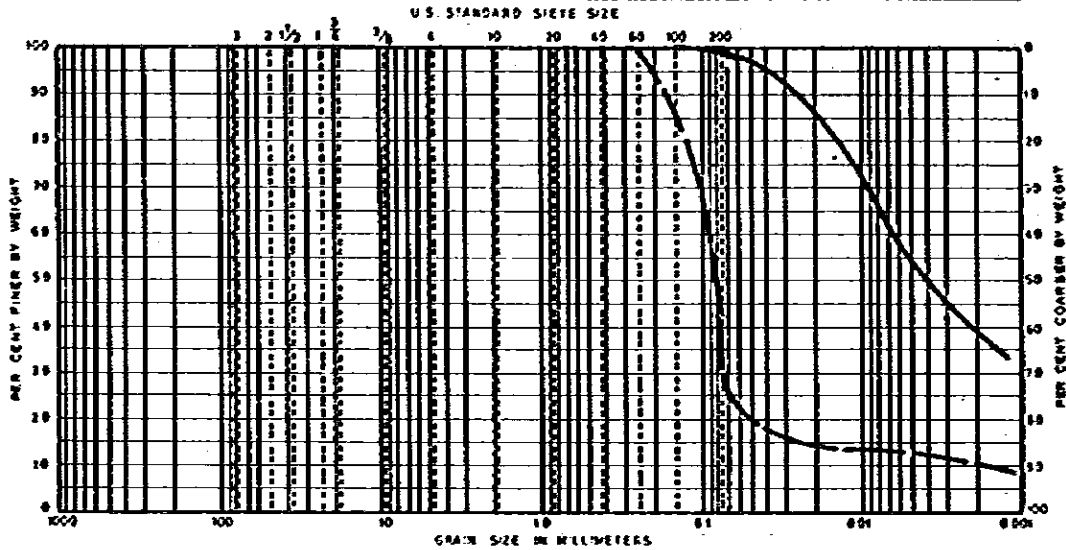
GRAIN-SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

DAMES & MOORE

REVISIONS
BY _____ DATE _____
BY _____ DATE _____
PLATE _____ OF _____

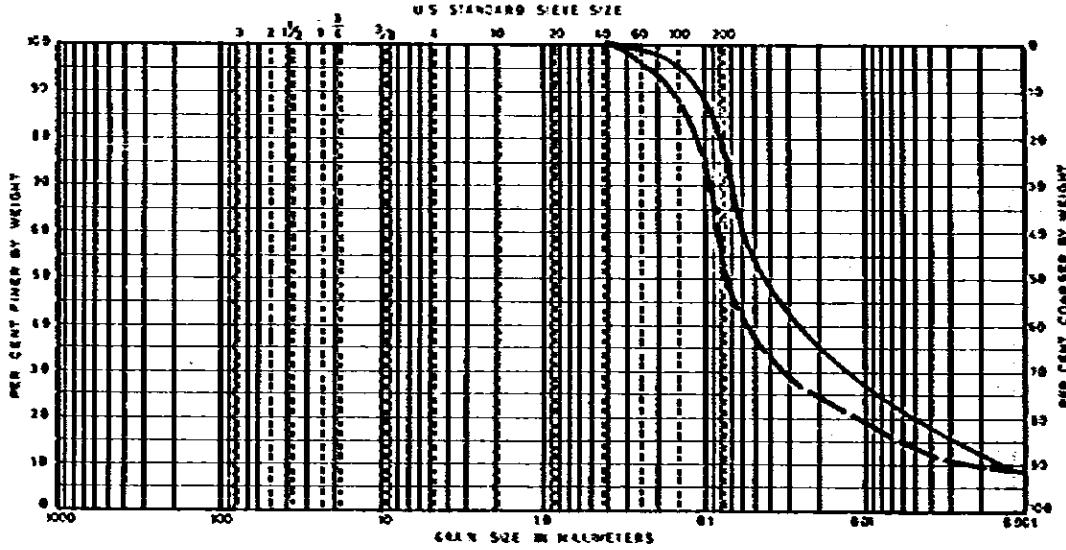
FILE 2255-1720
BY J.H. 12005/081 DATE 7-20-77
CHECKED BY _____ DATE _____

