3.2.4. Soil

(1) North Wahby and Com Osheem Areas

1) Soil Survey

A semi detailed soil survey in the areas was already carried out to select suitable lands for reclamation in 1961. Soil survey for the Project was carried out with reference to the result of the former work.

A total of 65 boreholes in both areas were staked out as shown in the soil maps. The distance between the holes was taken as about 1,000 meters (i.e. each hole represents 240 feddan). The depth of the holes was taken as two meters where soil permitted easy augering. However, augering was discontinued when hard pan layers were encountered.

Thus, the program of soil survey in this study was greatly referenced to the Report of Re-use of Drainage Water for Agricultural Purposes in Fayoum: By Dr. Dia El Din El Quesy, and Dr. Samia El Cuindi, December 1961, Drainage Research Institute, Water Research Center, Ministry of Irrigation, Egypt.

a. Preliminary Survey

The soil survey works started with the preliminary survey by field reconnaissance in order to grasp the general conditions of the survey area. During the preliminary survey, the landscape within the survey area, that is, topography, relief, land use, and existing road networks were carefully investigated.

b. Soil Profile Survey

In order to execute the profile survey, the existing soil map, that is, soil classification map of scale 1:25,000 which was prepared by the MOI in 1981 was used to select the representative sites of soils.

Soil profile survey in the representative sites was examined to a depth of approximately 100 centimeters where soil permitted easy digging. When hard pan layers or unweathered rock were encountered, digging was discontinued.

A total of 66 sites were selected for open pits and supplementary survey with small auger.

The morphological features of the soil profiles were carefully observed and described. These features are soil color, texture, gravel and stone, humus, structure, consistency, wetness, mottling, concretion, crust, spot, parent rocks, accumulations of salt, calcium carbonate and gypsum, and layer boundaries.

c. Soil Sampling

Soil samples for the chemical and physical analyses, pH and EC measurement were taken from two, three or four layers in each soil profile of open pits dug at the representative sites.

There were 60 soil samples selected for chemical and physical analyses, pH and EC measurements from 21 soil profiles. Besides these soil samples, 108 soil samples for pH and EC measurements were taken from the top-layer and sub-layer of profiles at 45 sites.

The chemical and physical analyses, pH and EC measurements for the above-mentioned soil samples collected from the survey areas were carried out in the laboratory of Agriculture at Fayoum, Cairo University.

2) Soil Classification

The Project Area is located in an arid region where annual average rainfall, evaporation and temperature are nine millimeters and 3,000 millimeters and 22°C, respectively. Soil profiles were classified according to Soil Taxonomy.

Aridisols

Aridisols are mineral soils that have an ochric and anthropic epipedon and a salic horizon within 75 centimeters of the surface and a thermic temperature region. These soils can be considered to belong to the *Order*, *Aridisols*, *suborder* Orthids, great group Salorthids, subgroup Typic Salorthids and up to the family level.

Typic Salorthids:

* Sandy, thermic soils with moderately hard pan; EBA-S-mP
* Sandy loam over sandy clay loam, thermic soils with moderately deep hard pan; EBA-SL/SCL-mP
* Sandy, thermic soils with deep zone; EBA-S-D_2
* Sandy clay, thermic soils with deep hard pan; EBA-SC-D_2P

Entisols

Entisols are mineral soils that have an ochric and an anthropic epipedon and do not have a diagnostic horizon. These soils have below the AP horizon or a depth of 25 centimeters, whichever is deeper, 35 percent (by volume) of rock fragments that have a texture of loamy fine sand or coarser in all subhorizons

wither to a depth of one meter to a lithic paralithic, or petroferric contact, whichever is shallower. These soils have torric moisture regime. Thus, these soils can be considered to belong to the Order Entisols, suborder Psamments, great group Torripsamments, subgroup Typic Toripsamments and up to family level.

Typic Torripsamments:

* Sandy, thermic soils with moderately hard pan; JCB-S-mP
* Sandy over sandy clay, thermic soils with moderately deep hard pan; JCB-S/SC-mP
* Sandy, thermic soils with deep zone; JCB-S-D_2
* Sandy, clayey, thermic soils with moderately deep hard pan; JCB-SC-mP
* Sandy over sandy clay loam, thermic soils with shallow hard pan; JCB-S/SCL-sP

  (refer to the soil maps for North Wahby and Com Osheem areas)

The area occupied each family is as follows;

(Unit: feddan)

	North Wahby Area		Com Osheem Area	
Soil Family	Survey Area	Project Area	Survey Area	Project Area
EBA-S-mP	150	-	390	390
EBA-SL/SCL-mP	1,010	1,010	1,020	1,020
EBA-S-D_2	1,100	400	760	760
EBA-SC-D_2P	290	-	370	370
JCB-S-mP	1,790	1,790	770	770
JCB-S/SC-mP	1,410	1,410	-	-
JCB-S-D_2	520	490	-	-
JCB-SC-mP	200	-	-	-
JCB-S/SCL-sP	-	-	390	390
Total	6,470	5,100	3,700	3,700

3) Soil Salinity

In general, the soils in the areas have high salinity ranging from two to 370 mmhos per centimeters. Thus, the salinity land type can be classified as follows.

