No. 53

THE ARAB REPUBLIC OF EGYPT

MINISTRY OF DEVELOPMENT, HOUSING AND LAND RECLAMATION
GENERAL AUTHORITY FOR REHABILITATION
PROJECTS AND AGRICULTURAL DEVELOPMENT

FEASIBILITY STUDY
ON
THE NORTH HUSSINIA VALLEY & SOUTH PORT SAID AGRICULTURAL DEVELOPMENT PROJECT
VOLUME. I

A. SOIL
B. LAND CAPBILITY CLASSIFICATION

JUNE 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

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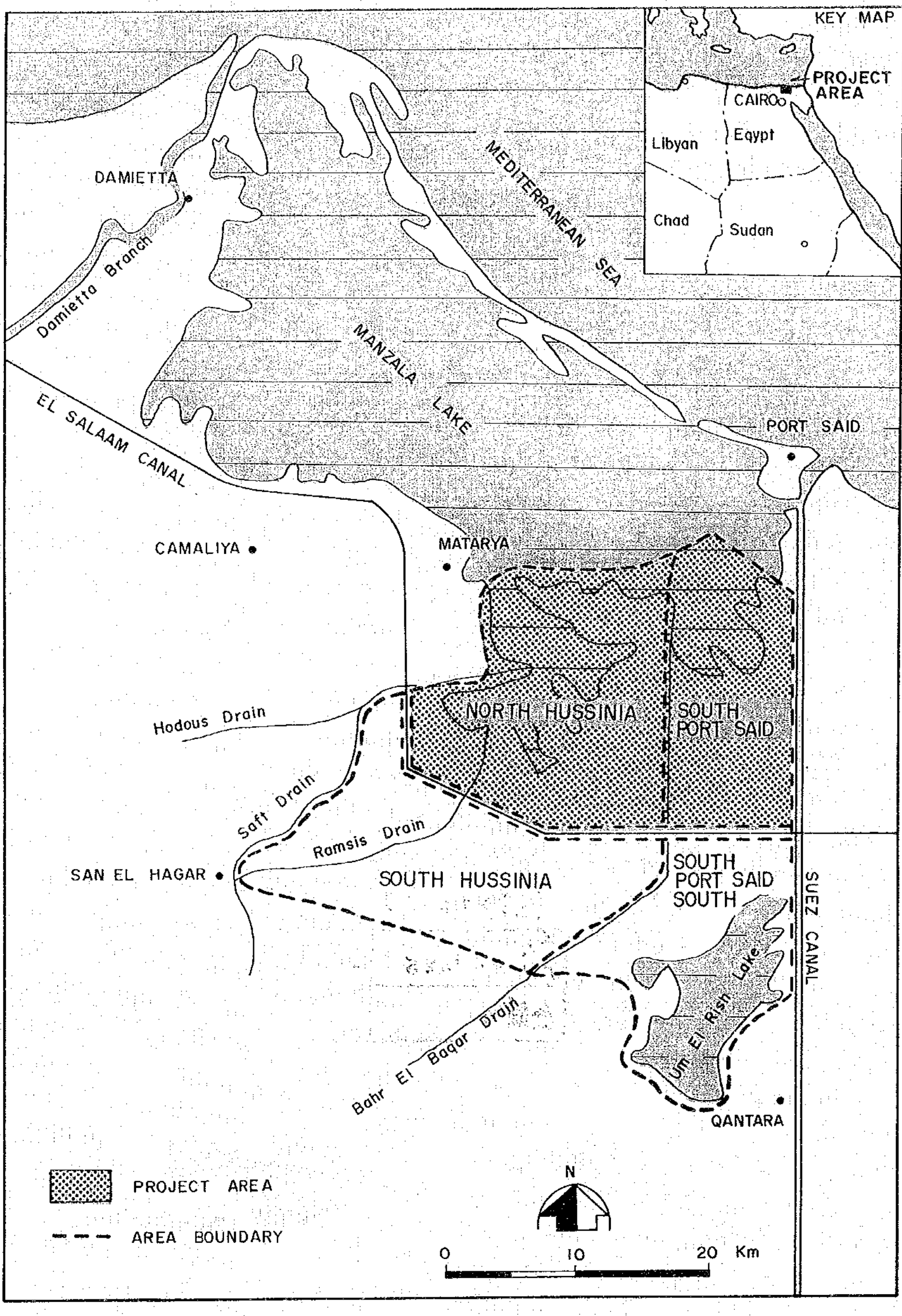
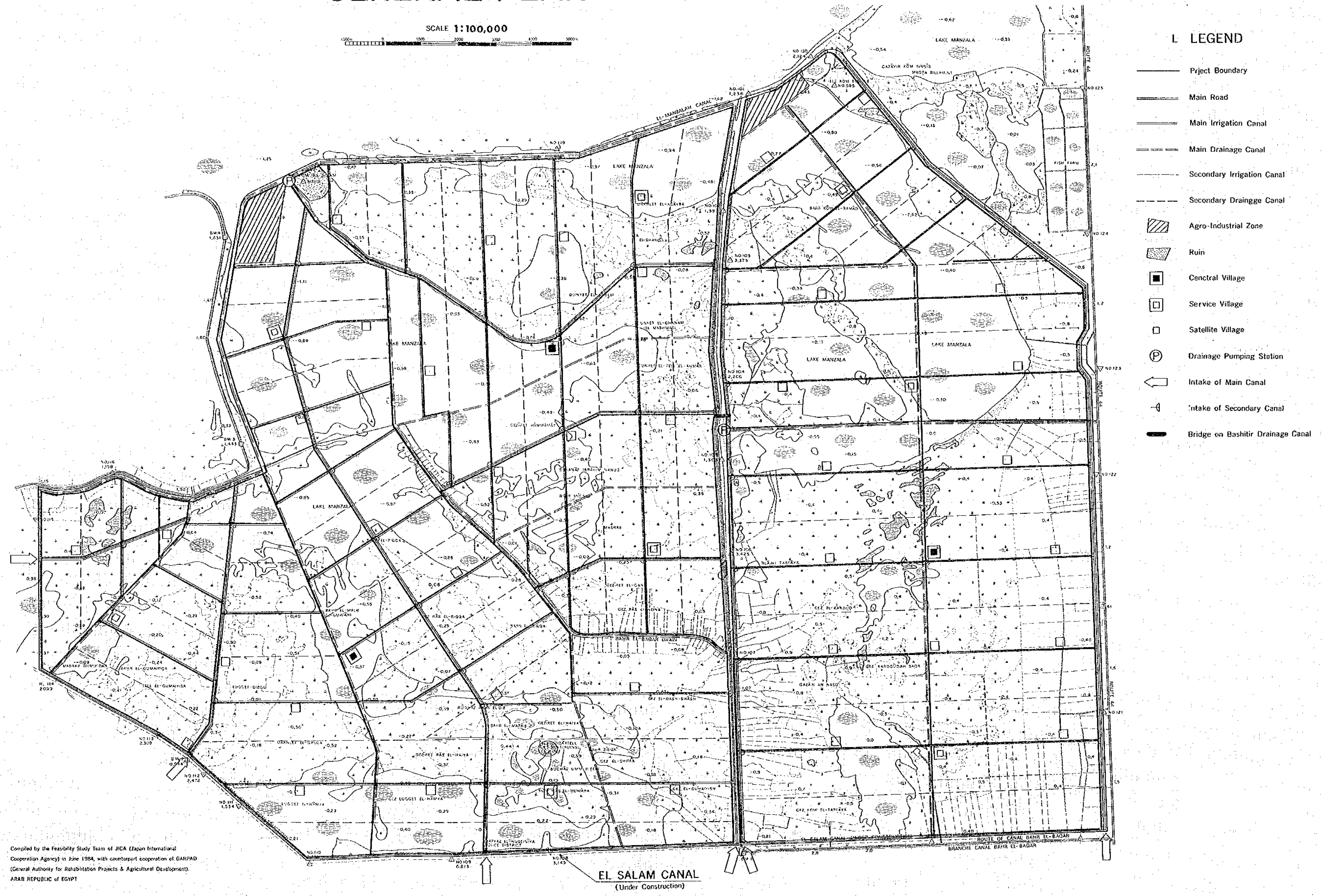
LOCATION MAP



NORTH HUSSINIA VALLEY AND SOUTH PORT SAID AGRICULTURAL DEVELOPMENT PROJECT

GENERAL PLAN

SCALE 1:100,000



Compiled by the Feasibility Study Team of JICA (Japan International Cooperation Agency) in June 1984, with counterpart cooperation of GARPAD (General Authority for Rehabilitation Projects & Agricultural Development).
ARAB REPUBLIC of EGYPT

C O N T E N T S

ANNEX

A. SOILS

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A. Soils

1. Summary

The Project Area is largely made up of fluviomarine alluvium deposits of fine texture which were transported by the River Nile. They are of recent origin and very deep although the depth of these clayey depostis cannot be clearly identified in the Area.
In northwest of Bahar El Baqar, however, it has been observed that they are overlying a medium textured substratum. Suggesting the past history of big floods caused by the River Nile, the profiles are mostly composed of several heavy or lighter textured layers.
Hence, profile development is very low except for gley and a few mottling phenomena. Lake Manzala which occupies a large part of the Project Area is still experiencing silting-up processes though at much lower rate than in the past because the Lake is now almost completely segregated from the Mediterranean Sea. Consequently, the Area seems to be turning drier especially since the construction of the Aswan High Dam. The origin of soil materials lies at the geological strata in the upper stream of the Nile. Through a long weathering process, sandstones partly inserted with limestones and granites had been transported to form the Nile Delta.
From the surface down to deep zone, texture is composed of clay and silt mixed with organic clay, and beneath this follow sand and gravel materials. Groundwater contains much dissolved salts.

2. Field and Laboratory Work

2-1 Field Work

The Project Area is around 110,000 feddan spread on dry land and inundated area.

A soil survey in the Project area inclusive of both dryland and inundated area was conducted, with the aid of the tentative soil map at a scale of 1:50,000 from May 21 to end-July 1983, with the profile density/depth as specified as below;

Profile density: Dry land = 2 open pits and 2 augerholes per 100ha
Inundated area = 1 borehole per 200 ha.

Profile depth: Dry land = 2 m (85%) and 3 m (15%) at open pits (when encountering water table at shallow depth auger was used to arrive at deeper depth)
Inundated area = 1.5 to 2.0 m-deep boreholes by use of the thin wall sampler

Samples were collected from all the open pits on the dry land and boreholes in the inundated area, at each depth of:

Dry land: 2 m-deep open pits = 0 to 30, 30 to 60, 60 to 120 cm (3 layers)
3 m-deep open pits = 0 to 30, 30 to 60, 60 to 120, 120 to 200, 200 to 300 cm (5 layers)

Inundated area: Same as above.

Thus, 86 open pits and 86 augerholes in the dry land, and 193 boreholes in the inundated area were surveyed, and about 872 soil samples were collected for physical and chemical analysis by GARPAD's Laboratory. Soil investigation site is shown in Fig.A-2-1.

Soil Survey Instruments

Soil Color Charts :

Soil Colors were referenced to Japanese Soil Color Charts (English and Japanese). This book is characterized in both colour of reduced and volcanic ash soil.

Inundated Soil Sampler :
Inundated deposits were sampled by use of Japanese sampler called "Thin wall Sampler". (See Fig. A-2-2)

Soil Auger :
Soil auger boring in the dry land area were conducted by the soil augeres with various length.

Soil Hardness Tester :
Soil hardness of each soil layer were measured by The Yamanaka's soil hardness tester in the dry land area.