BORING	DEPTH IN	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REF
8	11.5	32			CL	SILTY CLAY	
8	14.5	35			SM	SILTY FINE SAND	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH IN	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REF
8	17.5	18			ML	SANDY SILT	
8	22.5	22			CL	SANDY CLAY	

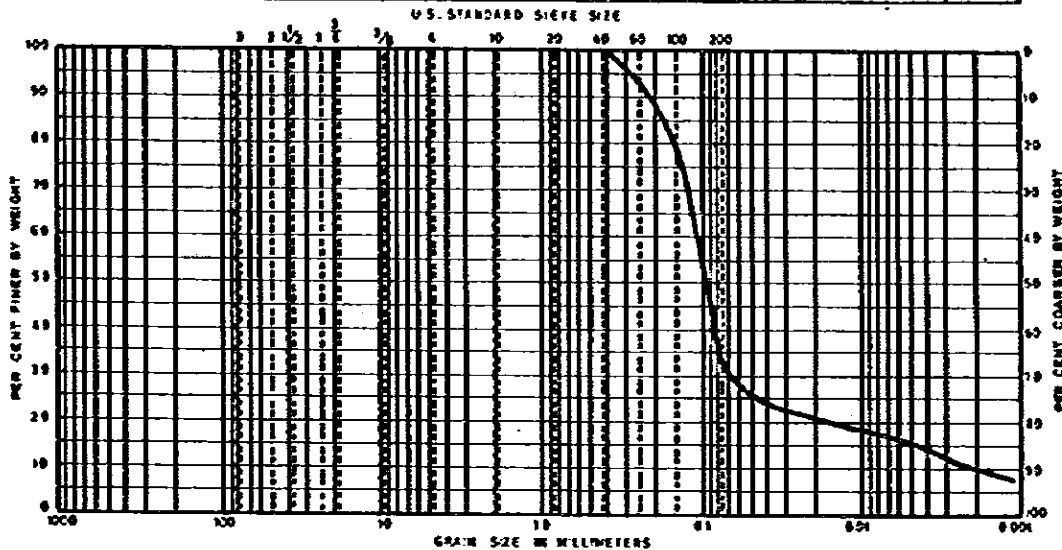


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

GRAIN-SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

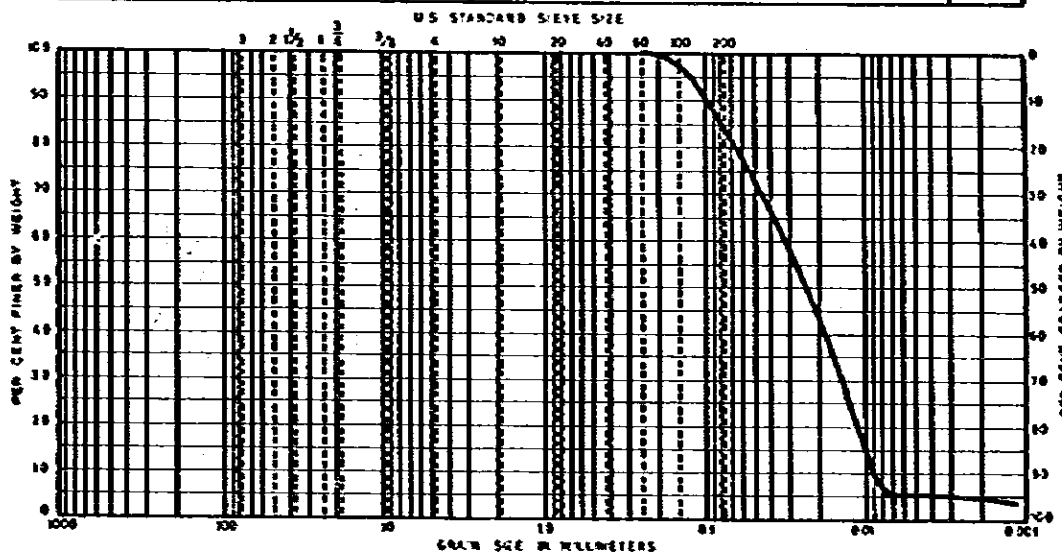
DAMES & MOORE

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	KEY
B	25.5	25			SM	SILTY FINE SAND	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	KEY
C	23.5	23			ML	CLAYEY SILT	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