Type	Surface/sub-surface	EC (mmhos/cm)
1	Salt free to weakly saline /weakly saline	less than 4/ less than 4
2	Weakly saline to moderately saline/weakly saline	4.1 to 8.0/ more than 4
3	Moderately saline to strongly saline/moderately saline	8.1 to 15.0/ more than 8.1
4	Strongly saline/strongly saline	more than 15.0/ more than 15.0

The salinity maps are attached in the Appendix C.

4) Soil Improvement

In order to make good soils, the following works are recommended.

a. Deep Harrowing

Hard pan consists of calcic sandstone, taff, shale and mineral colloidal materials. Calcic sandstone can be easily broken by agricultural machine. And taff, shale and colloidal material can be easily softened by adding water.

b. Leaching

Leaching the salt from the soils is very important, because the land has a high salinity.
(refer to soil salinity map in Appendix C)

Primary leaching should be carried out by irrigation water.

c. Soil Dressing

In general, gypsum application is necessary before leaching with reference to Indian Report (I.P.Abrol and D.R. Bhumbla; Leaching Salt Soils, April 1972, Indian Farming) In this report, the main object of gypsum application is to make well permeable in the soil profiles and decrease the toxic Na ion for plant growth in the soils. Most of the surface soils in the areas are sandy to sandy loam texture and contain a high percentage of soluble calcium and magnesium.

In general, surface soils in the areas have gravelly to sandy texture. And these soils have low water holding capacity and poor base exchange capacity. Thus, clayey soil dressing is recommended to be applied to the surface soils in the areas.

The soil gathered from the canal after the maintenance work is one of the best materials to dress the land surface.

d. Application of Organic Matter

The amount of organic matter contained in the soils of the Project Area is 0.3 percent on the average, this is considered to be extremely small. Content of nitrogen and phosphate in the soils was also found to be limited. Moreover, they are sandy and saline soils. The application of organic matter in such soils will create the following essential improvements.

a. enhancement of air permeability, water retentivity and fertilizer retentivity

b. control of soil consolidated caused by salt

c. create a source of supply of chemical substances especially nitrogen

d. create a buffer action against salinity

From the viewpoint of the soil features in the Project Area, application of organic matter will be important in realizing stable crop production. Manure and clover can be used as raw materials for creating the necessary amounts of organic matter. Since decomposition of organic materials is a lot faster in arid zone soils than in humid zone soils frequent application of organic matter will be required. The desirable amount of organic matter to be applied is ten tons per hectare or more, the lowest amount, which is acceptable is two to three tons.

5) Land Capability Classification

After finishing land reclamation and soil improvement, land capability in the area was classified according to the following categories.

I. Excellent, no limitation for agricultural use

II. Good, no important limitations for agricultural use

III. Fairly good, some limitations for agricultural use

IV. Low value, strong limitations for agricultural use

IV/V. Very low value, very strong limitations for agricultural use

V. Limited arable: not suitable for agricultural use

Thus, the land capability classes in the area are of type II and III. All available crops should be selected in each soil type. (refer to the land classification maps)

FAYOUM AGRICULTURAL DEVELOP

NORTH WAHBY AREA

SOIL MAP

LEGEND

○ ---- Small Auger

◉ ---- Open Pit

Soil Family

EBA-S-mP ; Sandy, thermic soils with m

EBA-SL/SCL-mP ;Sandy loam over sandy clay moderately deep hard pan

EBA-S-D2 ;Samdy, thermic soils with c

EBA-SC-D2P ;Sandy clayey, thermic soils

JCB-S-mP ;Sandy, thermic soils with m

JCB-S/SC-mP ;Sandy over sandy clay, the deep hard pan

JCB-S-D2 ;Sandy, thermic soils with c

JCB-SC-mP ;Sandy clayey, thermic soils

JCB-S-mP

JCB-S/SC-mP

EBA-SL/SCL-mP

JCB-SD2

EBA-SL/SCL-mP

JCB-S-D2

EBA-S-D2

JCB-SC-mP

EBA-S-mP

EBA-SC-D2P

EBA-S-D2

0

(Unit: feddan)

North Wahby Area

Soil Family	Study Area	Proposed Area
EBA-S-mP	150	-
EBA-SL/SCL-mP	1,010	1,010
EBA-S-D_2	1,100	400
EBA-SC-D_2P	290	-
JCB-S-mP	1,790	1,790
JCB-S/SC-mP	1,410	1,410
JCB-S-D_2	520	490
JCB-SC-mP	200	-
Total	6,470	5,100

FAYOUM AGRICULTURAL DEVELOPMENT PROJECT

NORTH WAHBY AREA

SOIL MAP

LEGEND

○ ---- Small Auger

◉ ---- Open Pit

Soil Family

EBA-S-mP ; Sandy, thermic soils with moderately deep hard pan

EBA-SL/SCL-mP ; Sandy loam over sandy clay loam, thermic soils with moderately deep hard pan