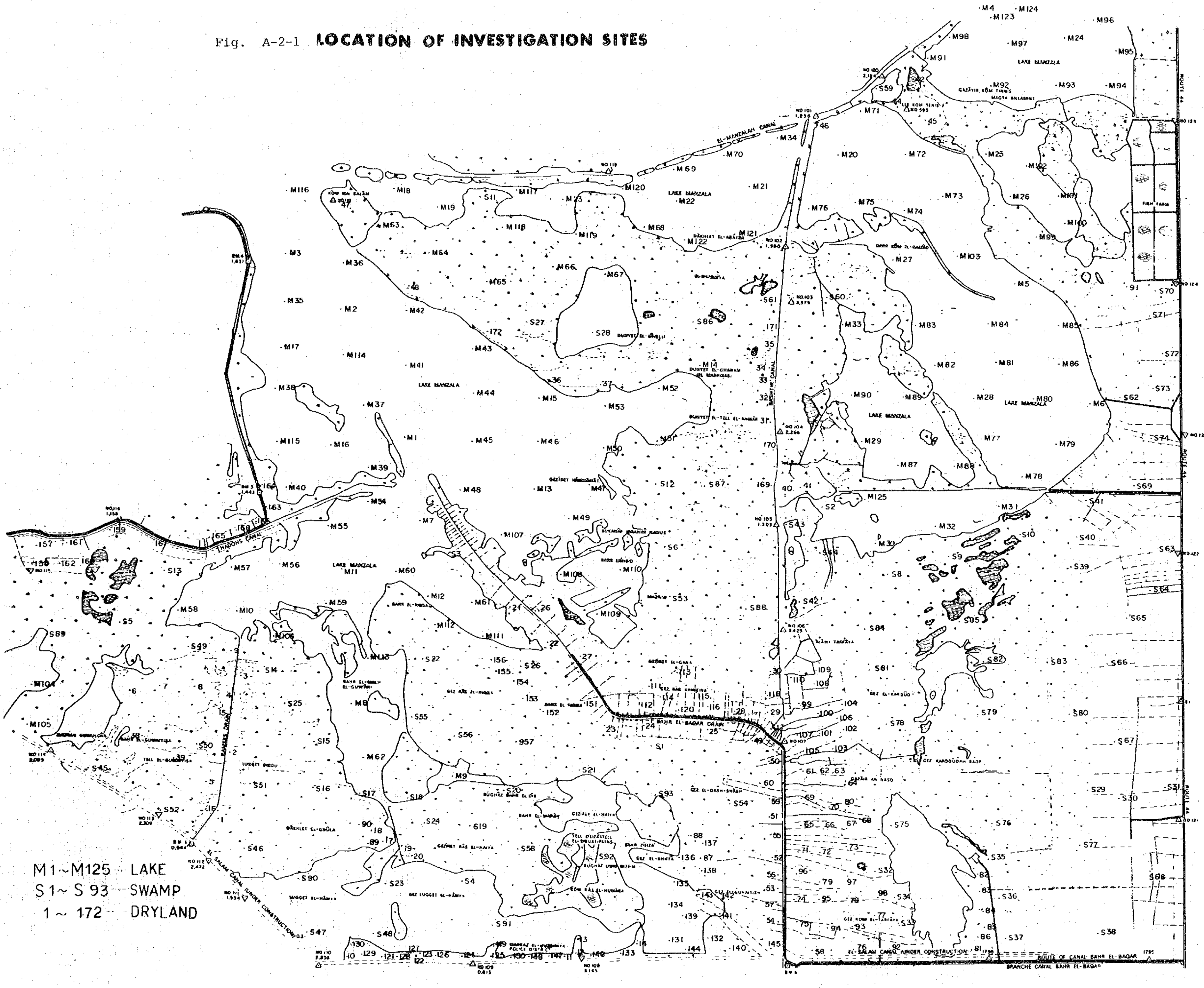


Fig. A-2-1 **LOCATION OF INVESTIGATION SITES**

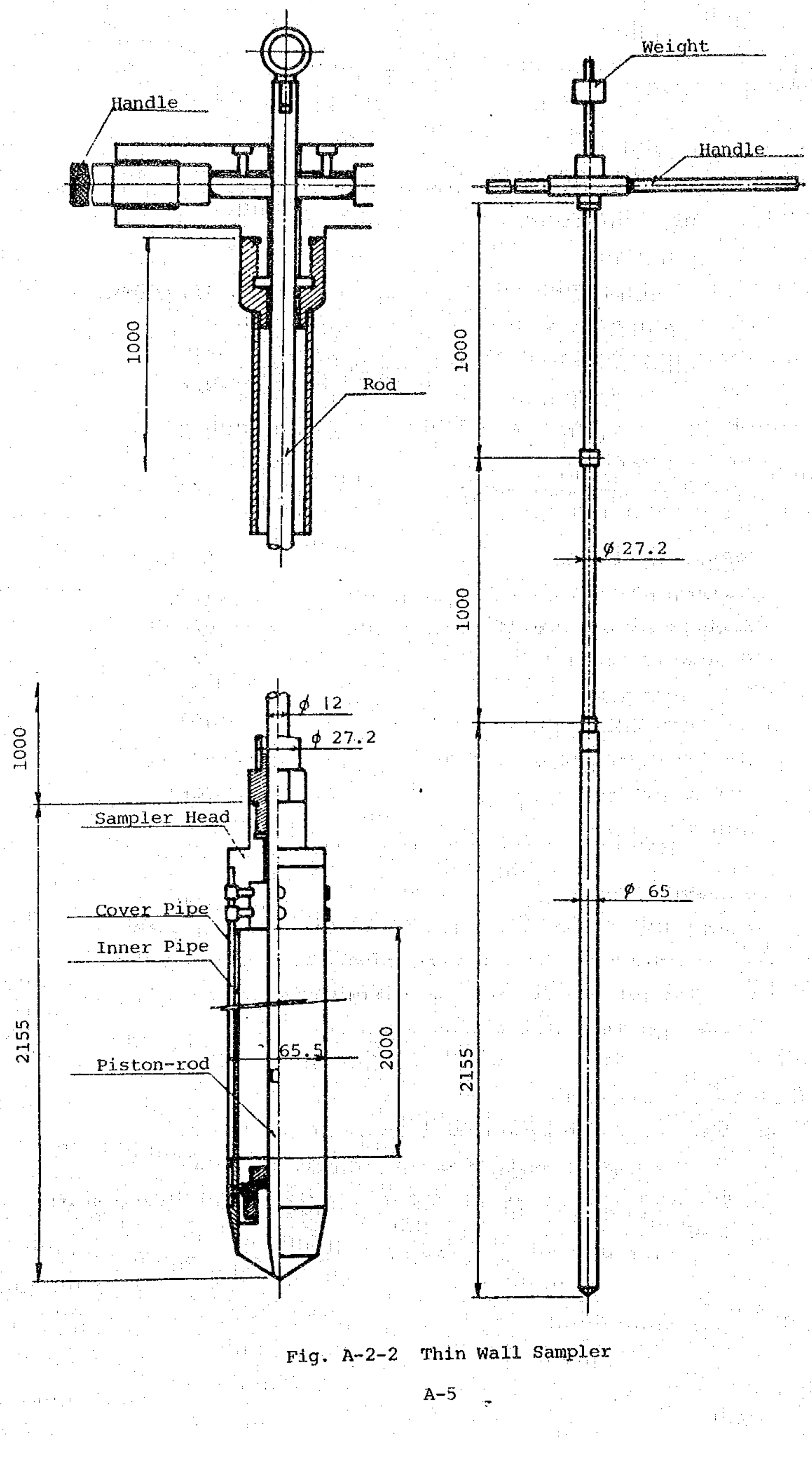


Fig. A-2-2 Thin Wall Sampler

2-2 Laboratory Analysis

1) Analysis Items

The following analysis were carried out to determine the physical and chemical properties of the soil samples.

Analysis Items	Samples Number
Physical analysis	
- Particle size distribution	151
- Saturation percentage	845
- pF curve	0
Chemical analysis	
- Electrical conductivity(EC)	845
- pH	845
- Soluble anions and cations	155
- Exchangeable bases	116
- Cation Exchange capacity	116
- Organic matter	134
- Total nitrogen	134
- Available phosphorus	134
- Available potassium	134
- Gypsum present	108
- Clay minerals	3

2) Soil Sample Preparation

The soil samples were air dried and sieved through a 2-mm screen to separate the coarse fraction. The remaining fine earth fraction was used for the determination of the soils' chemical and physical characteristics.

3) Methods of Analysis

a) Analysis of the Saturation Extract

Water saturated soil paste was prepared according to the procedure outlined by the U.S.D.A. Salinity laboratory staff, 1954.

The soil pH was determined in the saturated paste using a pH meter equipped with a glass electrode.

The electrical conductivity of the saturation extract (in mmhos/cm at 25°C) was determined using a conductivity bridge.

Soluble sodium and potassium were determined in the extract by flame emission. Using a flame photometer.

Calcium plus magnesium were determined by titration with standard versenate solution using ammonium chloride-ammonium hydroxide buffer and eriochrome black T indicator.

Calcium was determined by titration with versenate solution using 4N sodium hydroxide solution as a buffer and ammonium perporate indicator.

Soluble carbonate and bicarbonate were determined by titration with standard H_2SO_4 solution, phenolphthalein indicator and Methyl orange indicator respectively.

Chloride was determined by titration with a standard silver nitrate solution using potassium dichromate solution as an indicator.

Soluble sulphate was estimated arithmetically by substracting the sum of CO_3 + HCO_3 + CL from the total anions.

b) Determination of the Cation Exchange Capacity "CEC"

The cation exchange capacity was determined for most samples using the sodium acetate/ammonium acetate method.

c) Determination of the Exchangeable Sodium

The exchangeable sodium content was determined using the ammonium acetate method (U.S. Salinity laboratory staff). Exchangeable (plus soluble) cations were extracted with a normal neutral ammonium acetate solution. Sodium was determined in the extract by flame photometer. The exchangeable sodium was determined by substracting the saturation extract soluble sodium from the ammonium acetate extractable sodium. The exchangeable sodium was calculated as percent of the cation exchange capacity to obtain the exchangeable sodium percentage "ESP".

d) Determination of Total Nitrogen

Available nitrogen was extracted from representative samples with 10 percent potassium sulphate solution. Nitrogen was then determined in the extract by the Kjeldahl method (U.S. Salinity laboratory staff).

e) Determination of Available Phosphorus

Water soluble phosphorus was extracted from representative samples and determined colorimeterically in the water extract using the ammonium molibdate method.

f) Determination of the Organic Matter Content

The organic matter content was determined in representative samples using the wet combustion method (U.S. Salinity laboratory staff, 1954).

g) Determination of the Gypsum Present

The gypsum content was determined by the difference between Calcium plus Magnesium in the suspension 1:100 (soil:water) and the calcium plus magnesium in the extract.

h) Mechanical Analysis

This analysis was performed to determine the percentage of the different soil particles in the samples. It was carried out for a known weight of soil using a dispersing agent consisting of sodium hexametaphosphate carbonate. The Bouyoucos hydrometer method (1951) was used to separate the textures without removing calcium and magnesium carbonates..

The results are expressed as a percentage of sand, silt and clay. The different size of separates are as follows based on U.S.D. System:

Clay : < 2 micron

Silt : 2 to 20 micron

Sand : 50 to 2,000 micron

i) Clay Minerals

The clay portion (2 um) was collected by the sedimentation method from the soil samples which had been dispersed in water by a ultra-sonic machine. After deferration by Mehra and Jacksos's method, each of clay samples was divided into two parts, and saturated with K-and Mg-ions respectively.
After being oriented on a slide glass, they were x-rayed by a diffractometer.

j) *Three Phases of Soil*

Soil Composition consists of the solid, liquid and air phases, and total volume of solid and liquid is called due actual volume. The actual volumes of soils are measured by means of the actual volumemometer according to the principle of Boyle's law.
The apparatus shown in Fig. A-2-3 is a single element type of one air system. Assuming to know the actual volume, V, total weight, W, and true density, d, three phases percentage of soils can be calculated by the following formulae;

$$\text{Solid volume ; } Sv = \frac{W-V}{d-1}$$

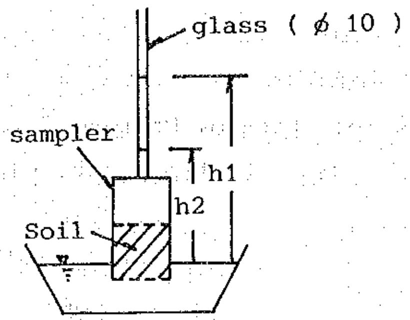
$$\text{Liquid volume; } Mv = V-Sv$$

$$\text{Air volume ; } Av = 100-V$$

Fig. A-2-4 shows the Location of Sampling Site for three phase of soil.

k) Water Conductivity

Coefficient of water conductivity by laboratory test is computed by the following formula:



$$K = \frac{a.l}{A} \cdot \frac{2.30}{t_2 - t_1} \cdot \log \left(\frac{h_1 + l}{h_2 + l}\right)$$

where ; K=Percolation coefficient (cm/sec)

a=Close section of glass (cm^2)

A=Close section of sampler (cm^2)