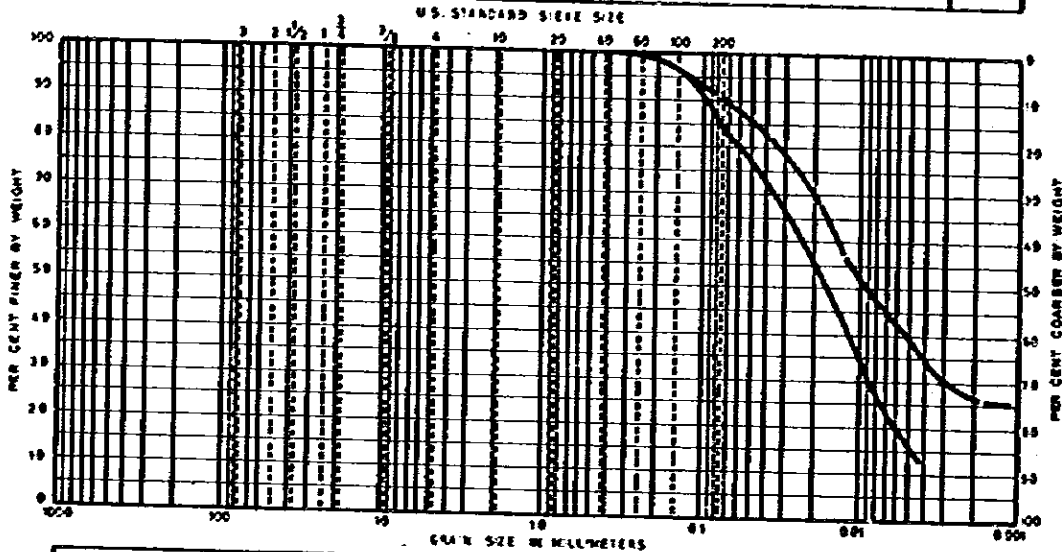
GRAIN-SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

DAMES & MOORE

REVISIONS
BY _____ DATE _____
BY _____ DATE _____
PLATE _____

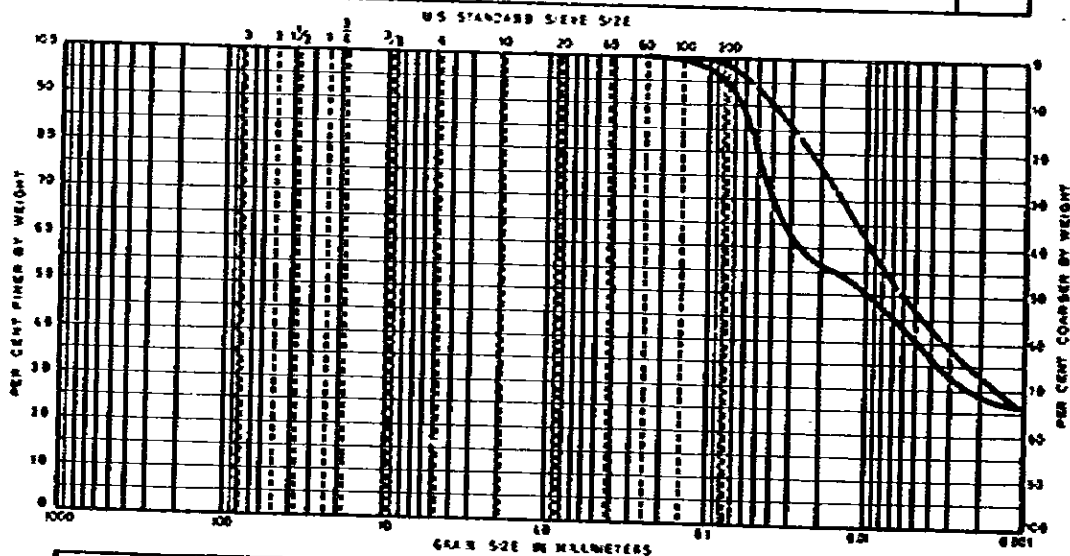
FILE 255-172-3
BY J. H. MOORE DATE 7-26-72
CHECKED BY _____ DATE _____

BORING	DEPTH M	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	KEY
9	2.5	3			ML	CLAYEY SILT	———
9	5.5	6			CL	SILTY CLAY	---