EBA-S-D2 ; Samdy, thermic soils with deep zone

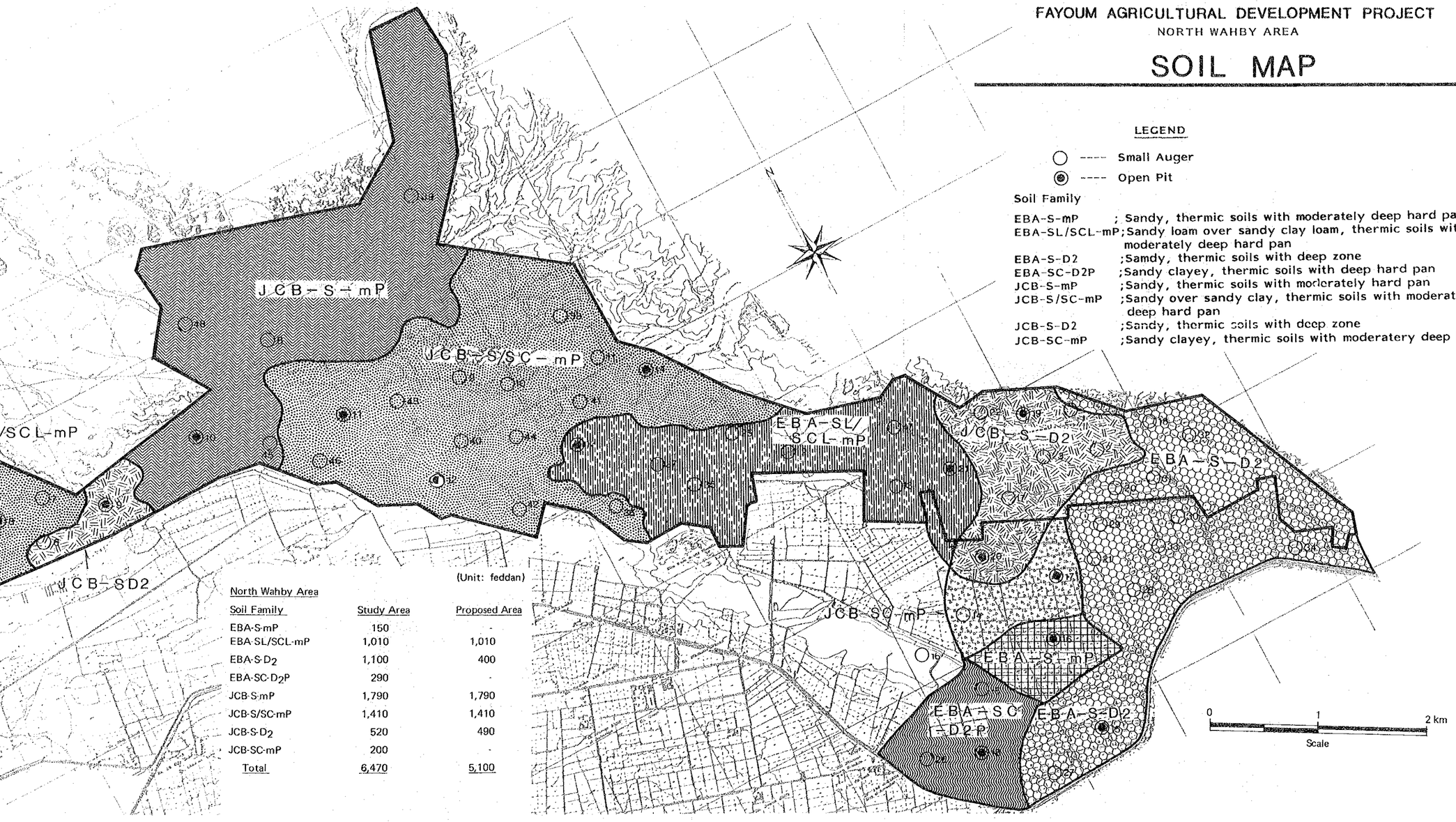
EBA-SC-D2P ; Sandy clayey, thermic soils with deep hard pan