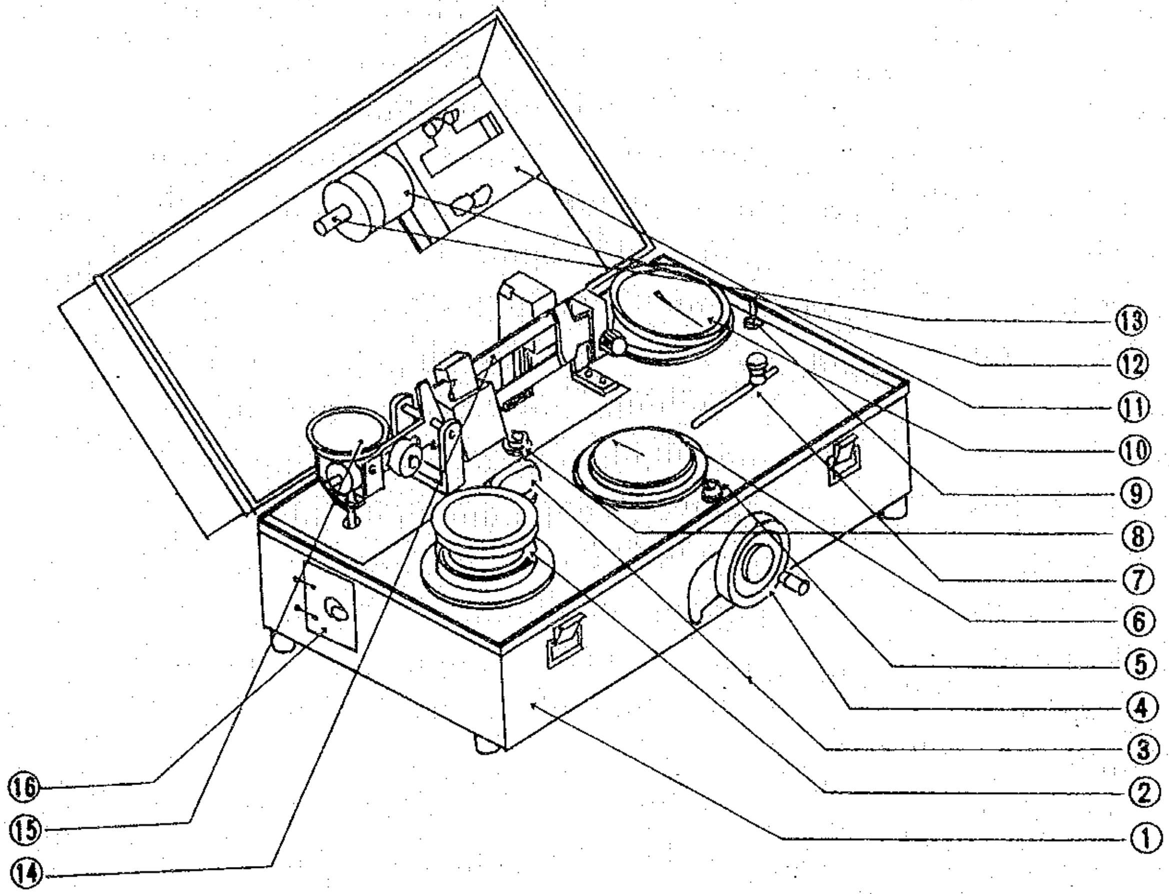
l=Length of soil sampler (5cm)

t=Time (second)

Further, borehole (1 to 2 m deep)permeability tests and cylinder intake rate tests were also carried out for the conductivity in the proposed area.

ℓ) Basic Intake Rate

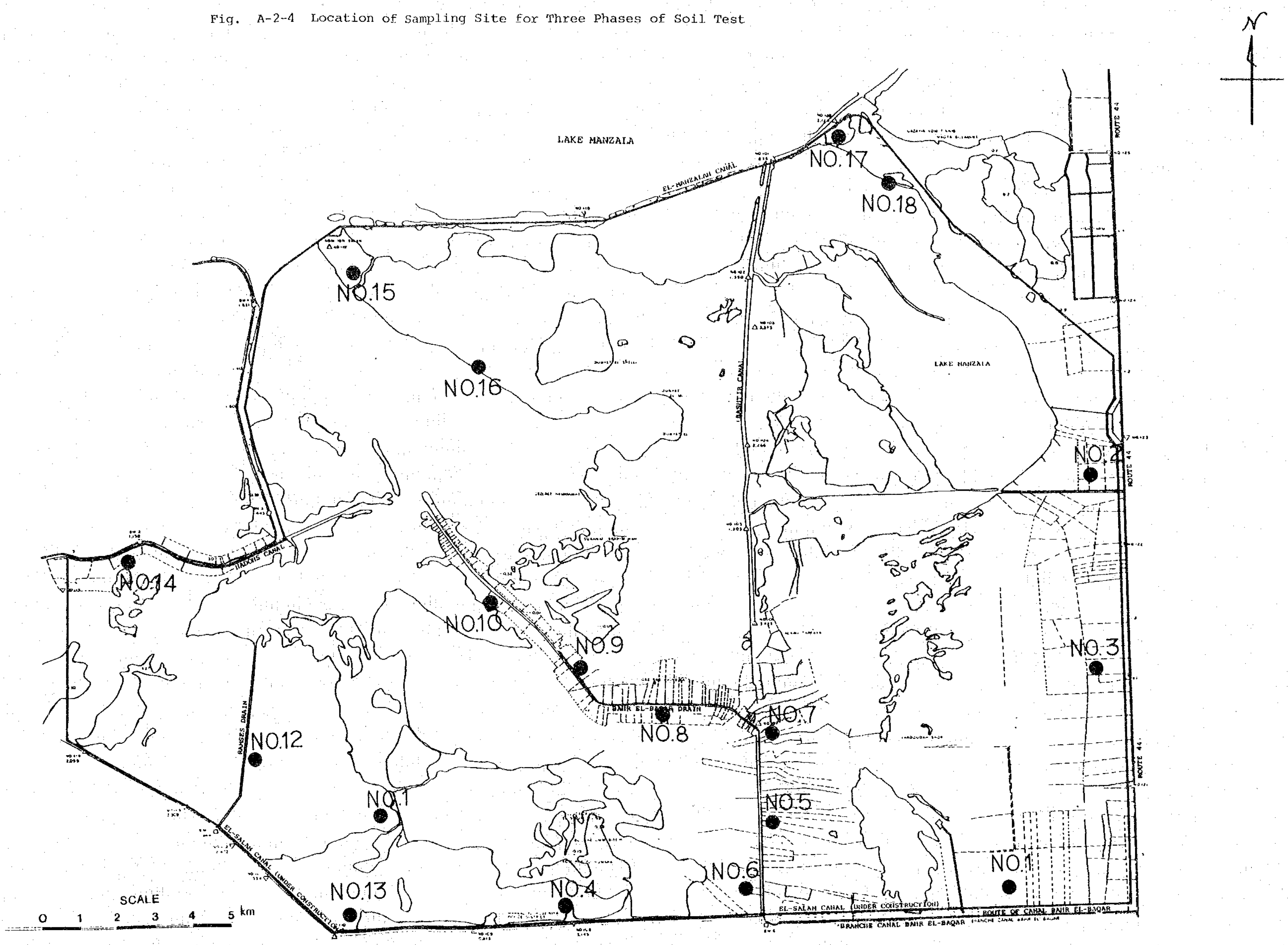
Basic intake rate was measured by cylinder intake rate method with a cylinder having 30 cm in diameter and 30 cm in length.



1.	Case	9.	Indicator lamp switch
2.	Sample chamber (100cc)	10.	Pressure gauge
3.	Normal pressure valve	11.	Hand wheel clamp frame
4.	Hand wheel	12.	Test piece
5.	Starting point indicator lamp	13.	Test piece stopper
6.	Volume gauge	14.	Balance
7.	Gauge knob	15.	Weighting saucer
8.	Level	16.	Battery container

Fig. A-2-3 Actual Volumenometer of Simple Element Type

Fig. A-2-4 Location of Sampling Site for Three Phases of Soil Test



3. Results of Soil Analysis

(1) General Characteristics

pH

Most soils are slightly alkaline having pH value ranging from 7.2 to 7.8. (Refer to "B. Land Capability Classification")

EC

The data show highly in dryland, moderately in swamp and lower in lake. In the dry land, the data for uncultivated soils are generally higher than those of cultivated ones. (Refer to "B. Land Capability Classification")

Cation contents in water saturated soil paste

The contents of Ca^{2+}, Mg^{2+}, Na^{+}, and K^{+} in uncultivated soil of the dry land are higher than those of cultivated one. The content of these cations decrease for the lower places following dryland, swamps and lakes.

Anion contents in water saturated soil paste

Anions are combined with cations and so their contents are higher in dry land, moderate in swamp and lowest in lakes. The Sodium concentration is higher than the total concentration of Mg and Ca and is mainly in the form of chloride and sulphate.

Exchangeable cation

All exchangeable cations determined were apparently higher in dry land soils than in those of swamps and lakes.

CEC

The CEC value ranged from an average of 22 to 30 meq/100 g.

Exchangeable sodium ESP

Soil samples of dry land with an "ESP" more than 15 percent are considered as alkaline soils while, other samples of swamps and lakes having "ESP" less than 15 percent are considered free from alkalinity. (Refer to "B. Land Capability Classification")

Total carbon, nitrogen and available phosphorus

The contents of organic matter, total nitrogen, and available phosphorus in dry land are higher in uncultivated soils than in cultivated ones. Carbon and nitrogen are the highest for swamps and available phosphorus are the highest in lake.

Mechanical analysis

The texture of most of the soil in the dry land, swamps and lakes varies between clay and silty clay. The clay contents in their respective profiles decrease at a certain depth.

Clay minerals

The clay fraction of the sample No.1 is almost completely composed of montmorillonite as shown in Fig. A-3-1. The spacings of 18.8 Å with Mg-grycerol, 15.8 Å with Mg-air dry and 13.6 Å with K-air dry are (001) of montmorillonite. The spacing of 10.2 Å must be (001) of illite but not hydrated halloysite because it did not shift to 11 Å with Mg-glycerol. Kaolinite is also contained to some degree, becoming 7.20 Å (001) and 3.59 Å (002) which are not of chlorite because their spacings are larger than those of the latter. The spacing of 3.35 Å must be composed of mixtures of quarts (101) and illite (003).

The position of clay minerals in the samples No.2 and No.3 seems to be very similar to that of the sample No.1 because the x-ray diffractograms with K-air dry are almost the same as shown in Fig. A-3-2. A considerable amount of quartz and feldspar are contained in the coarse fraction of all samples as shown in Fig. A-3-3. Illite seems to be contained more in the sample No.3 than in the others and develops the highest peak at 10.2 Å as shown in Fig. A-3-2.

Samples were collected as belows:

No.1: Surface deposit of Inundated area

No.2: Deep zone deposit of Inundated area

No.3: Surface of dry land

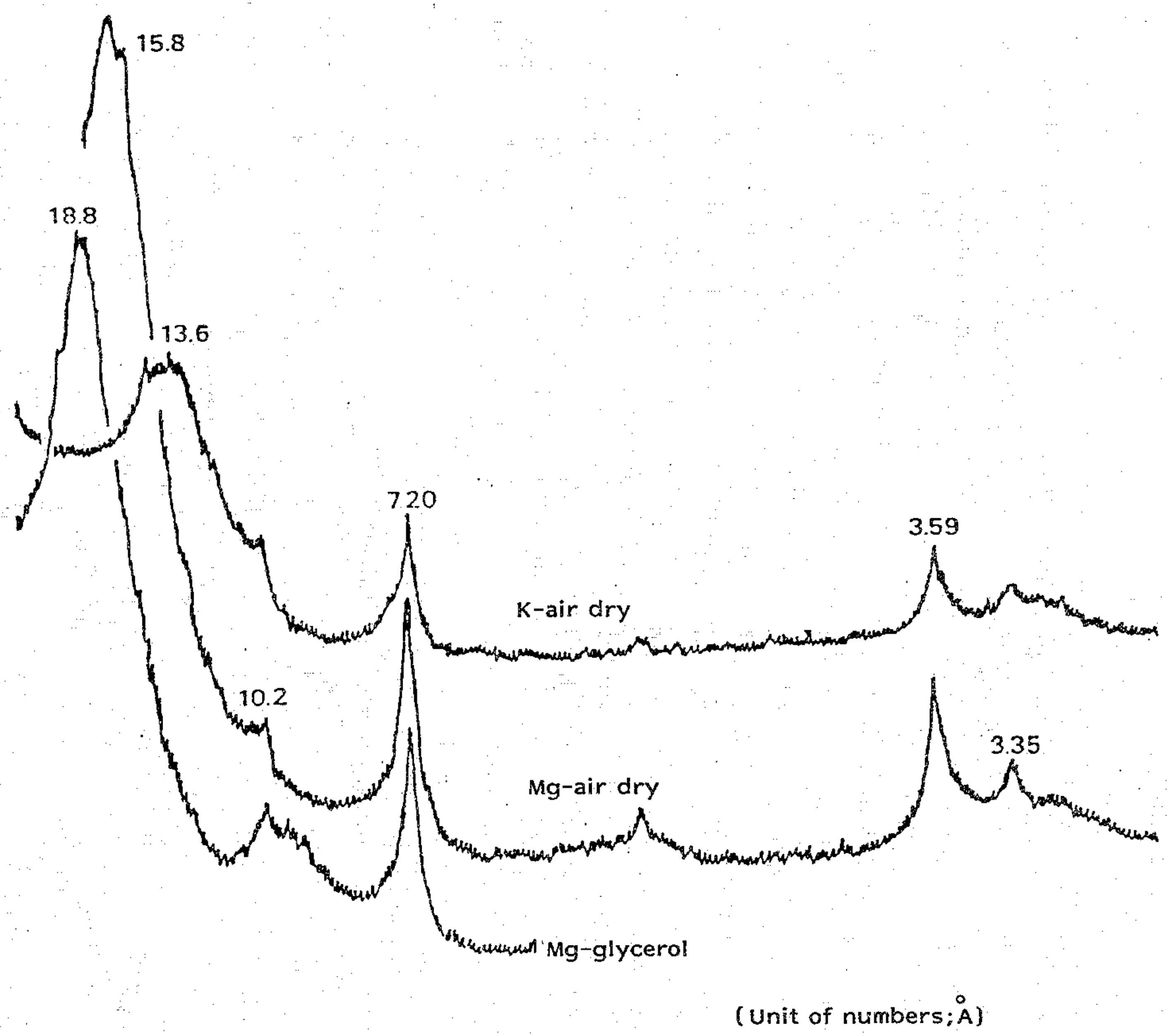


Fig. A-3-1 Clay fraction of No. 1

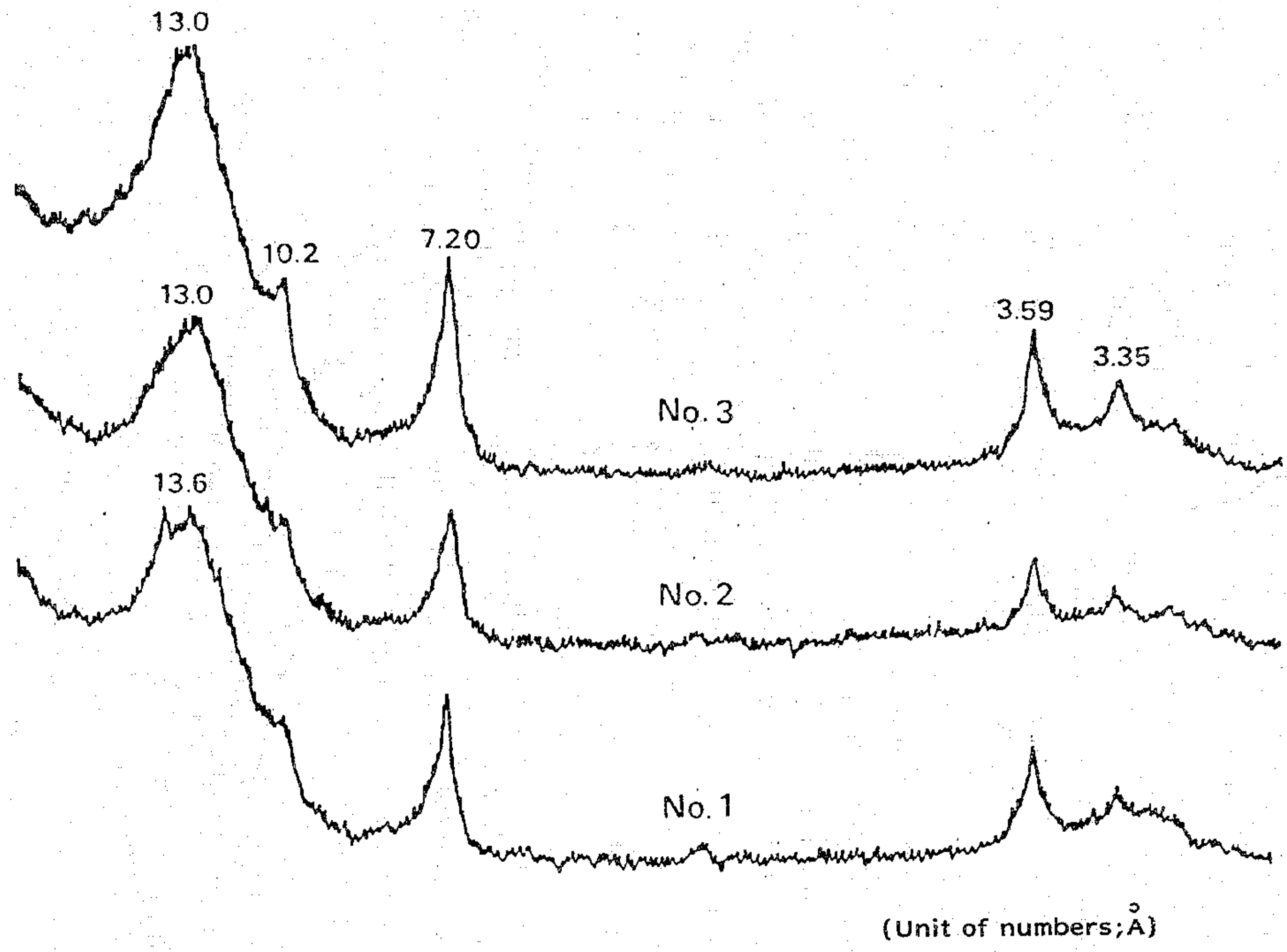


Fig A-3-2 Clay fractions Saturated with K-ion

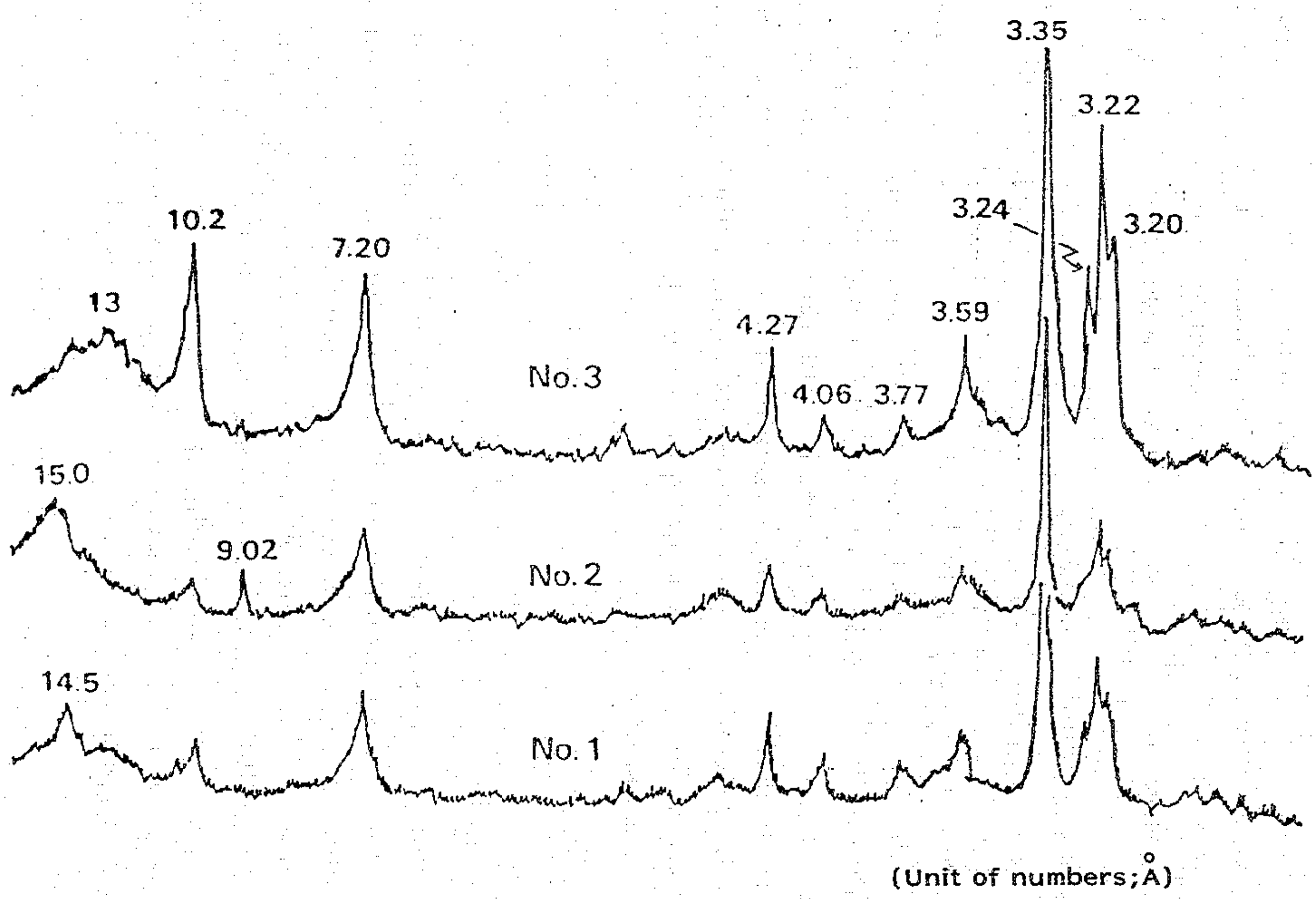


Fig. A-3-3 Coarse fraction (>Clay)

Three Phases of soil

The ratio of solid, liquid and vapor phase is useful to find the degree of soil structural development. The soil taken at 0 to 80 cm deep on most of the upland area includes solid phase by 40 to 50 percent, liquid phase by 50 to 60 percent, and vapor phase by 1 to 10 percent. This soil is characterized by little air supply to root zone of dry crops as shown in its extremely small vapor phase. (See A-4 Appendix)

Coefficient of Water Conductivity

Most values of conductivity by augar hole tests are distributed in the range of 10^{-4} to 10^{-5} cm/sec, while the highest conductivity is 7×10^{-4} cm/sec and the lowest is in the range of 10^{-6} to 10^{-7} cm/sec. Most values of conductivity by other methods show in the range of 2×10^{-4} to 3×10^{-3} cm/sec, while 8×10^{-3} cm/sec occurs in the northern loamy clay type soil section. Such scattering of values seems to be caused by the ground water condition, soil structure and influence of sampling. With consideration of these causes, most values of the conductivity is estimated to be in the range of 2×10^{-4} to 6×10^{-4} cm/sec. (See Table A-3-1)

Basic Intake Rate

The measured values were 0 to 5 mm/hr in the southern section and along Hadous Drain, 10 to 50 mm/hr in the central section, and 100 to 200 mm/hr in the northern section of the area. The area with low basic intake rate, especially the southern section, badly needs intensive soil improvement practices if intended for successful irrigation farming. Measurement could be done only in the upland area but, in consideration of the common features being shared by most of the soils including sludge on the bottom of the lake or swaps, small basic intake rate is assumed for most of the proposed area. These results are shown in Table A-3-2.