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH M	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	KEY
9	7.5	8			CL	SILTY CLAY	———
9	11.5	12			CL	SILTY CLAY	---

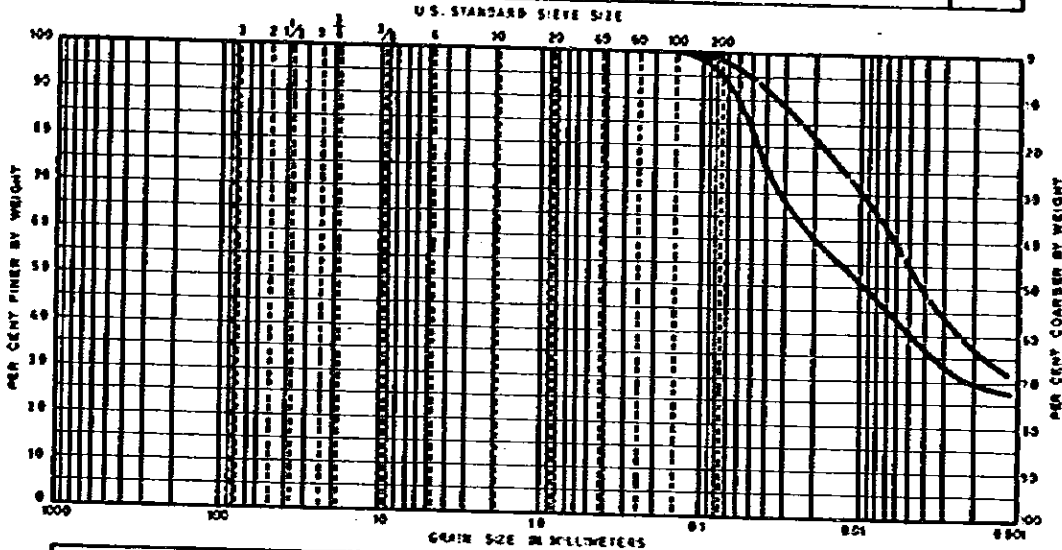


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

GRAIN-SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

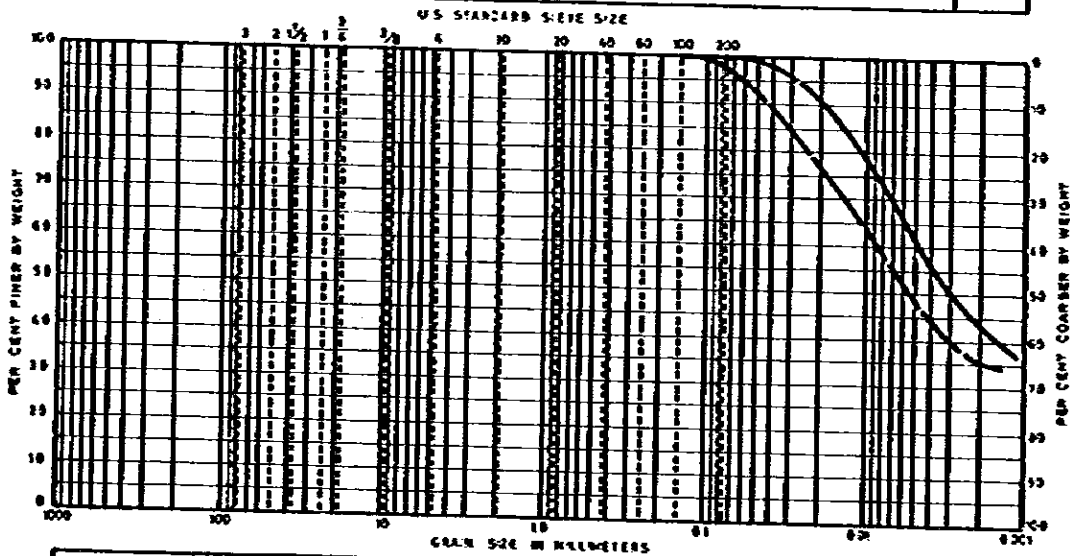
BARNS & MOORE

BORING	DEPTH M.	SAMPLE	LIQUID LBET	PLASTIC LBET	SYMBOL	SOIL DESCRIPTION	KEY
9	9.5	10			CL	SILTY CLAY	—————
9	13.5	14			CL	SILTY CLAY	—————