JCB-S-mP ; Sandy, thermic soils with moderately hard pan

JCB-S/SC-mP ; Sandy over sandy clay, thermic soils with moderately deep hard pan

JCB-S-D2 ; Sandy, thermic soils with deep zone

JCB-SC-mP ; Sandy clayey, thermic soils with moderatery deep hard



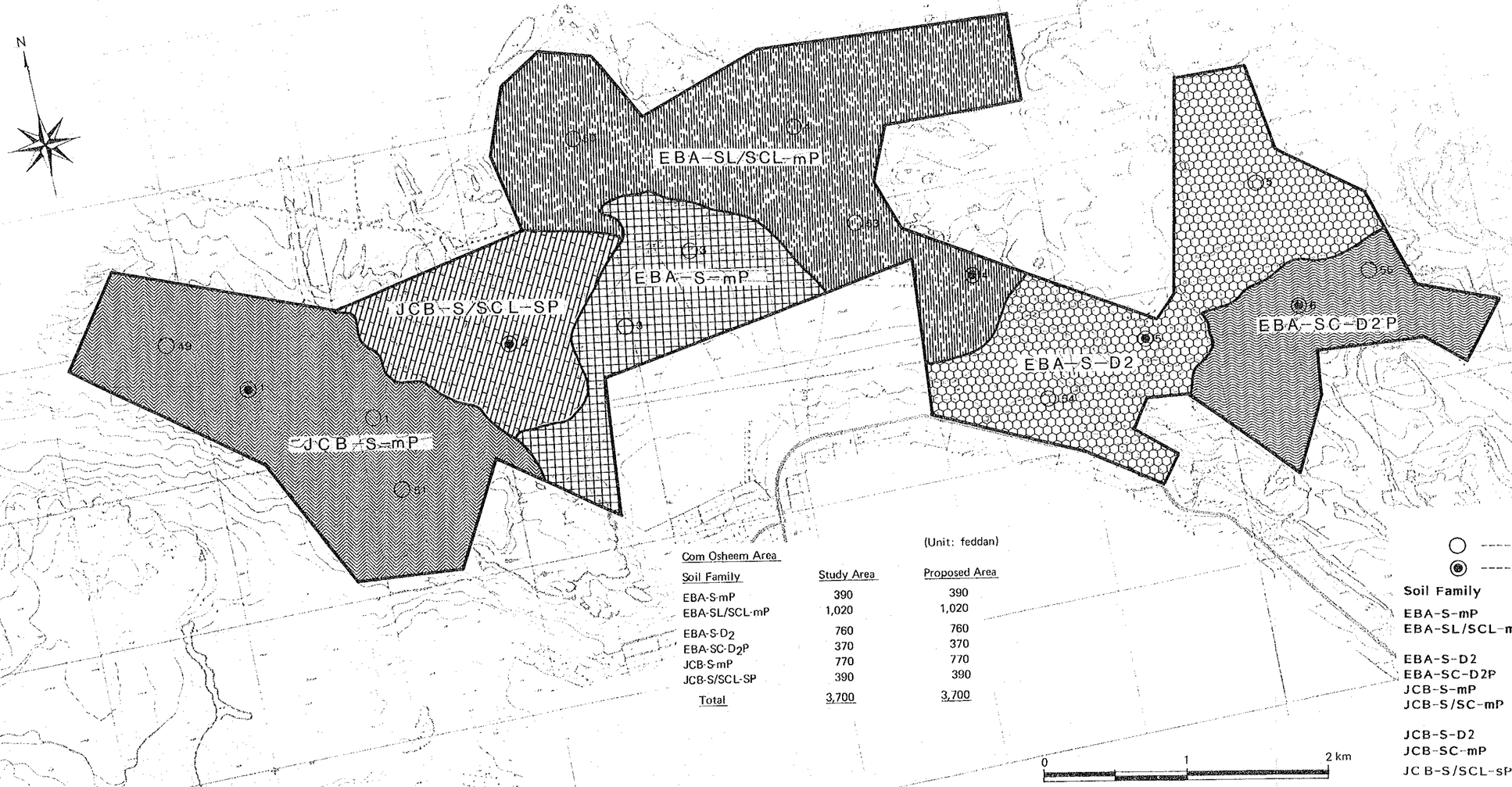
(Unit: feddan)

North Wahby Area

Soil Family	Study Area	Proposed Area
EBA-S-mP	150	-
EBA-SL/SCL-mP	1,010	1,010
EBA-S-D_2	1,100	400
EBA-SC-D_2P	290	-
JCB-S-mP	1,790	1,790
JCB-S/SC-mP	1,410	1,410
JCB-S-D_2	520	490
JCB-SC-mP	200	-
Total	6,470	5,100

FAYOUM AGRICULTURAL DEV
COM OSHEEN A

SOIL M



Com Osheem Area

(Unit: feddan)

Soil Family	Study Area	Proposed Area
EBA-S-mP	390	390
EBA-SL/SCL-mP	1,020	1,020
EBA-S-D_2	760	760
EBA-SC-D_2P	370	370
JCB-S-mP	770	770
JCB-S/SCL-SP	390	390
Total	3,700	3,700