Table A-3-1 Coefficient of Water Conductivity (Auger-hole Method)

No.	K_{20}	No.	K_{20}
1	1.2×10^{-4} cm/sec	10	1.9×10^{-4} cm/sec
2	6.1×10^{-4}	11	2.7×10^{-4}
3	2.2×10^{-4}	12	2.2×10^{-4}
4	1.7×10^{-4}	13	3.4×10^{-5}
5	6.8×10^{-6}	14	9.4×10^{-5}
6	-	15	7.4×10^{-5}
7	9.2×10^{-6}	16	2.6×10^{-4}
8	6.9×10^{-7}	17	3.9×10^{-4}
9	4.5×10^{-4}	18	5.6×10^{-4}

Table A-3-2 Basic Intake Rate

No.	Intake Rate		Basic Intake Rate (I_β)	No.	Intake Rate		Basic Intake Rate (I_β)
	D	I			D	I	
			(mm/hr)				(mm/hr)
1	$1.6T^{0.34}$	$32.6T^{-0.66}$	0.6	10	$2.0T^{0.60}$	$72.0T^{-0.40}$	8.0
	$5.0T^{0}$	-	-		$1.4T^{0.66}$	$55.4T^{-0.34}$	9.1
2	$1.9T^{0.65}$	$74.1T^{-0.35}$	11.4	11	$2.0T^{0.46}$	$55.2T^{-0.54}$	2.4
	$1.7T^{0.74}$	$75.5T^{-0.26}$	20.3		$2.5T^{0.56}$	$84.0T^{-0.44}$	7.2
3	$2.8T^{0.48}$	$82.3T^{-0.51}$	4.4	12	$1.3T^{0.85}$	$66.3T^{-0.15}$	33.8
	$1.8T^{0.54}$	$58.3T^{-0.68}$	4.4		$1.4T^{0.9}$	$75.6T^{-0.10}$	50.2
4	$2.7T^{0.32}$	$51.8T^{-0.68}$	0.9	13	$2.6T^{0.39}$	$60.8T^{-0.61}$	1.7
	$5.0T^{0}$	-	-	14	$4.0T^{0}$	-	-
5	$32.2T^{-0.33}$	$32.2T^{-0.33}$	5.6	15	$3.8T^{0.88}$	$200.6T^{-0.12}$	120.1
	$8.0T^{0}$	-	-		$5.3T^{0.87}$	$276.7T^{-0.13}$	157.0
6	$12.0T^{0}$	-	-		$6.6T^{0.84}$	$332.6T^{-0.16}$	160.2
	$4.0T^{0}$	-	-	16	$5.8T^{0.68}$	$236.6T^{-0.40}$	26.4
7	$2.0T^{0}$	-	-		$6.6T^{0.56}$	$221.8T^{-0.44}$	19.1
	$4.0T^{0}$	-	-	17	$5.0T^{0.78}$	$234.0T^{-0.22}$	79.9
8	$1.2T^{0.47}$	$33.8T^{-0.53}$	1.6		$3.5T^{0.98}$	$205.8T^{-0.02}$	195.8
	$4.0T^{0}$	-	-				
9	$0.68T^{0.87}$	$35.5T^{-0.13}$	20.1				
	$1.05T^{0.78}$	$44.1T^{-0.22}$	16.8				
	$0.54T^{0.84}$	$27.2T^{-0.16}$	13.1				

Note: D = Accumulated intake
I = Intake rate
T = Time

4. Basic Considerations on Soil Classification

The present soil classification is made in conformity with the "Soil Taxonomy" system compiled by the U.S. Soil Survey Staff, 1975.

In reference to the Soil Taxonomy system, the following terms of soil features are taken into particular consideration for the soil classification and mapping in the Project Area.

Basic Soil Formation;

1) Dry land;

Salinization/alkalinization process, and gleization caused by ground water under the acid and thermic conditions.

Soils are moderately to highly saline, in which no diagnostic horizon is seen. In some places, a salt crust or a white salt plain is visually observed.

2) Inundated area;

Fluvio-marine deposits are reduced under brackish water. Continuously diagnostic profile features and soil chemical and physical properties.

Inundated soils in the Project Area are in the tidal marshes of Lake Manzala along the Mediterranean Sea where the soil is continuously covered with brackish water. Lake water tasted salty. In some places, it smelt of the seashore and not so in other places. All soils had no evidence of the development of pedogenic horizon.

Pyrites were discovered in these soils, and the oxidated final pH is about 4.5 (after complete draining).

Parent material;

Fluvio-marine deposits, generally of clay to silty clay, are sub soil layer which often contains shells. The soils are mostly consisted of sodic-montmorillonite.

5. Soil Classification According to Soil Taxonomy

5-1 Dry Land:

The Project Area belongs to arid region where annual average rainfall and evaporation are 67 mm and 2,000 mm, repectively. Natural vegetation KARSA which have strong tolerance to the salt are sparsely scattered on uncultivated land in the Project Area.

Soil profiles in the Project Area have some diagnastic horizons such as an ocric (light colored) or anthropc (mollic-like) epipedon and a salic horizon.

The Aridisols was definited as Ordirs.
They commonly have a salic horizons of accumulation of soluble salts.

The Orthids was defined as sub orders.
Soil profiles have a salic horizon whose upper bourdary is within 75 cm of the soil surface and are saturated with brackish water to a depth of 1 m for one month or more in most years.

The Sulorthids was defined as great groups.
Soil Profiles have a shallow salic horizon and little organic matter.

The Typic Salorthids was defined as sub groups.
All profiles were classified into 6 family classes as follows.

Clayey, montomorillonitic, thermic soils with very shallow reduced zone
EBA-AR1

Light clayey, thermic, montomorillonitic soils with shallow reduced zone
EBA-AR2

Silty clayey, montomorillonitic, thermic with moderatily deep zoon
EBA-AD1

Clayey, montomorillonitic, thermic with deep zone
EBA-AD2

Silty clayey, montomorillonitic, thermic soils with very deep zone
EBA-AD3

Clayey over hard clay, montomorillonitic, thermic soils with very deep zone
EBA-AD3-H

5-2 Inundated Area

The Team member on soils has some reservation as to soil classification of the inundated area. The comments say under Draft Final Study Reports that the inundated area could not be classified according to soil taxonomy because this area is submerged with water. In this connection, he likes to call attention of the GARPAD'S soil experts to the following excerpt from Chapter 1: The Soil that We Classify of SOIL TAXONOMY, Agriculture, December 1975.

"Soil is the collection of natural bodies on the earth's surface, in places modified or even made by man of earthy materials, containing living matter and supporting or capable of supporting plants out-of-doors. Its upper limit is air or shallow water. At its margins it grades to deep water or to barren areas of rock or ice."

Inundated deposits in the Project Area are in tidal marshes of Lake Manzala along the Mediteranean Sea where the deposits are continuously covered with brackish water. Lake water tasted of Salt. In some places, it smelled of seashore. Inundated deposits are all reduced (greyed) and contain pyrites, organic matter and available phosphorous as the results of biological activity. Thus, the deposits of inundated area can be classified according to Soil Taxonomy.

Profiles are mineral soils showing little or no evidence of development of pedogenic horizons.

The Entisols was defined as orders.
Profiles are permanently saturated with brackish water and have in all horizons below 30 to 150 cm.

The Aquents was defined as sub orders.
Profiles have n value of 1.5 and that have at least 8 percent clay in all subhorizons between a depth of 20 and 50 cm and that have a mean annual soil temperature higher than 15°C.

The Hydroaquents was defined as great group.
Profiles have a pH 4.5 (1:1 water) in all horizons after drainage.

The Sulfic Hydroaquents was definited as sub groups.

All profiles are classified into 5 family groups as follows:

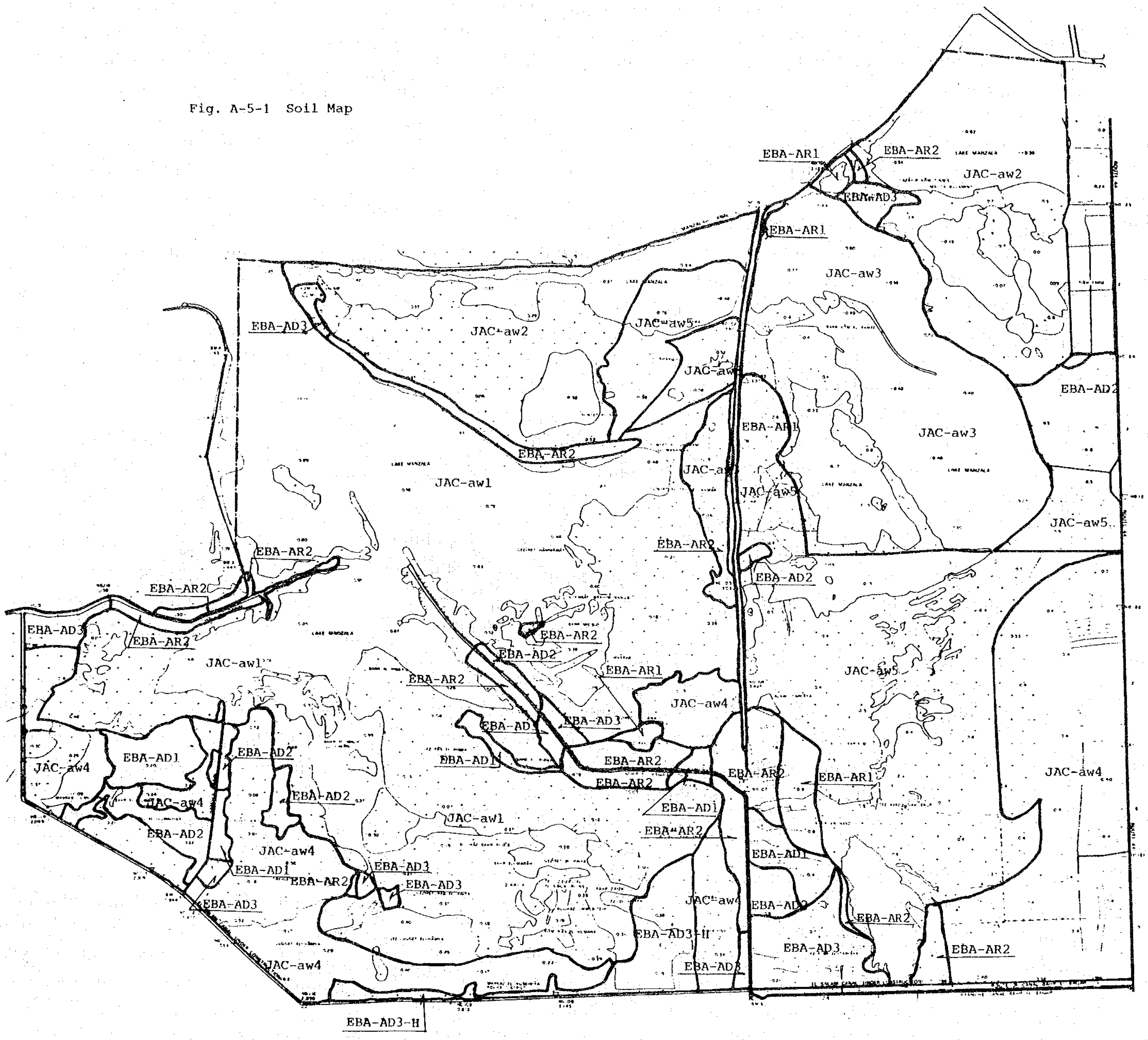
Clayey, montomorillonitic, thermic with hard clayey soils	JAC-aw1
Loamy, thermic soils	JAC-aw2
Loamy, over clayey, thermic soils	JAC-aw3
Clayey, Montomorillonitic, thermic, sub soil brown soils	JAC-aw4
Clayey, Montomorillonitic, thermic, with deep zone	JAC-aw5

The following table shows distributed Area by Soil classification.

Table. A-5-1 Distributed Area by Soil Classification

Soil Classification	Area
EBA - AR1	400 feddan
EBA - AR2	3,600
EBA - AD1	2,200
EBA - AD2	1,500
EBA - AD3	2,700
EBA - AD3-H	1,500
JAC - aw1	42,500
JAC - aw2	15,100
JAC - aw3	14,000
JAC - aw4	17,000
JAC - aw5	19,000
Total	110,000

Fig. A-5-1 Soil Map



6. Characteristics of Soil Mapping Unit

6-1 Dry Land

(1) Clayey, montomorillonitic, thermic Soils with very Shallow reduced zone; EBA-AR1

These lands occupy the cultivated and uncultivated land in the Project Area. The reduced zone ranges 25 to 30 cm up to the surface soil.

Natural vegetation KARSA was often found in uncultivated land. These soils are clayey in texture. These are moderately to highly saline soils, in which no diagnostic horizon was seen. Reclamation of this family should begin with the lowering of the water table to a suitable depth (100 to 150 cm below the surface of the soil). Leaching, in a downward and outward flow, should be promoted to remove salts from the soil. The soils of this family are moderately to highly saline, and thus large amount of water (1 to 2 m) must pass through the soil profile before draining away, in order that the salt content be reduced to a degree that will allow improvement in the productivity level of the soil.

Leaching can be facilitated by lowering the exchangeable sodium level of the sodic soil. This will promote aggregation and prevent degradation of the structure of the soil.

Soil Profile: L-42

Classification:	EBA-AR1
Topography:	EL=0.5 m
Vegetation:	KARSA
Date of Sampling:	June 26th, 1983

Horizon	Description
0 - 30 cm	Dull yellowish brown (10YR4/3), silty loam, loose structure
30 - 60	Dark greenish gray (10GY3/1), silty loam
60 - 120	Dark greenish gray (10GY3/1), heavy clay
120 - 200	Greenish gray (10GY2/1), heavy clay

Number of Soil Profile belongs to EBA-ARI Family

Cultivated Area;

63, 64, 100, 101, 108, 109

Uncultivated Area;

9, 33, 34, 35, 42, 46, 102, 103, 104, 106, 111, 113, 114, 171

(2) Clayey, montomorillonitic, thermic soils with Shallow Reduced Zone; EBA-AR2

These lands occupy the cultivated and uncultivated land in the Project area. The reduced zone ranges 30 to 60 cm up to the surface soil.