COBBLES	GRATEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH M.	SAMPLE	LIQUID LBET	PLASTIC LBET	SYMBOL	SOIL DESCRIPTION	KEY
9	19.5	20			CL	SILTY CLAY	—————
9	16.5	17			CL	SILTY CLAY	—————



COBBLES	GRATEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

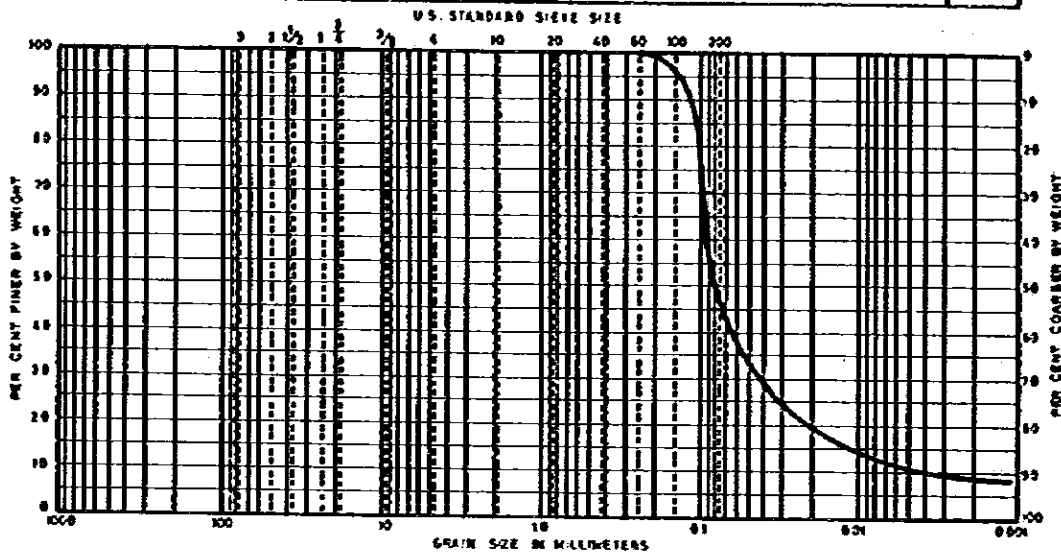
GRAIN-SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

DANES & MOORE

REVISIONS
BY _____ DATE _____
BY _____ DATE _____
PLATE _____

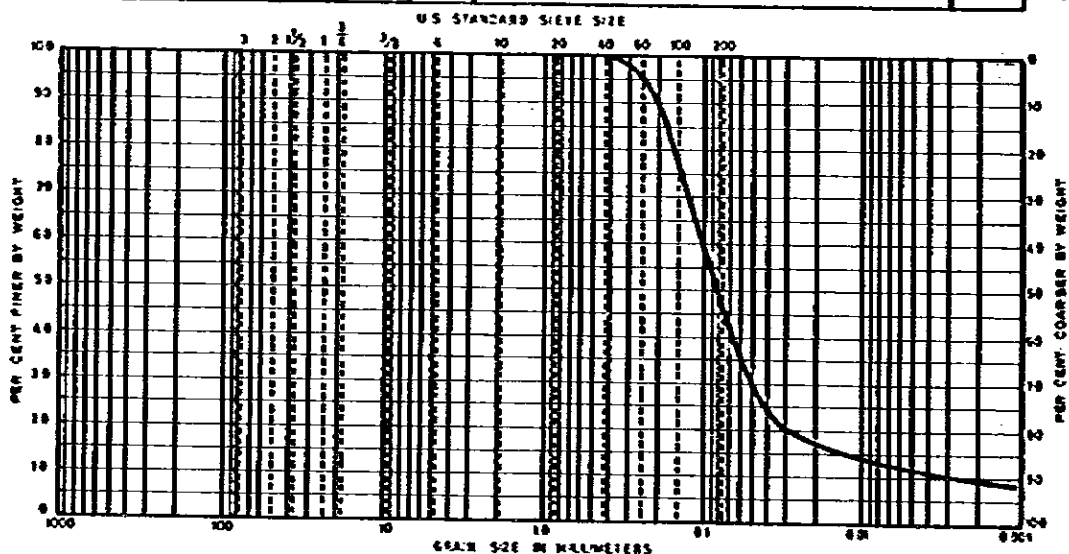
FILE _____
BY _____ DATE _____
CHECKED BY _____ DATE _____