LEGEND

○ ---- Small Auger

◉ ---- Open Pit

Soil Family

EBA-S-mP ; Sandy, thermic soils

EBA-SL/SCL-mP ;Sandy loam over san moderately deep har

EBA-S-D2 ;Samdy, thermic soils

EBA-SC-D2P ;Sandy clayey, therm

JCB-S-mP ;Sandy, thermic soils

JCB-S/SC-mP ;Sandy over sandy c deep hard pan

JCB-S-D2 ;Sandy, thermic soils

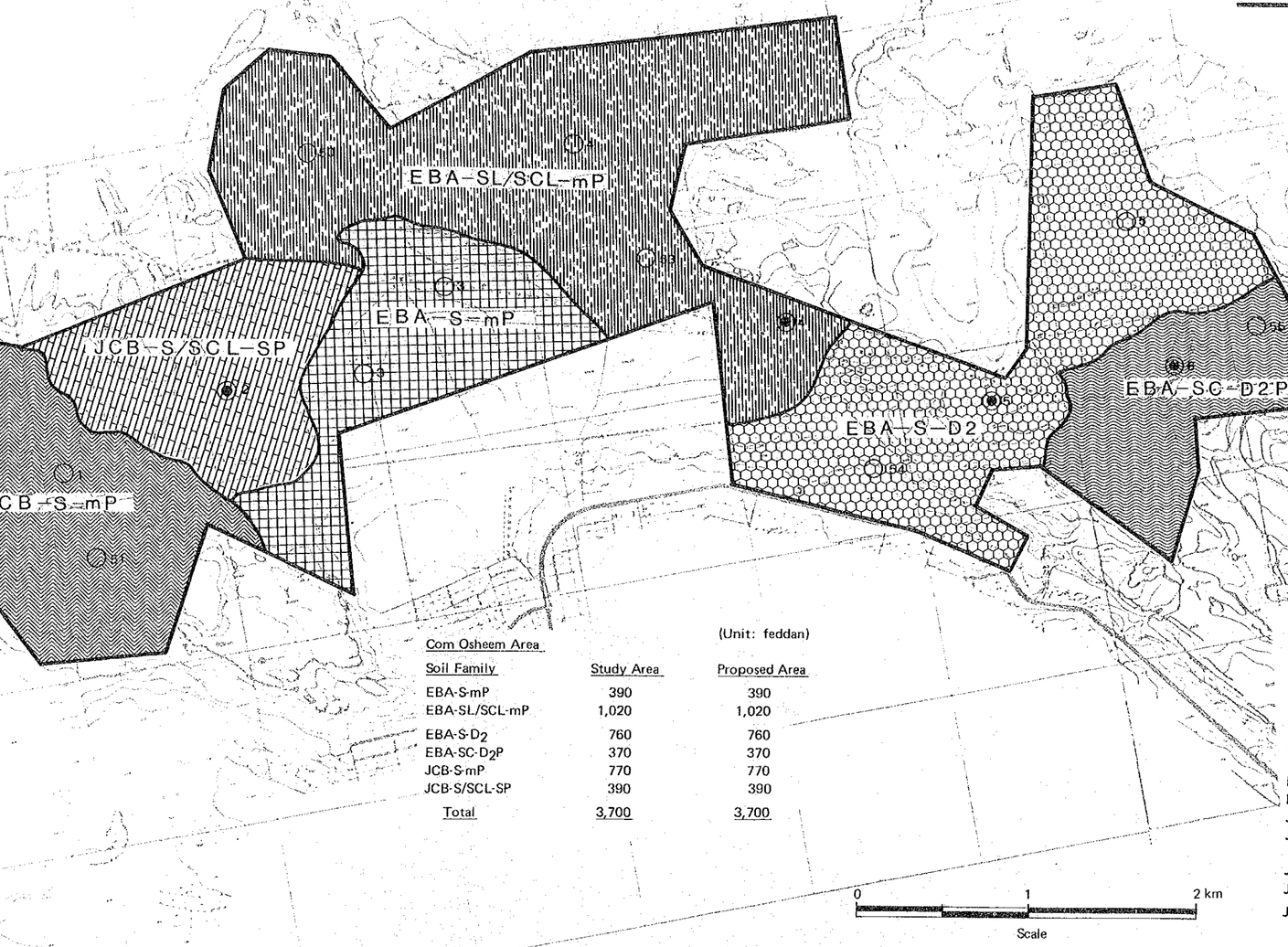
JCB-SC-mP ;Sandy clayey, therm

JCB-S/SCL-sP ; Sandy over sandy c hard pan

FAYOUM AGRICULTURAL DEVELOPMENT PROJECT

COM OSHEEN AREA

SOIL MAP



(Unit: feddan)

Com Osheem Area

Soil Family	Study Area	Proposed Area
EBA-S-mP	390	390
EBA-SL/SCL-mP	1,020	1,020
EBA-S-D_2	760	760
EBA-SC-D_2P	370	370
JCB-S-mP	770	770
JCB-S/SCL-SP	390	390
Total	3,700	3,700

LEGEND

○ ---- Small Auger

◉ ---- Open Pit

Soil Family

EBA-S-mP ; Sandy, thermic soils with moderately deep hard pan

EBA-SL/SCL-mP ; Sandy loam over sandy clay loam, thermic soils with moderately deep hard pan