Natural vegetation KARSA are often seen in the uncultivated land. These soils are clayey in texture. Soil physical and chemical properties of soils similar to those of AR1-soil family. And thus, soil improvement of this type should be closed to those of AR1 family. Underdrainage system is necessary in these soil families.

Soil Profile: L-50

Classification:	EBA-AR2
Topography:	EL= 0.2 m
Vegetation:	Rio, cotton
Water table:	80 cm
Date of Sampling:	26th June, 1983

Horizon	Description
0 - 30 cm	Brownish balck (10YR2/2), silty clay, blocky structure
30 - 60	Bluish balck (7.5GY2/1), light clay, gley layer
60 - 90	Bluish black (7.5GY2/1), light clay

SOIL PROFILE: 170

Classification:	EBA-AR2
Topography	EL= 0.1 m
Vegetation:	KARSA
Water Table	130 cm

Horizon	Description
0 - 30 cm	Silty clay
30 - 60	Silty Clay
60 - 120	Clay
120 -	130 cm gley layer

Number of Soil Profile belongs to EBA-AR2 Family

Cultivated Area;

21, 22, 23, 24, 29, 30, 48, 49, 50, 51, 52, 55, 56, 59, 60, 62, 99, 105, 107, 110, 112, 115, 116, 117, 118, 119, 120, 163, 164, 165, 166, 167, 168,

Uncultivated Area;

31, 32, 36, 37, 81, 82, 83, 84, 85, 86, 89, 90, 169, 170, 172.

(3) Clayey, Montomonillonitic, thermic Soils with Moderately Deep Zones; EBA-AD1

These lands occupy the cultivated and uncultivated land in the Project Area. Natural vegetation and cropping pattern in these land are similar to those of AR1 and AR2 family soils.

The depth of the reduced zone ranges from 60 to 90 cm up to the surface soil and have a deep clayey in texture. Physical and chemical properties of this family of soils are similar to those of the AR1 and AR2 family soils.

Soil Profile: L-2

Classification:	EBA-AD1
Vegetation:	Cultivated, Barcium
Water Table:	130 cm
Parent Material:	Fluvio marine deposit, mont.
Date of Sampling:	12th June, 1983

Horizon	Description
0 - 30 cm	Brownish balck (7.5YR3/1), silty clay brocky structure
30 - 60	Dark olive brown (25Y3/3), silty loam
60 - 80	" "
80 - 120	Dark greenish gray (7.5GY3/1), clay loam, gley layer
120 -	Dark greenish gray (7.5GY3/1), silty clay

Soil Profile: L-70

Classification: EBB-AD1

Vegetation: Cultivation

Water table: 130 cm

Parent material: Fluvio marine deposit

Date of sampling: July 6, 1983

Horizon	Description
0 - 30 cm	Brownish black (7.5YR3/1), light clay, blocky structure
30 - 70 cm	Brownish black (7.5YB3/1), heavy clay
70 - 120 cm	Dark greenish gray (7.5GY3/1), Silty clay
120 -	Dark greenish gray (7.5GY3/1), Silty clay

Soil Profile: L-6

Classification: EBB-AD1

Topography: EL=0.2 m

Water Table: 50 cm

Date of Sampling: 14th June, 1983

Horizon	Description
0 - 30 cm	Dark reddish brown (5YR3/2), silty clay, blocky structure
30 - 70	Dark reddish brown (5YR3/3), silty clay
70 - 120	Dark greenish gray (7.5GY4/1), light clay, gley layer
120 - 200	Dark greenish gray (7.5GY3/1), silty clay loam

SOIL PROFILE: L-61

Classification:	EBA-AD1
Topography:	EL=0.8 m
Vegetation:	Cultivated farm, 10 years
Date of Sampling:	12th July, 1983

Horizon	Description
0 - 30 cm	Brownish black (7.5YR3/1), silty clay, blocky structure
30 - 70	Browning gray (7.5YR6/1), silty clay
70 - 120	Dark olive gray (5BG2/1), silty clay, gley layer
120 -	Dark olive gray (5BG2/1), light clay

SOILIPROFILE: L-31

Classification:	EBB-AD1-1
Topography:	EL=0.1 m
Vegetation:	KARSA (uncult.)
Water Table:	130 cm
Parent Material:	Fluvio marine deposit, Mont.
Date of Sampling:	5th July, 1983

Horizon	Description
0 - 30 cm	Grayish brown (7.5YR4/2), loam blocky
30 - 70	Grayish brown (7.5YR4/2), silty loam
70 -	Dark greenish gray (7.5GY3/1), clay loam

November of Soil Profile belongs to EBA-AD1 Family

Cultivation Area;

2, 25, 28, 61, 67, 68, 69, 70, 73, 80, 152, 153, 154, 155, 156,

Uncultivation Area;

6, 7, 8,

(4) Clayey Montomonillonitic, Thermic Soils with Deep Zone; EBA-AD2

These lands occupy the cultivated and the uncultivated area. Landscape and vegetation in this family at soils are similar to those of the previous family at soils.

The depth of reduced zone ranges from 90 to 120 cm up to the surface soil and have a deep clayey zone.

Physical and chemical properties of this family soils are similar to those of AR1, AR2 and AD1, AD2 family at soils. Thus, underdraining, leaching the salt from the soil, adding the gypsum to the soil are very necessary for soil improvement.

Number of Soil Profile belongs to EBA-AD2 Family

Cultivated Area;

3, 4, 15, 16, 26, 65, 66, 71, 72.

Uncultivated Area;

5, 38, 39, 40, 41, 91.

(5) Clayey, Montomorillonitic, Thermic Soils with Very Deep Zone; EBA-AD3

In this type of soil profile, the reduced layer ranges from 150 to 200 cm or more.

0 to 50 cm, brownish black silty clay; blocky structure, sometimes earthworm, when cultivated farm yard.

50 to 175 cm, brownish black heavy clay, blocky structure. These lands occupy the cultivated area in the region. However the EC values of these soil are not yet lowering to suitable amounts for good agriculture. Under draining should be necessary in order to prevent the salt water from the water table.

SOIL PROFILE: L-1

Classification:	EBA-AD3
Topography:	EL=0.3 m
Water Table:	150 cm
Parent Material:	Fluvio marine deposit, mont.
Date of Sampling:	10th June, 1983

Horizon	Description
0 - 30 cm	Dark brown (7.5YR3/3), silty clay blocky structure
30 - 60	Dark brown (7.5YR3/3), silty clay
60 - 120	Dark brown (10YR3/3), silty clay
120 - 240	Dark greenish gray (7.5GY3/1) heavy clay, gley layer

SOIL PROFILE: L-47

Classification: EBA-AD3

Topography: EL=0.5 m

Vegetation: Uncult

Date of Sampling: 30th May, 1983

Horizon	Description
0 - 30 cm	Clay loam
30 - 60	Silty loam
60 - 120	Silty clay
120 - 200	150 cm, gley layer

SOIL PROFILE: L-145

Classification: EBA-AD3

Topography: EL=0.3 m

Water Table: Cult, farm yard, 20 years

Date of Sampling: 14th July, 1983

Horizon	Description
0 - 30 cm	Dark brown (7.5YR3/3), Silty clay loam, blocky structure
30 - 60	Dark brown (7.5YR3/3), loam
60 - 90	Dark brown (7.5YR3/3), clay loam
90 - 120	Dark reddish brown (5YR3/2), semi-hard layer, silty clay loam
120 - 200	Dark reddish brown (5YR3/2), clay

SOIL PROFILE: L-54

Classification:	EBA-AD3
Topography:	EL=0.3 m
Vegetation:	Cultivated
Water Table:	200 cm
Parent Material:	Fluvio marine deposit, Monmorine
Date of Sampling:	18th July, 1983

Horizon	Description
0 - 30 cm	Brownish gray (5YR4/1), silty clay, blocky structure
30 - 60	Brownish gray (5YR4/1), heavy clay
60 - 120	Gray (10Y4/1), silty clay, few shells
120 - 200	Gray (10Y4/1), heavy clay
200 -	Dark greenish gray (10GY4/1), heavy clay, gley layer

Number of Soil Profile belongs to EBA-AD3 Family

Cultivated Area;

1, 19, 27, 53, 54, 57, 58, 74, 75, 76, 77, 78, 79, 92, 93, 94, 95, 96, 97, 98, 145, 151, 157, 158, 159, 160, 161, 162.

Uncultivated Area;

17, 18, 20, 43, 44, 45, 47.

(6) Clayey, over hardclay Montomorillonitic, Thermic Soils with deep zone; EBA-AD3-H

These soils occupy the uncultivated land which spread along the El Salam Canal.

In this type of land natural vegetation of KARSA and a thin salt crust and white salt plain are often seen. This family of soil profiles has a surface soil reddish gray color light clay, blocky structure, sub soil having hard clay at a depth of 80 cm up to the surface, reduced zone ranging 150 to 200 cm up to the surface.

As for the deep clayey soils having hard clay, subsoiling and shorter distance underdraining are much in demand.

The cause of the hardness of hard clay must be further investigated.

SOIL PROFILE; L-10

Classification: EBA-AD3-H

Topography: EL=0.4 m

Vegetation: Uncult.

Water Table: 240 cm

Parent Material: Fluvio marine deposit, mont.

Date of Sampling: 16th June, 1983

Horizon	Description
0 - 30 cm	Very dark brown (7.5YR2/3), silty clay loam, blocky structure
30 - 60	Dark brown (7.5YR3/4), silty clay, blocky structure
60 - 120	Brown (7.5YR4/3), silty clay, blocky structure
120 - 200	Brownish black (7.5YR2/2), silty clay

SOIL PROFILE: L-11

Classification: EBA-AD3-H

Topography: EL=0.4 m

Water Table: 240 cm

Date of Sampling: 20th June, 1983

Surface: Very saline

Horizon	Description
0 - 30 cm	Dark brown (7.5YR3/3), clay loam, blocky structure
30 - 60	Brownhish balck (7.5YR3/2), clay laom, blocky structure
60 - 120	Brownish black (7.5YR2/2), clay loam, structure
120 - 200	Brownish black (7.5RY2/2), light clay
200 - 240	Gray (10Y5/1), silty clay loam
240 -	Dark olive gray (2.5GY3/1), gley layer, silty clay

SOIL PROFILE: L-14

Classification:	EBA-AD3-H
Topography:	EL=0.3 m
Vegetation:	KARSA
Date of Sampling:	18th June, 1983

Horizon	Description
0 - 30 cm	Black (N2/0), silty clay, salt crust
30 - 60	Dark reddish brown (5YR3/1), light clay, blocky structure
60 - 90	Brownish black (5YR2/2), light clay blocky structure
90 - 120	Brownish black (5YR2/2), light clay, none structure
120 - 200	Brownish black (7.5YR2/2), heavy clay, none structure

Number of Soil Profile belongs to EBA-AD3.-H Family

Cultivated Area; None

Uncultivated Area;

10, 11, 12, 13, 14, 87, 88, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 146, 147, 148, 149, 150.

6-2 Inundated Area

(1) Clayey, montomorivitic, thermic soils with hard clay soil; JAC-awl

This type of soil profile is clayey in texture having hard clay.

0 to 30 cm; dark greenish gray (12G 3/1), silty clay with some shells, 30 to 70 cm; dark greenish gray (10G 4/1) silty clay, 70 to 90 cm; dark greenish (10G 3/1), compact, 90 cm more; dark greenish gray (10G 4/1), very compact.