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REV
9	27.5	27			SC	CLAYEY FINE SAND	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH M.	SAMPLE	LIQUID LIMIT	PLASTIC LIMIT	SYMBOL	SOIL DESCRIPTION	REV
9	29.5	23			SC	CLAYEY FINE SAND	



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

GRAIN-SIZE DISTRIBUTION (UNIFIED SOIL CLASSIFICATION SYSTEM)

DAMES & MOORE

DESIGNED BY _____ DATE _____
CHECKED BY _____ DATE _____

REVISIONS BY _____ DATE _____

REVISIONS BY _____ DATE _____

BORING NO.	SAMPLE DEPTH (M)	SPECIFIC GRAVITY
1	4.5	2.66
2	3.5	2.74
5	1.5	2.67

SPECIFIC GRAVITY TEST RESULTS

BORING NO.	DEPTH (M)	SOIL CLASSIFICATION	pH (%)	SULPHATE (%)
1	4.5	SC	7.82	0.53
2	2.5	SC	7.32	0.61
5	1.5	SM	7.10	0.48
7	1.5	CL	7.05	0.55
8	0.5	CL	7.12	0.59

CHEMICAL TEST RESULTS

RAMMO & MOORE

SOIL CLASSIFICATION CHART

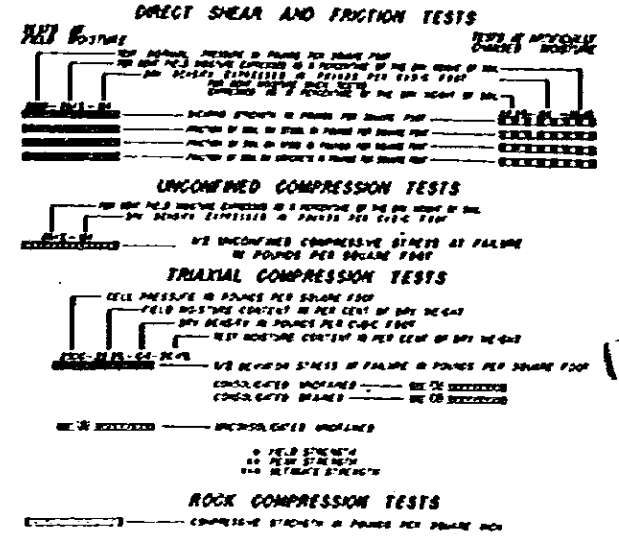
MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS		
COARSE GRAINED SOILS	GRAVEL AND GRADUATED GRAVELS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-SORTED GRAVELS, SANDY GRAVELS, SANDS, SILTS, CLAYS OR NO FINES		
		GRAVELS WITH FINES (APPROXIMATELY 5% TO 12% FINES)		GP	POORLY-SORTED GRAVELS, SANDY GRAVELS, SANDS, SILTS, CLAYS OR NO FINES		
	MORE THAN 50% OF MATERIAL PASSING THROUGH NO. 40 SIEVE	SANDS AND SANDY GRAVELS	CLEAN SANDS (LITTLE OR NO FINES)		GM	SANDY SILTS, SILTY SANDS, SANDS, SILTS, CLAYS	
			GRAVELS WITH FINES (APPROXIMATELY 5% TO 12% FINES)		GC	CLAYEY GRAVELS, SANDY-SILT CLAYEY GRAVELS	
		MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SANDS AND SILTY SANDS	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-SORTED SANDS, SANDS, SILTS, CLAYS OR NO FINES
				GRAVELS WITH FINES (APPROXIMATELY 5% TO 12% FINES)		SP	POORLY-SORTED SANDS, SANDY SANDS, SILTS, CLAYS OR NO FINES
	FINE GRAINED SOILS	SILTS AND CLAYS	LIGHTLY LIQUEFIED LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLAKES, SILTY OR CLAYEY FINE SANDS OR CLAYS, SILTS WITH SLIGHT PLASTICITY	
			CLAYS		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, ORGANIC CLAYS, SANDY CLAYS, SILTY CLAYS, LOAM CLAYS	
		SILTS AND CLAYS	CLAYS LESS THAN 50		MH	INORGANIC SILTS, SILTS OR SILTY CLAYS OF HIGH PLASTICITY, FAT CLAYS	
			CLAYS GREATER THAN 50		CH	INORGANIC CLAYS OF HIGH TO VERY HIGH PLASTICITY, ORGANIC SILTS	
HEAVY ORGANIC SOILS				OH	ORGANIC CLAYS OF HIGH TO VERY HIGH PLASTICITY, ORGANIC SILTS		
				PT	PEAT, MUDS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS		