EBA-S-D2 ; Samdy, thermic soils with deep zone

EBA-SC-D2P ; Sandy clayey, thermic soils with deep hard pan

JCB-S-mP ; Sandy, thermic soils with moderately hard pan

JCB-S/SC-mP ; Sandy over sandy clay, thermic soils with moderately deep hard pan

JCB-S-D2 ; Sandy, thermic soils with deep zone

JCB-SC-mP ; Sandy clayey, thermic soils with moderatery deep hard

JCB-S/SCL-sP ; Sandy over sandy clay loam, thermic soils with shallow hard pan

FAYOUM AGRICULTURAL DEVELOP

NORTH WAHBY AREA

LAND CLASSIFICA

LEGEN

---- Survey P

---- Class II

---- Class III

---- Boundar

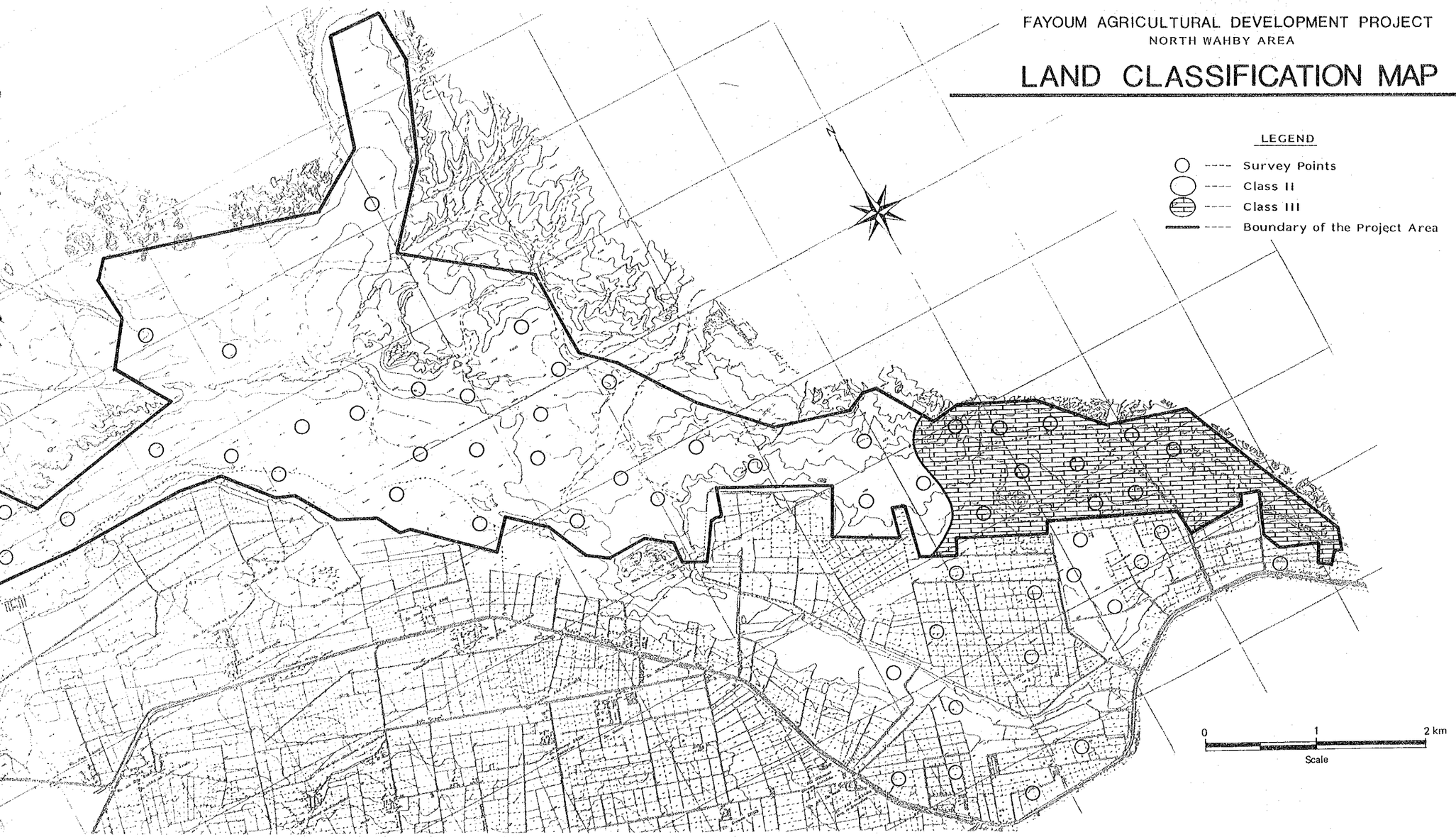
N

0

FAYOUM AGRICULTURAL DEVELOPMENT PROJECT

NORTH WAHBY AREA

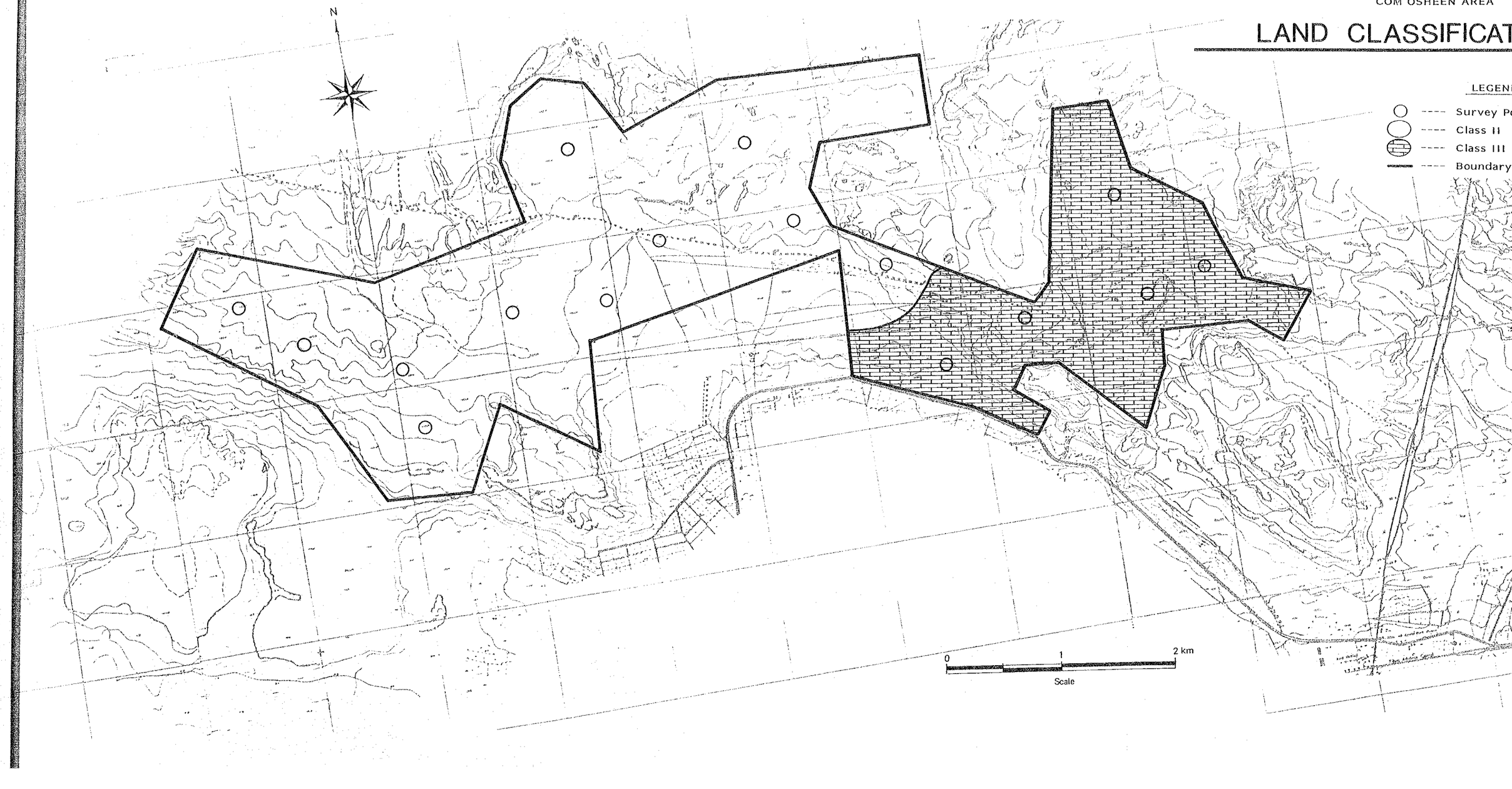
LAND CLASSIFICATION MAP



FAYOUM AGRICULTURAL DEVELOPM

COM OSHEEN AREA

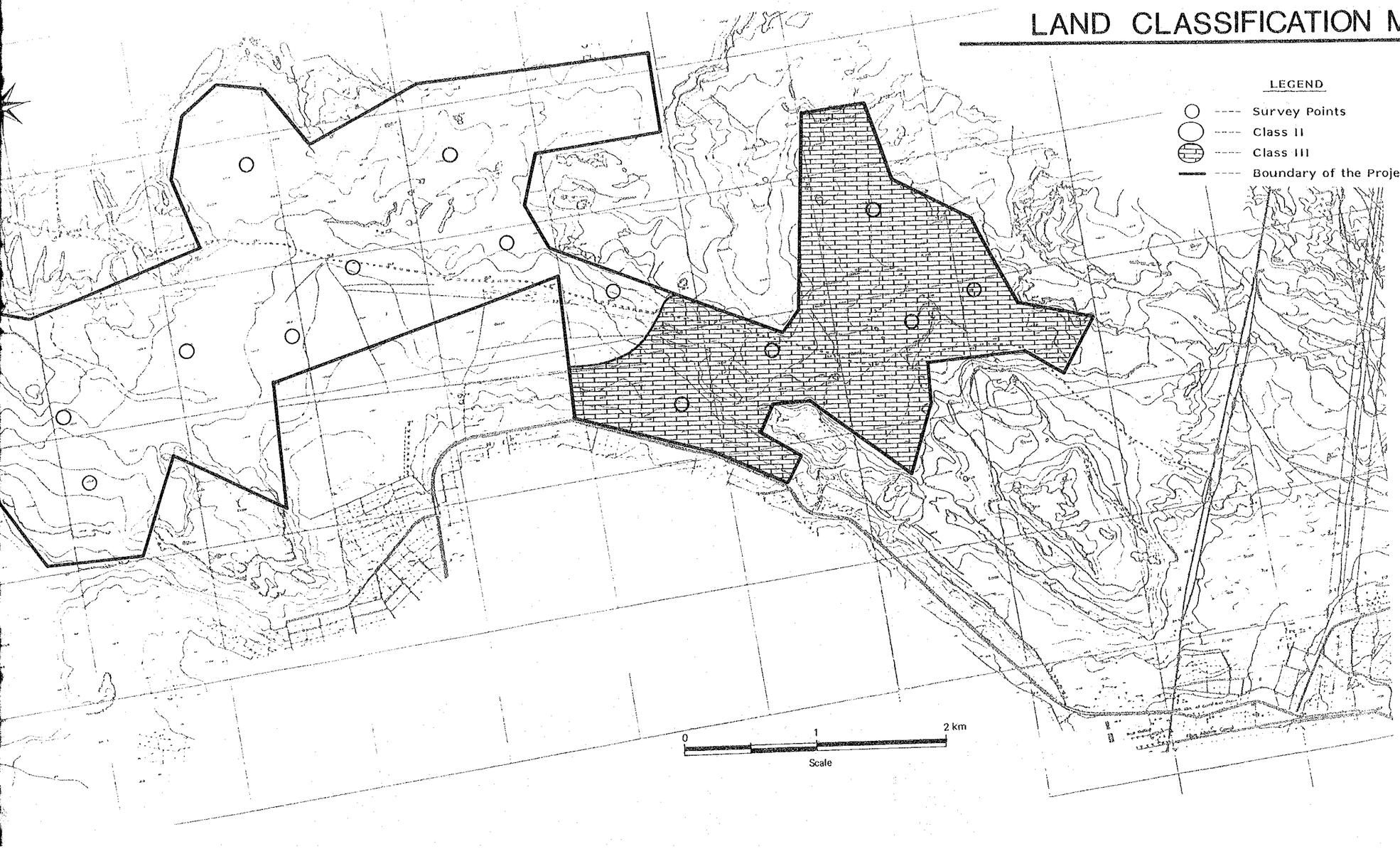
LAND CLASSIFICAT



FAYOUM AGRICULTURAL DEVELOPMENT PROJECT

COM OSHEEN AREA

LAND CLASSIFICATION MAP



(2) Wahby Downstream Area and South Area of Lake Qarun

1) Soil Survey work

a. Preliminary Survey

Same as Chapter 3.2.4.

b. Soil Profile Survey

Soil profile survey in the representative sites was examined to a depth of 120 centimeters and more where soil permitted easy digging when hard rocks was encountered, digging was discontinued.

Twenty sites were selected for open pits and 65 sites were selected for supplementary survey using Japanese small auger. The location of soil profile survey sites (open pits) are shown in the soil maps.