SOIL PROFILE: S-4

Classification	JAC-awl
Topography	EL = 0.2 m
Water Depth	20 cm
Date of Sampling	4th June, 1983
Horizon	Description
0 - 80 cm	Dark greenish gray (10GY4/1), light clay
80 -	Olive black (5Y3/1), silty clay, very compact Japanese thin wall sampler can not penetrate

SOIL PROFILE: M-1

Classification	JAC-awl
Topography	EL = -1.0 m
Water Table	140 cm
Date of Sampling	25th May, 1983
Horizon	Description
0 - 20 cm	Dark greenish gray (10G3/1), silty clay
20 - 50	Dark greenish gray (10G4/1), silty clay loam with shell
50 - 100	Dark greenish gray (10G4/1), clay
100 - 150	Dark olive gray (5GY4/1), clay with ancient blick, compact

SOIL PROFILE: M-7

Classification	JAC-awl
Topography	EL = - 0.9 m
Water Depth	130 cm
Parent Material	Fluvio marine deposit
Date of Sampling	4th June, 1983

Horizon	Description
0 - 50 cm	Dark greenish gray (7.5GY4/1), sandy clay loam, iron mottling, org. matter contain, loose
50 - 80	Olive black (10Y3/1), heavy clay, org. matter rich
80 - 150	Dark bluish gray (5BG4/1), heavy clay, org. matter rich compact, readish brown iron

SOIL PROFILE: M-8

Classification	JAC-awl
Topography	EL = -0.6 m
Water Depth	100 cm
Parent Material	Fluvio marine deposit
Date of Sampling	5th June, 1983

Horizon	Description
0 - 30 cm	Dark greenish gray (7.5GY4/1), silty clay loam with much shell
30 - 90	Gray (7.5Y4/1), clay, org. matter rich, loose
90 - 150	Gray (10Y5/1), clay, compact, mottling rich

SOIL PROFILE : M-9

Classification	JAC-awl
Topography	EL = -0.4 m
Water Detph	75 cm
Date of Sampling	5th June, 1983

Horizon	Description
0 - 30 cm	Dark greenish gray (7.5GY4/1), sandy clay loam, loose org. matter contain
30 - 60	Dark greenish gray (7.5GY8/1), clay, org. Matter contain
60 - 120	Gray (5Y4-1), clay, very compact, org. matter contain

SOIL PROFILE: M-10

Classification	JAC-awl
Topography	EL = -0.7 m
Water Depth	110 cm
Parent Material	Fluvio marine deposit
Date of Sampling	6th June, 1983

Horizon	Description
0 - 30 cm	Dark greenish gray (5G4/1), silty clay loam, org. matter contain, loose
30 - 60	Gray (N4/0), silty clay loam, very compact
60 - 120	Dark greenish gray (15G4/0), clay

SOIL PROFILE: M-12

Classification	JAC-awl
Topography	EL = -0.6 m
Water Depth	100 cm
Parent Material	Fluvio marine deposit
Date of Sampling	6th June, 1983

Horizon	Description
0 - 30 cm	Olive black (10Y3/1), loam org. matter rich
30 - 70	Dark greenish gray (10GY4/1), clay loam with shell, loose, org. matter rich
70 - 80	Dark greenish gray (10GY3/1), silty clay loam, org. matter rich compact
80 -	Dark greenish gray (10GY4.5/1), silty clay, org. matter contain yellow brown mottling, compact

SOIL PROFILE: M-13

Classification	JAC-awl
Topography	EL = -0.7 m
Water Depth	100 cm
Parent Material	Fluvio marine deposit
Date of Sampling	7th June, 1983

Horizon	Description
0 - 30 cm	(7.5GY4/1), clay loam
30 - 50	Dark greenish gray (7.5GY4/1), clay loam, loose
50 - 110	Dark greenish gray (10GY4/1), clay, loose
110 - 130	Dark greenish gray (5G3/1), silty clay loam
130 - 150	Dark greenish gray (5G4/1), silty clay, very compact, yellow brown, mottling

SOIL PROFILE: M-14

Classification	JAC-awl
Topography	EL = -0.3 m
Water Depth	70 cm
Parent Material	Fluvio marine deposit
Date of Sampling	7th June, 1983

Horizon	Description
0 - 15 cm	Dark greenish gray (5G5/1), sandy clay loam
15 - 70	Dark greenish gray (5G4/1), silty clay with shell
70 - 90	Dark greenish gray (5G3/1), silty clay
90 -	Dark greenish gray (10G4/1), silty clay

SOIL PROFILE: M-15

Classification	JAC-awl
Topography	EL = -0.7 m
Water Depth	110 cm
Parent Material	Fluvio marine deposit
Date of Sampling	7th June, 1983

Horizon	Description
0 - 30 cm	Dark olive gray (2.5GY4/1), clay loam
30 - 50	Dark greenish gray (10GY4.5/1), silty clay loam
50 - 90	Dark greenish gray (10GY5/1), clay
90 -	Dark greenish gray (5G2/1), clay - silty clay, compact

SOIL PROFILE: M-17

Classification	JAC-awl
Topography	EL = -1.0 m
Water Depth	Fluvio marine deposit
Date of Sampling	8th June, 1983

Horizon	Description
0 - 30 cm	Dark greenish gray (10G4/1), clay
30 - 70	Dark greenish gray (5G4/1), sandy loam
70 - 130	Dark greenish gray (5G3/1), silty clay

Number of Soil Profile belongs to JAC-awl Family

Marsh area;

1, 2, 3, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116

Swamp area;

1, 3, 4, 5, 6, 12, 13, 15, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 49, 53, 55, 56, 57, 58, (87), (88), (89), (92), (93)

(2) Loamy montomorivitic, thermic soils, JAC-aw2

This type of profile's loamy in texture. These soils occupy the northern side of the Project Area.

0 to 25 cm, dark greenish gray (10GY 4/1) sandy loam, with some shell.

25 to 45 cm, dark greenish gray (5G 4/1) loamy soils with some shell.

45 to 150 cm, greenish gray (10GY 5/1) moderately compact, sandy loam, or loamy sand.

These soils are annually covered with brackish water. These soils are saline and contain pyrites.

SOIL PROFILE: M-18

Classification	JAC-aw2
Topography	EL = -0.0 m
Water Depth	40 cm
Parent Material	Fluvio marine deposit
Date of Sampling	8th June, 1983
Horizon	Description
0 - 50 cm	Dark greenish gray (5GY3/1), loam
50 - 80	Dark greenish gray (5GY3/1), sandy loam, loose
80 - 110	Dark greenish gray (7.5GY4/1), loam
110 - 140	Dark greenish gray (7.5GY3/1), heavy clay, compact
140 - 160	Dark bluish gray (5GB3/1), loam

SOIL PROFILE: M-23

Classification	JAC-aw2
Physiographic Position	Lake
Topography	EL = -0.4 m
Water Depth	80 cm
Parent Material	Fluvio marine deposit
Date of Sampling	9th June, 1983

Horizon	Description
0 - 50 cm	Gray (7.5Y4/1), silty clay
50 - 100	Greenish gray (10GY4/1), silty clay loam with shell
100 - 112	Dark greenish gray (5G5/1), silty clay loam
112 - 139	Dark greenish gray (5G3/1), silty clay loam
150 - 170	Dark greenish gray (5G4/1)., sandy loam

SOIL PROFILE: M-24

Classification	JAC-aw2
Topography	EL = -0.5 m
Water Depth	80 cm
Parent Material	Fluvio marine deposit
Date of Sampling	11th June, 1983

Horizon	Description
0 - 25 cm	Dark greenish gray (10G3/1), sandy loam, loose
25 - 70	Dark greenish gray (10G4/1), sandy clay loam
70 - 80	Dark greenish gray (10G4/1), sandy loam with shell
80 - 160	Dark greenish gray (5G3/1), sandy loam

SOIL PROFILE: M-25

Classification	JAC-aw2
Physiographic Position	Lake
Topography	EL = -0.0 m
Water Depth	40 cm
Parent Material	Fluvio marine deposit
Date of Sampling	11th June, 1983

Horizon	Description
0 - 25 cm	Dark greenish gray (5G4/1), loamy sand
25 - 85	Dark greenish gray (10G4/1), silty clay
85 - 100	Dark greenish gray (10G4/1), sandy loam
100 - 160	Greenish gray (5G5/1), sandy loam

SOIL PROFILE: M-26

Classification	JAC-aw2
Physiographic Position	Lake
Topography	EL = -0.0 m
Water Depth	40 cm
Parent Material	Fluvio marine deposit
Date of Sampling	11th June, 1983

Horizon	Description
0 - 50 cm	Greenish gray (5G4/1), silty clay loam
50 - 70	Greenish gray (5G4/1), silty clay loam with shell
70 - 140	Dark greenish gray (5G3/1), silty clay with shell
140 -	Dark greenish gray (5G4/1), sandy

Number of Soil Profile belongs to JAC-aw2 Family

Marsh area;

4, 18, 19, 23, 24, 25, 26, 34, 63, 64, 65, 66, 67, 68, 69, 70, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100,

Swamp area;

11, 27, 28

(3) Loamy montomovillonitic, thermic soils over clay, JAC-aw3

This soil also has fluvio-marine deposits and inundated soils developing over South Port Said.

These soils are saline will have pyrites. Surface soil have a loamy texture. Subsoils are clayay in texture below 60 cm up to the surface. Soil profiles have reduced color.

SOIL PROFILE: M-20

Classification	JAC-aw3
Topography	EL = -0.7 m
Water Depth	110 cm
Date of Sampling	9th June, 1983
Horizon	Description
0 - 30 cm	Dark bluish gray (5BG4/1), sandy clay loam
30 - 60	Dark bluish gray (5BG4/1), silty clay with shell, loose
60 - 85	Dark bluish gray (5BG4/1), silty clay with shell
85 - 130	Dark greenish gray (5G3/1), clay loam, little compact

SOIL PROFILE: M-27

Classification	JAC-aw3
Physiographic Position	Lake
Topography	EL = -0.4 m
Water Depth	80 cm
Parent Material	Fluvio marine deposit
Date of Sampling	12th June, 1983

Horizon	Description
0 - 25 cm	Dark greenish gray (10G4/1), silty clay loam
25 - 75	Dark greenish gray (10G4/1), silty clay with shell
75 - 132	Dark greenish gray (5G3/1), loam with peat (as natural state)
132 - 170	Dark greenish gray (5G3/1), silty clay

SOIL PROFILE: M-28

Classification	JAC-aw3
Physiographic Position	Lake
Topography	EL = -0.4 m
Water Depth	75 cm
Parent Material	Fluvio marine deposit
Date of Sampling	12th June, 1983

Horizon	Description
0 - 40 cm	Dark greenish gray (10G4/1), sandy loam
40 - 60	Dark greenish gray (10G4/1), loam with shell
60 - 125	Dark greenish gray (10G3/1), silty clay, compact
125 - 200	Dark greenish gray (10G3/1), clay

SOIL PROFILE: M-29

Classification	JAC-aw3
Physiographic Position	Lake
Topography	EL = -0.1 m
Water Depth	50 cm
Parent Material	Fluvio Marine Deposit
Date of Sampling	12th June, 1983

Horizon	Description
0 - 40 cm	Dark greenish gray (10G4/1), loam, loose
40 - 75	Dark greenish gray (10G4/1), silty clay, loose
75 - 125	Dark greenish gray (5G3/1), clay, some compact
125 -	Dark greenish gray (10G4/1), clay with shell, compact

SOIL PROFILE: S-6

Classification	JAC- aw3
Topography	EL = -0.4 m
Water Depth	80 cm
Date of Sampling	17th June, 1983

Horizon	Description
0 - 35 cm	Dark greenish gray (5G4/1), silty clay
35 - 85	Dark greenish gray (10G3/1), silty clay-Heavy clay, organic matter rich, compact
85 - 150	Dark greenish gray (10G4/1), silty clay, very compact

Number of Soil Profile belongs to JAC-aw3 Family

Marsh area;

5, 6, 20, 27, 28, 29, 33, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 103

Swamp area;

60, 61, (86)

(4) Clayey montomovillonitic, thermic subsoil brown soil, JAC-aw4

This land is also continuously covered with brackish water. However the water depth is relatively low. No vegetation is found on these land.

These profiles are clayey in texture and have yellow-brown subsoil.

Number of Soil Profile belongs to JAC-aw4 Family

Marsh area;

104, 105

Swamp area;

14, 16, 29, 30, 31, 36, 37, 38, 45, 46, 47, 48, 50, 51, 52, 63, 64, 65, 66, 67, 68, (77), (80), (90), (91)

(5) Clayey, montomovillonitic, thermic soils with deep zone, JAC-aw5

This type of soil profiles has deep zone clayey in texture, 0 to 30 cm, dark greenish gray, soft, silty clay 30 to 60 cm, dark greenish gray, soft, silty clay 30 to 60 cm, dark greenish gray, soft silty clay, silty clay with some shell moderately, 60 to 120 cm, dark greenish gray, heavy clay (with some peat). These soils are continuously covered with brackish water.