NOTE: SAND SYMBOLS ARE USED TO INDICATE DOMINANT SOIL CLASSIFICATIONS.

<p>LIQUID LIMIT</p> <p>LIQUID LIMIT (LL) IN PERCENT</p> <p>TRACE..... 0 TO 10</p> <p>LOW..... 10 TO 20</p> <p>MEDIUM..... 20 TO 30</p> <p>HIGH..... 30 TO 40</p> <p>VERY HIGH..... 40 TO 50</p> <p>EXTRA HIGH..... 50 TO 60</p> <p>EXTRA VERY HIGH..... 60 TO 70</p> <p>EXTRA VERY VERY HIGH..... 70 TO 80</p> <p>EXTRA EXTRA VERY VERY HIGH..... 80 TO 90</p> <p>EXTRA EXTRA EXTRA VERY VERY HIGH..... 90 TO 100</p>	<p>PLASTICITY INDEX</p> <p>PLASTICITY INDEX (PI) IN PERCENT</p> <p>TRACE..... 0 TO 1</p> <p>LOW..... 1 TO 2</p> <p>MEDIUM..... 2 TO 4</p> <p>HIGH..... 4 TO 6</p> <p>VERY HIGH..... 6 TO 8</p> <p>EXTRA HIGH..... 8 TO 10</p> <p>EXTRA VERY HIGH..... 10 TO 12</p> <p>EXTRA EXTRA VERY VERY HIGH..... 12 TO 14</p> <p>EXTRA EXTRA EXTRA VERY VERY HIGH..... 14 TO 16</p>	<p>SHRINKAGE</p> <p>SHRINKAGE (S) IN PERCENT</p> <p>TRACE..... 0 TO 1</p> <p>LOW..... 1 TO 2</p> <p>MEDIUM..... 2 TO 4</p> <p>HIGH..... 4 TO 6</p> <p>VERY HIGH..... 6 TO 8</p> <p>EXTRA HIGH..... 8 TO 10</p> <p>EXTRA VERY HIGH..... 10 TO 12</p> <p>EXTRA EXTRA VERY VERY HIGH..... 12 TO 14</p> <p>EXTRA EXTRA EXTRA VERY VERY HIGH..... 14 TO 16</p>
--	---	--

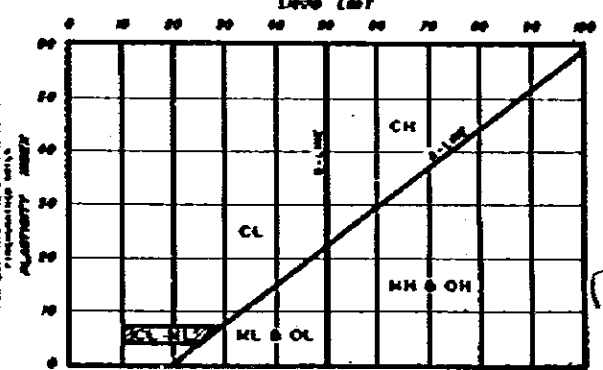
UNIFIED SOIL CLASSIFICATION SYSTEM

KEY TO TEST DATA



KEY TO SAMPLES

- INDICATES DEPTH OF UNDISTURBED SAMPLE
- INDICATES DEPTH OF DISTURBED SAMPLE
- ◇ INDICATES DEPTH OF SAMPLING ATTEMPT WITH NO RECOVERY
- △ INDICATES DEPTH OF SPILL-SPOON SAMPLE
- ▽ INDICATES DEPTH AND LENGTH OF CORING RUN



PLASTICITY CHART FOR FINE GRAINED SOILS



PARTICLE SIZE DISTRIBUTION FOR COARSE GRAINED SOILS

DANES & MOORE
APPLIED EARTH SCIENCES