The morphological features of the soil profiles were carefully observed and described. These features are soil color, texture, gravel and stone, structure consistency, wetness mottling, concretion, salt crust, spot, parent rocks, accumulation of salt, calcium carbonate and gypsum, and layer boundaries. In addition, cropping pattern and natural vegetation were also investigated.

c. Soil sampling

Soil samples for the chemical and physical analysis were taken from three or four layers in each soil profile of 20 open pits and were also taken from two layers in each soil profile of 65 auger holes. Thus, there were 60 soil samples selected for complete soil analyses, and 130 soil samples were selected for measurements for pH and electric conductivity.

The chemical and physical analysis, pH and electric conductivity measurements for the above-mentioned soil samples collected from the survey areas were carried out in the laboratory of Agriculture, Fayoum, Cairo University.

2) Soil Classification

Soil profiles have an ohcric or anthropic epipedon and have a calcic or a salic horizon within 75 centimeters of the surface and a thermic temperature regime. According to the soil taxonomy, these soils can be considered to belong to the order Aridisols, suborder orthids, great group calciorthids, salorthids, sub group Typic Calciorthids, Typic Salorthids and the family level.

Typical calciorthids:

* Sandy, thermic soils with very deep zone; EBE-SD_3
* Sandy clay loam, thermic soils with very deep zone; EBE-$SCL/S-D_3$