SOIL PROFILE: M-21

Classification	JAC-aw5
Topography	EL = -0.8 m
Water Depth	120 cm
Parent Material	Fluvio marine deposit
Date of Sampling	9th June, 1983

Horizon	Description
0 - 40 cm	Dark greenish gray (5G4/1), sandy - silty clay loam
40 - 65	Dark greenish gray (5G4/1), clay loam
65 - 100	Dark greenish gray (10G3/1), silty clay loam
100 - 150	Dark greenish gray (5G3/1), silty clay

SOIL PROFILE: M-30

Classification	JAC-aw5
Physiographic Position	Lake
Topography	EL = 0.0 m
Water Depth	40 cm
Parent Material	Fluvio marine deposit
Date of Sampling	13th June, 1983

Horizon	Description
0 - 25 cm	(5G4/1), silty clay loam
25 - 75	(5G4/1), silty clay with shell
75 - 90	Dark greenish gray (10G3/1), silty clay with peat, compact
90 - 160	Dark greenish gray (10G3/1), loam, compact
160 - 170	Dark greenish gray (10G3/1), sandy loam

SOIL PROFILE: M-32

Classification	JAC-aw5
Topography	EL = 0.0 m
Water Depth	40 cm
Parent Material	Fluvio marine deposit
Date of Sampling	14th June, 1983

Horizon	Description
0 - 50 cm	Dark greenish gray (5G4/1), clay loam with shell
50 - 95	Dark greenish gray (10G4/1), sandy clay with shell
95 - 125	Dark greenish gray (10G3/1), sandy clay with peat
125 - 140	Dark greenish gray (10G3/1), clay
140 -	Dark greenish gray (10G3/1), silty clay loam

SOIL PROFILE: S-2

Classification	JAC-aw5
Topography	EL = 0.1 m
Water Depth	30 cm
Parent Material	Fluvio marine deposit
Date of Sampling	31st May, 1983

Horizon	Description
0 - 45 cm	Dark greenish gray (10G3/1), silty clay loam, organic matter rich
45 - 100	Dark greenish gray (10G5/1), silty clay, organic matter contain
100 - 150	Dark greenish gray (10G5/1), clay loam, organic matter contain

SOIL PROFILE: S-7

Classification	JAC-aw5
Topography	EL = 0.1 m
Water Depth	30 cm
Date of Sampling	22nd June, 1983

Horizon	Description
0 - 50 cm	Dark greenish gray (10G3/1), silty clay
50 - 75	Dark greenish gray (10G4/1), sandy clay
75 - 100	Dark greenish gray (5G4/1), clay (with shell)
100 - 130	Dark greenish gray (10G4/1), silty clay
130 -	Dark greenish gray (10G3/1), clay, compact

SOIL PROFILE: S-8

Classification	JAC-aw5
Topography	EL = 0.2 m
Water Depth	25 cm
Parent Material	Fluvio marine deposit
Date of Sampling	23rd June, 1983

Horizon	Description
0 - 30 cm	Dark greenish gray (10G4/1), silty clay loam
30 - 60	Gray (5Y5/1), clay, compact
60 - 90	Dark greenish gray (5G4/1), heavy clay, loose
90 - 120	Dark greenish gray (5G4/1), sandy loam (with shell)

SOIL PROFILE: S-9

Classification	JAC-aw5
Topography	EL = 0.3 m
Water Depth	10 cm
Parent Material	Fluvio marine deposit
Date of Sampling	23rd June, 1983

Horizon	Description
0 - 45 cm	Dark greenish gray (5G4/1), clay - sandy clay
34 - 70	Dark greenish gray (5G4/1), silty clay loam, with shell
70 - 110	Dark greenish gray (10G4/1), silty clay, with shell
110 - 140	Dark greenish gray (7.5GY4/1), silty clay, with peat
140 -	(5G3.5/1), sandy

SOIL PROFILE: S-10

Classification	JAC-aw5
Topography	EL = 0.2 m
Water Depth	20 cm
Parent Material	Fluvio marine deposit
Date of Sampling	24th June, 1983

Horizon	Description
0 - 60 cm	Dark greenish gray (10G3/1), silter loam
60 - 140	Dark greenish gray (10GY4/1), silty clay with shell
140 - 170	Dark greenish gray (10GY4/1), silty clay loam
170 - 200	Dark greenish gray (10GY4/1), silty clay

Number of Soil Profile belongs to JAC-aw5 Family

Marsh area;

21, 22, 30, 31, 32, 121, 122, 125

Swamp area;

2, 7, 8, 9, 10, 32, 33, 34, 35, 39, 40, 41, 42, 43, 44, 54, 59, 62, 69, 70, 71, 72, 73, 74, (75), (76), (78), (79), (81), (82), (83), (84), (85)

7. BORING SURVEY

7-1 Field Survey

(1) Location and Number of Boreholes

Thirteen boreholes in the inundated or swamp area and five holes in the upland, area were examined; these points are shown in Fig. A-7-1.

(2) Methods

A borehole has three inches (8 cm) diameter and ten meters deep. The applied equipments include derrick and winch operating a light steel cable with a pulley installed on top of the derrick, and all these equipments are on a special juck-up barge to bore in the lake.

The clay and silty soil were found with clay cutter and auger. The cutter includes an open steel tube with a cutting shoe, following the rotating boring rods with tiller bar and sinker bar. The soil is gradually filled in the cutter tube in boring, and then, the cutter is raised to collect the soil.

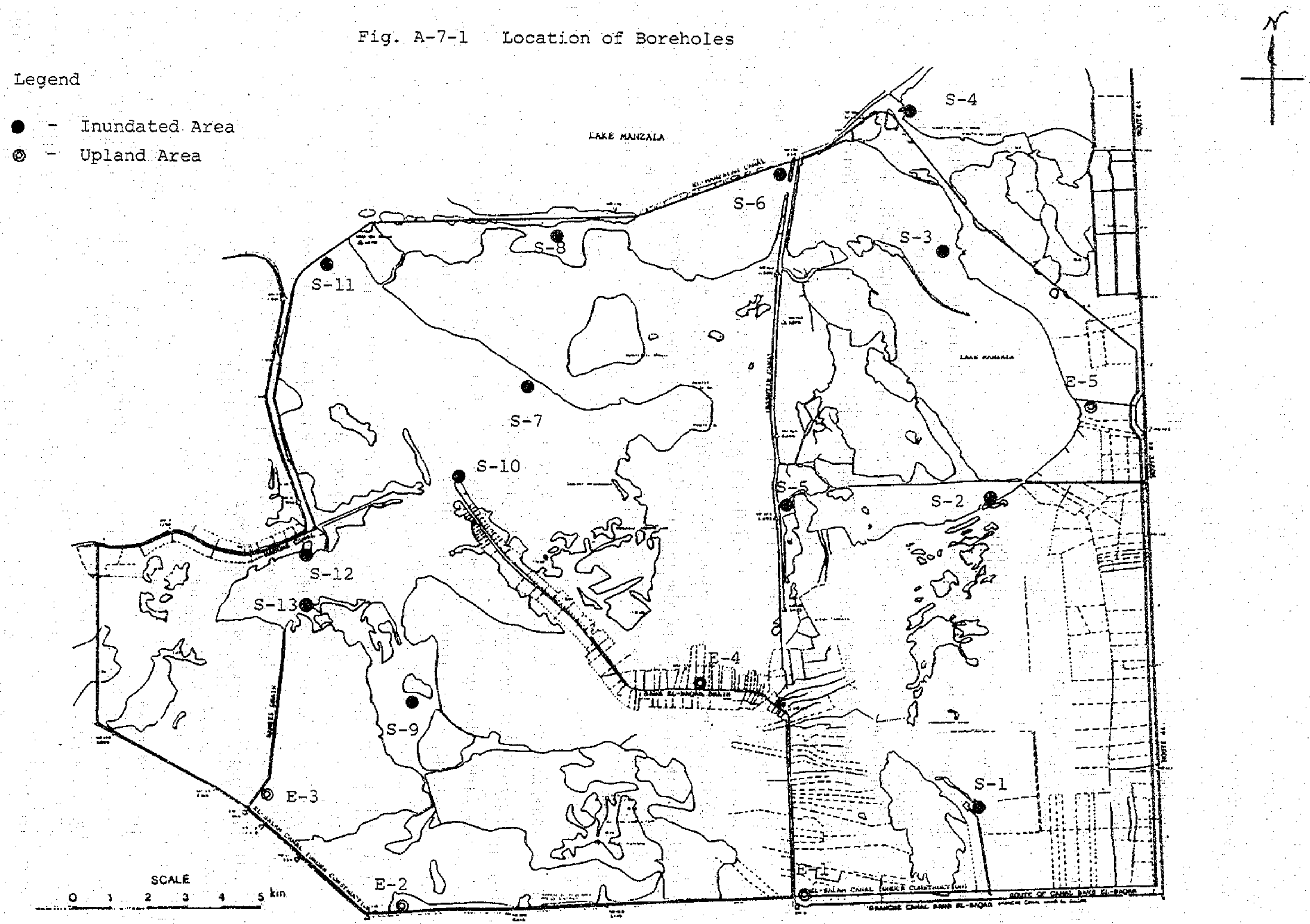
(3) Sampling

One kilogramme or more soil sample for each one meter depth was collected. Disturbed sample and undisturbed one whose surface is covered with parafin or wax were collected by thin wall tube samplers.

(4) Field Tests

Two types of field test were carried out, involving standard penetration test and permeability test. The latter was executed by drilling one to one and half meter deep under the casing, drying the hole, and then, measuring the raised water height with time elapsed.

Fig. A-7-1 Location of Boreholes



7-2 Data Analysis

(1) Soil Texture

As the result of soil survey, surface soil texture by 2 m deep in the Project Area are mainly clay or silty clay soil. In this physical soil survey, almost same results were obtained as the results of soil survey. Soil profiles in North Hussinia area and South Port Said area are shown in A-6 Appendix.

For the sub-soil by 10 m deep, it was found that silty clay or clay soil are widely distributed in the Project Area (see Table A-7-1).

(2) Standard Penetration Test

It is found that the results of standard penetration test (N-value) are divided into two groups of the surface by 2 m deep and the sublayer by 10 m deep.

1) N-values in Surface Soil

In upland area N-values show 3 to 7, and thus bearing capacity of the ground is estimated to be 10 to 20 ton/m^2, which is sufficient as a general fundation of construction works.

However, since in the inundated or swamp area N-values show 1 to 2 in general, bearing piles will be, here, needed for construction works. And the tile drain system should be provided after settlement of ground.

2) N-values in Sublayer Soil

N-values of the sublayer soil in the upland area are relatively low, but it is no problem as the fundation for solid state of the surface.

In the inundated area, since the sublayer soil has relatively high N-value, the sublayers of 4 to 5 m deep can be used as the bearing zone.

(3) Permeability

Premeability in the Project Area was investigated by using of boholes and so, the Values of premeability ranges from 2×10^{-3} cm/sec to 6×10^{-4} cm/sec. (See Table A-7-2).

Table A-7-1 Texture and N-Value by Using of Borehole

	Surface Soil		Sublayer Soil	
Borehole No.	Texture	N-Value	Texture	N-Values
E1	SiC	3	SiC	2
E2	SiC	5	Clay	2
E3	SiC	6	Clay	2
E4	SiC	5	Clay (4 m)	12
E5	SiC (Shell)	7	SiC (7 m)	7
S1	SiC	7	SiC	3
S2	C (Shell)	1	SiC (5 m)	9
S3	C (Shell)	1	SiC (5 m)	20
S4	SiC (Shell)	1	SiS (5 m)	24
S5	SiC	1	SiC (Shell) (5 m)	5
S6	SiC	1	C (6 m) S (8 m)	2 12
S7	SiC (Shell)	5	SiC (4 m)	2
S8	C (Shell)	2	SiC (5 m)	2
S9	SiC	1	C (5 m)	1
S10	C (Shell)	1	C (4 m)	3
S11	C (Shell)	5	SiC (4 m)	3
S12	C (Shell)	3	C (Shell) (4 m)	5
S13	C (Shell)	1	C	1

Table A-7-2 Permeability Test Results by Boring Survey

Borehole No.	Diameter (m)	Permeability K
E-1	135	3.24×10^{-4}
2	125	1.6×10^{-3}
3	140	6.47×10^{-4}
4	120	4.95×10^{-4}
5	135	2.72×10^{-4}
S-1	135	1.48×10^{-3}
2	130	1.91×10^{-3}
3	150	2.11×10^{-4}
4	150	2.76×10^{-4}
5	100	4.33×10^{-4}
6	150	1.87×10^{-4}
7	110	4.45×10^{-4}
8	100	3.63×10^{-4}
9	110	4.17×10^{-4}
10	130	3.34×10^{-4}
11	125	3.01×10^{-4}
12	85	1.09×10^{-3}
13	125	4.28×10^{-4}