* Clayey, montomorillonitic, thermic soils with very deep zone; EBE-CD_3

Typic Salorthids:

* Clayey, montomorillonitic, thermic soils with very shallow reduced zone; EBA-CR_1

Another group of soil profiles in the both areas have an ohcric or anthropic epipedon and have no evidence of development of pedogenic horizon and a thermic temperature region.

According to the soil taxonomy these soils can be considered to belong to the order Entisols. These soils are permanently saturated with water or during part of the year. These soil profiles belong to suborder Quents, great group: Hydroaquents or Fluviaquents, sub group: Typic Hydroaquents or Typic Fluviaquents and up to the family level.

Hydroaquents:

* Clayey, montomorillonitic, thermic soils with moderately deep zone; JAD-CD_1

Fluvaquents:

* Sandy, thermic soils with very deep zone; JAD-SD_3
* Clay loamy, thermic soils with very deep zone; EAD-CLD_3
* Clayey, montomorillonitic, thermic soils with very deep zone; JAD-CD_3
* Sandy over clay loam, thermic soils with very deep zone; JAD-SCL-D_3

(refer to the soil maps for Wahby Downstream Area and South Area of Lake Qarun)

The area occupied each family is as follows;

(Unit: feddan)

Soil Family	Survey Area	Project Area
Wahby Downstream Area		
EBE-SD_3	2,090	2,090
EBE-CL-SD_3	2,040	2,040
EBE-CD_3	1,070	1,070
JAD-SD_3	3,390	3,390
JAD-SLD3	8,110	8,110
JAD-CD_3	500	500
Total	17,200	17,200
South area at Lake Qarun		
EBA-CR_1	1,700	270
JAB-CD_1	3,460	3,460
JAD-CD_3	14,420	3,040
JAD-S-CLD_3	6,050	-
Total	25,630	6,770